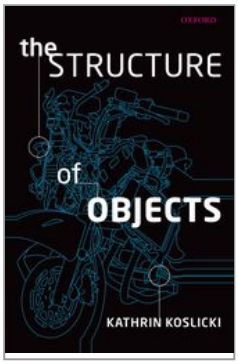

The Structure of Objects
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Objects as Structured Wholes

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Abstract and Keywords

This chapter demonstrates that a structure-based neo-Aristotelian mereology for ordinary material objects can be defended utilizing a single relation of parthood with relatively straightforward formal properties. A substantive restriction on composition can be derived from a comparatively minimal and metaphysically neutral independently motivated ontology of kinds. The thoroughly mereological conception of composition defended here recommends itself based on Leibniz's Law and the Weak Supplementation Principle. Among its benefits are the following: it yields the Uniqueness of Composition as a derived principle; it contributes to the Problem of Constitution and, possibly, the Grounding Problem; and it clarifies the relation between a whole and both its material and its structural components. Finally, it is demonstrated how, on the approach defended here, wholes can be thought of as both ontologically committing and genuinely unified, despite the apparent Aristotelian regress caused by a never-ending demand for further principles of unity.

Keywords: neo-Aristotelian mereology, parthood, kinds, form, matter, Leibniz's Law, Weak Supplementation Principle, Uniqueness of Composition, Problem of Constitution, Grounding Problem

§VII.1 Introductory Remarks

It is time now to pull together the theory of parthood and composition which we have in effect been gradually building over the course of the previous six chapters. My strategy in what follows will be, first, to state in general terms the distinguishing features of the theory of parthood and composition which in my view best fulfills the demands we have encountered up to this point. Some of the missing details will be filled in in Chapter IX, when we turn in greater depth to

the notion of structure and to some illustrations of particular kinds of structured wholes.

§VII.2 Outlines of the Theory

§VII.2.1 Mereological Non-Proliferation: A Single Relation of Parthood

To avoid Fine's proliferation of primitive, *sui generis* relations, whose characteristics must be stipulatively imposed on them by means of distinct bodies of postulates, the present approach assumes a *single* notion of parthood, at least for the domain of material objects. This single notion is taken to satisfy at least the minimal formal requirements Simons views as constitutive of any genuinely mereological operation: proper parthood must be at least a strict partial ordering, governed by a supplementation principle of some kind, which we can for now assume to be the weakest possible one, the “Weak Supplementation Principle” (WSP), until our commitments concerning the Uniqueness of Composition are further clarified. The characteristics of proper parthood, which we can take as our single primitive notion, are thus captured by the following principles:

Axiom 1 (Asymmetry):	$x<y \rightarrow \sim(y<x)$
Axiom 2 (Transitivity):	$(x<y \ \& \ y<z) \rightarrow x<z$
Axiom 3 (Weak Supplementation):	$(x<y) \rightarrow (\exists z)\,(z<y \ \& \ z \wr x)$

The *irreflexivity* of proper parthood follows from Axioms 1 and 2. The remaining mereological concepts of proper or improper part, overlap, disjointness, and the like, can be defined in terms of proper parthood in the standard fashion.

(p.168) Recall that, according to the Weak Supplementation Principle, an object that has a proper part must have at least another proper part disjoint from the first. To make WSP more vivid, it may help to appeal to the notion of a *remainder*: thus, WSP dictates that, if a proper part were to be subtracted from a whole of which it is a proper part, a remainder, i.e., a proper part disjoint from the first, should be left over as a result of this operation of subtraction. Most philosophers are happy to accept a relation of proper parthood governed by WSP for the domain of material objects, as long as the presupposition is satisfied that material objects have only material parts; to these philosophers I now issue a warning that, later on in this chapter, WSP will turn out to play a crucial role in motivating the position that material objects have *formal* parts in addition to their ordinary material parts.[1] Those who object to this use of WSP on the grounds that they were willing to follow me in adopting the conception of parthood outlined above for the domain of material objects only as long as their presupposition was satisfied, should be reminded of the following two points from Chapter I.

First, since not every strict partial ordering can be interpreted as a relation of proper parthood, the question arises of what further formal properties distinguish proper parthood from other non-mereological strict partial orderings such as “is less than”; thus, those who do not regard WSP as minimally constitutive of the notion of proper parthood for material objects owe us an explanation of why we should interpret *their* strict partial ordering as a relation of proper parthood. Secondly, the plausibility of WSP as an additional formal constraint on the relation of proper parthood is further buttressed by the observation that WSP is the weakest possible addition to Axioms 1 and 2 by means of which the following two kinds of models can be ruled out: (i) models consisting of infinitely descending linear chains of objects whose proper parts are themselves proper parts of the objects' proper parts; (ii) models consisting of objects all of whose proper parts overlap each other. I take it that a relation which does not exclude both types of models is too weak to capture the mereological characteristics of ordinary material objects.

§VII.2.2 The Restricted Nature of Composition

One of the main points of departure between the current system and CEM is the Axiom of Unrestricted Composition, also referred to in Simons (1987) as the “General Sum Principle” (GSP):

> Unrestricted Composition: Whenever there are some things, then there exists a fusion of those things.
> **(p.169)**
> Axiom 24 (General Sum Principle):(∃x) (F(x)) → (∃x)(∀y) ((y°x) ↔ (∃z) (F(z) & (y°z)))

GSP states that for any of the objects that satisfy the predicate in question, there exists a sum of these objects (provided that the predicate has a non-empty extension). Once Axiom 24 is added to Axioms 1, 2 and 3, the resulting system is formally equivalent to CEM and any of the possible weaker, intermediary assumptions concerning the conditional or unconditional existence of sums in finite or infinite models have thereby become redundant.

Composition, according to CEM, is thus not a very involved affair: it takes place whenever there is a plurality, *any* plurality, of objects, no matter what relations obtain or fail to obtain among these objects. In contrast, the current approach takes composition to be *restricted*: it occurs only when certain conditions are satisfied and the conditions in question of course concern, among other things, the *manner of arrangement* exhibited by any given plurality of objects; more generally, they require that the dictates of some particular formal components are satisfied. I will, for now, state the Restricted Composition Principle (RCP) in an overly simplified, timeless fashion which still leaves open many important questions to be addressed further below:

> (RCP) Restricted Composition (First Version): Some objects, $m_1, \ldots, m_n$, compose an object, O, just in case $m_1, \ldots, m_n$, satisfy the constraints dictated by some formal components, $f_1, \ldots, f_n$.

Among the questions left open by RCP, for example, is the question of how exactly we ought to think about the formal components of objects. For one thing, RCP does not settle the *ontological category* to which the formal components of objects belong, i.e., whether they are themselves objects, whether they are properties or relations, or whether they belong to some other ontological category still. These questions will be discussed in more detail in Chapter IX below; for now, however, we may think of the formal components associated with a particular kind of whole, following Verity Harte's model as discussed in Chapter V, as the sorts of entities which provide “slots” to be filled by objects of a certain kind: thus, the formal components belonging to a particular kind of whole will generally specify not only the *configuration* to be exhibited by the material components in question, i.e., how these objects are to be arranged with respect to one another; they will also usually specify the *variety* of material components of which the whole in question may be composed, i.e., what sorts of objects can go into the various “slots” provided by the formal components.

RCP also leaves open the nature of the *mechanism* by which these sorts of constraints are imposed on the material components of a particular kind of whole. Clearly, according to the abundant conception of structure adopted by both Plato and Kit Fine, the restriction placed on composition by RCP would amount to no real restriction at all, since any plurality of objects whatsoever **(p. 170)** can be thought of as exhibiting some mathematical relation and any plurality of objects whatsoever can be thought of as the manifestation of some function-like principle which maps times onto objects. Even an explicitly added requirement of *spatio-temporal proximity* would not be strong enough to exclude pluralities of objects which are intuitively gerrymandered but happen to be connected in space and time: to use an example from van Inwagen (1990a), two people shaking hands, on such an approach, would compose a further object, for as long as they are engaged in the handshake, simply because their hands are touching. On the other hand, the more meaty conception of structure we

encountered in Aristotle, according to which the formal components of each whole contribute their own localized teleological content, brings with it such controversial metaphysical machinery as the mysterious actual/potential distinction and its closely aligned Homonymy Principle. Thus, a middle ground of some sort, between Plato's and Fine's deflationary mathematical conception of structure and Aristotle's localized teleological conception, is called for.

§VII.2.3 An Ontology of Kinds

This middle ground, I propose, can be derived from a commitment to an ontology of *kinds*, which will be justified in more detail in the next chapter. According to this conception, a plurality of objects composes a whole of a particular kind, when the objects (material components) in question satisfy the selection requirements set by the formal components associated with wholes of that particular kind, e.g., requirements concerning, for example, the variety, configuration and sometimes even the number of parts out of which wholes of that particular kind may be composed. Due to considerations primarily from the philosophy of biology, which will concern us in the next chapter, the sort of conception of kinds which is assumed here is relatively minimal, in the sense that it presupposes neither that all members of a single kind will always share an *essence*; nor that it will always be possible to provide *necessary and sufficient conditions* for membership in a particular kind.[2, 3]

(p.171) ### §VII.2.4 Ontology and Mereology

The question of which kinds there are I take to be one that is not answered by the mereologist proper, but by the ontologist at large, in conjunction with other domains, such as science and common sense, which turn out to have something to contribute to the question, “What is there?”, or, more specifically, to the question, “What *kinds* of objects are there?”. In contrast, I take the mereologist's job to be to devise an appropriate conception of parthood and composition which accurately reflects the conditions of existence, spatio-temporal location and part/whole structure of those objects to which we take ourselves to be already committed as part of the presupposed scientifically informed, commonsense ontology. Thus, mereology, on this conception, does not settle matters of ontological commitment; rather, it presupposes them to be resolved elsewhere within metaphysics or outside of philosophy altogether.

In this division of labor between the tasks performed by mereology proper and ontology at large, my approach differs from the standard conception as well as from Fine's theory of embodiments, both of which view the mereologist as a specialized sort of ontologist, whose job it is precisely to tell us what mereologically complex objects (if any) the world contains. Standard mereology yields the highly *revisionary* answer that for each plurality of objects, no matter how disparate and dissimilar, the world contains a further object, their sum; the result is an ontology which, along with whatever entities are assumed to play the role of individuals, consists of a population of often intuitively gerrymandered

composite entities, such as the notorious “trout-turkey”, whose existence is not in any way recommended to us by evidence independent of CEM's predictions. Fine answers, in an even more revisionary vein, that for each principle of variable embodiment, which maps times in function-like manner to objects, the world contains a further object, a variable embodiment; since no apparent restrictions are placed on which function-like principles are suitable for this purpose, the result is an ontology that is exponentially even more abundant than that of standard mereology. In contrast, by 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.

(p.172) §VII.2.5 Form and Matter

Next, I propose that we once more follow Plato and Aristotle in assuming that the world is best described by taking ordinary material objects to be mereologically and ontologically complex in the sense that they are composed of both material and formal components.[4] Given the present, non-teleological, construal of form, I take the primary job of an object's formal components to consist in the specification of a range of selection requirements that must be satisfied by a plurality of objects in order to compose a whole of a particular kind. We may thus think of an object's formal components as a sort of *recipe* for how to build wholes of that particular kind. An object's *material components* or *matter*, on the other hand, may be thought of as the *ingredients* that are called for in the recipe: they are the objects which, in a successful case of composition, in fact satisfy the conditions dictated by the formal components.

In the preceding remarks, we have, among the requirements set by the formal components of ordinary material objects, singled out in particular those that concern the *spatio-temporal proximity* and, more generally, the *manner of arrangement* that must be exhibited by an object's material components.[5] However, as we know from our discussion of Aristotle, formal components may also set additional constraints, for example, concerning the *variety*, and in some cases even the *number*, of material components from which a given whole may be composed. Exactly which requirements are specified by some given formal components of course depends on the kind of object under consideration and cannot be settled in abstraction from particular cases.

To use one of Aristotle's favorite illustrations, an ax, for example, must be made of materials that are sufficiently hard to allow the ax to retain its own material integrity while being able to affect that of other materials on which it is intended to be used; the requirements set by the formal components of an ax are specific enough to rule out, for example, liquids or gases, but they are not so specific as

to select, say, a single kind of material, since various sorts **(p.173)** of metal and other sufficiently hard materials (such as stone) might do the job equally or comparably well.[6] Moreover, given the sorts of tasks for which an ax is intended to be used, its handle must of course, in some appropriately solid fashion, be attached, i.e., brought into close spatio-temporal proximity, to its blade; someone who is in possession of an unattached ax-blade and an unattached ax-handle may have all the ingredients needed to assemble an ax, but there is as of yet no ax until the handle and the blade have been properly fastened to one another.[7] More specific requirements concerning the variety, number, spatio-temporal proximity and configuration of the material components are set, for example, by the formal components which characterize H_2O molecules: these formal components dictate that a whole of this kind must be composed of a single oxygen atom and two hydrogen atoms, arranged in the particular configuration of chemical bonding, which requires the atoms in question to share electrons. Thus, while an object's formal components need not be very precise in the range of requirements they set for its material components, as is illustrated by axes and other macroscopic objects in our environment, they may in fact in other cases be quite precise, as is illustrated by the case of H_2O molecules just considered.

We can now reformulate RCP in the following, somewhat less open-ended manner, which of course still leaves undecided numerous important questions to be considered in more detail below:

> (RCP) Restricted Composition (Second Version):Some objects, $m_1, \ldots, m_n$, compose an object, O, of kind, K, just in case $m_1, \ldots, m_n$, satisfy the constraints dictated by some formal components, $f_1, \ldots, f_n$, associated with objects of kind, K.[8, 9]

(p.174) RCP, in this formulation, is to be read in light of the two assumptions just taken on board: first, that a mereology for ordinary material objects takes as its starting point a presupposed scientifically informed, commonsense ontology of kinds, which descriptively settles the question of what mereologically complex objects the world contains; and, secondly, that objects of a single kind have associated with them a set of formal components which act as a sort of recipe in specifying the parameters for how a whole of that particular kind may be constructed. Thus, composition, on the present restricted conception of it, takes place, first, only when the resulting whole would belong to a kind whose existence can be accommodated by the presupposed ontology; and, secondly, only when the recipe contained in the formal components associated with wholes of that kind has been followed, in the sense that the candidate plurality of objects is of the right number, variety and configuration to compose a whole of the particular kind under consideration.

§VII.2.6 An Ontology of Structured Wholes

The present approach attributes to *all* mereologically complex material objects the dichotomous nature Aristotle recognizes only in what we have earlier called "high-level wholes", viz., form/matter compounds like Socrates and the shoe.[10] It is a consequence of this approach, then, that the world contains only mereologically complex objects whose composition is not random, in the sense that only candidate pluralities of objects which meet more or less specific selection requirements can compose a whole of a particular kind. To spell out the selection requirements is the job of the *formal components* of a whole; to exhibit them is the job of the *material components*. Thus, all wholes, according to the present approach, are taken to consist of the two components of *structure* or *form*, on the one hand, and *content* or *matter*, on the other.

Content or matter, as we argued at the end of Chapter V, is best viewed as consisting of a domain of objects that are themselves already structured: this conception breaks down only when applied to a "first" level of composition (if there is such a thing), made up of entities that are not further composed of anything; however, since these ground-level entities are presumably not also mereologically complex, a theory which concerns the relation between wholes and their parts does not apply to them and is hence not violated by their non-dichotomous nature.

Structure or form has been tied to an ontology of kinds: each kind of object is taken to have associated with it a set of selection requirements which act as a recipe of sorts in specifying the range and configuration of material components eligible to compose a whole of that particular kind. We have, however, up to **(p. 175)** this point left open the *ontological category* to which the formal components of objects are to be assigned, i.e., whether these entities belong to the category of objects, to that of properties and relations, or to some other category still. These issues will be investigated further and in more detail in Chapter IX.

Since it is of course in part an empirical question whether the world in fact consists of structured wholes of the kind described by the current approach, our only option in justifying the proposed conception of parthood and composition is to extrapolate from known and representative examples what shape a theory of mereologically complex objects must take. The account thus remains open to the following sorts of counterexamples: if a domain, which is deemed a legitimate contributor to the question, "What kinds of objects are there?", finds it necessary to posit a kind of mereologically complex object which lacks any of the structural characteristics that could plausibly be attributed to the presence of formal components within the whole in question, then we would have to conclude that the present theory of parthood and composition has not given an exhaustive characterization of the world's recognized population of mereologically complex objects. But the admission that such select cases of

unstructured wholes cannot be ruled out in advance and on purely a priori grounds of course does not amount to anything nearly as strong as the thesis that mereologically complex objects in general are best analyzed in the manner of standard sums.

Standard mereology itself, however, cannot be thought of as providing such independent evidence for the existence of mereologically complex objects which, like sets, are free from the sorts of constraints that could be reasonably attributed to the presence of formal components within these objects: for mereological sums, according to the standard conception, need not satisfy any of the selection requirements concerning the variety, number or configuration of their parts; rather, their composition, as we pointed out earlier, is completely unconstrained and happens whenever there is *any* plurality of objects, regardless of what characteristics these objects bear and how these objects are related to one another. The only evidence a CEM-style theory can muster for the existence of standard sums in the present environment is that the best analysis of ordinary material objects overall is one which identifies these objects with standard mereological sums. But we have already encountered reasons for believing that CEM does not in fact yield the best overall analysis of ordinary material objects: for standard mereology does not have the resources to capture properly the conditions of existence and spatio-temporal location as well as the part/whole structure of ordinary material objects; moreover, its commitment to arbitrary sums leaves us with an ontology populated, among other things, with objects which tend to be excluded from the range of our quantifiers, except while we are engaged in technical metaphysical discussions of parthood and composition, and whose existence is not justified by means of evidence independent of CEM's predictions. Thus, there are no reasons coming from CEM itself to think that the world contains mereological sums, according to the standard conception; and there are **(p.176)** plenty of reasons against accepting CEM as the correct tool for the analysis of ordinary material objects. Unless, then, we are independently moved to recognize a category of objects whose composition is as unconstrained as that of standard mereological sums, we may proceed on the assumption, which is in fact confirmed by independent evidence, that the world is instead populated by mereologically complex objects that have the characteristics of structured wholes.[11]

§VII.2.7 The Dichotomous Nature of Wholes

In line with the “wholes as *composed* of structure” model discussed in Chapter V, the present approach adopts a thoroughly *mereological* conception of composition: both the material components and the formal components of a whole, on this view, are taken to be *proper parts* of it. Depending on the ontological category to which the formal components of objects are found to belong, this thoroughly mereological conception of composition may strike us as

the most radical aspect of the current approach; it is, however, recommended by the following considerations.

§VII.2.7.1 Material Components as Proper Parts

That the relation between a structured whole and its *material* components is that of parthood I take to be fairly obvious and uncontroversial. For one thing, mereologically complex objects do not come into existence *ex nihilo* and, besides the agency of their creator (where applicable), their material components are intuitively that *from* which these wholes come into existence. Consider, for example, a table which is brought into existence by assembling four legs, a top and an assortment of screws, nuts and bolts, and other hardware. These pre-existing ingredients are of course by themselves not sufficient to bring the table into existence, since they may exist without the table existing (and possibly vice versa, depending on the sorts of changes the table in question can sustain with respect to its material composition);[12] but they are nevertheless what we would point to, besides the agency of the carpenter, as those elements within the **(p. 177)** world of space-time which the process of bringing the table into existence takes as its most obvious starting point. Since the process of assembling the table in the normal case only changes the ingredients' non-essential relational characteristics, there is no reason to think, given the persistence conditions we ordinarily ascribe to these objects, that they cease to exist merely as a result of being rearranged. For example, it seems plainly compatible with the persistence conditions of the two pieces of wood, which we describe (looking towards the future) as a table-leg and a table-top, that the two may come into closer proximity to one another.[13] Thus, unless there is additional evidence to the effect that the pre-existing ingredients are somehow destroyed during the process of assembling the table, it is thus natural to view them as still maintaining a “presence” of some sort within the resulting table; the most obvious way in which their continued “presence” within the resulting table may be understood is by appeal to the notion of parthood.

Furthermore, unless we recognize at least the ingredients as components, i.e., proper parts, of the resulting table, the close connection between the characteristics of the ingredients and those of the resulting table becomes utterly mysterious. To illustrate, if the top, the four legs and the hardware together weigh thirty pounds, and nothing else is added or taken away during the process of assembling the table, then the resulting table can be expected to weigh thirty pounds. Moreover, the connection between the combined weight of the ingredients and that of the resulting table is in no way accidental; for wholes in general inherit such properties as their weight from the material components which compose them. Thus, in explaining the striking similarity between (certain of) the characteristics of the table on (certain of) the characteristics of its ingredients, it is again helpful to appeal to the fact that the ingredients continue to “live on” within the table, as components of it, and are thus able to pass some of their characteristics on to the whole which they come to compose. The

relation between these characteristics of the table and the corresponding characteristics of the ingredients then becomes analogous to that between, say, me and my hands: *I* have ten fingers, because *my hands*, which are part of me, do; and it is not the case that together we have twenty.[14]

Thirdly, to deny that even the material components of the table are proper parts of it (while simultaneously holding the objects in question to be numerically **(p. 178)** distinct) would commit us to a sort of coincidence which, if at all possible, is best avoided. For such a view would force us to subscribe to the thesis that two (or more) numerically distinct material objects, neither of which is a proper part of the other and which share many of their parts, can occupy a single region of space-time.[15] If, on the other hand, its material components are taken to be proper parts of the table, then the sort of coincidence that obtains between them is of the same benign nature as that which holds, say, between a man and his forearm: the man inhabits the region of space-time occupied by his forearm by virtue of having a part, viz., the forearm, which occupies the region of space-time in question; though the two objects are numerically distinct, the sort of spatio-temporal coincidence which obtains between them does not strike us as resulting in any sort of overcrowding. The reason for our relaxed attitude towards this sort of coincidence is that one of the objects in question is a proper part of the other.

Thus, among the overwhelming evidence in favor of taking the material components of a whole to be among its proper parts are the following considerations: (i) first, the pre-existing ingredients, which come to be the material components of a whole, are, besides the agency of its creator (where applicable), the most obvious candidates within the world of space-time for what processes of generation take as their starting point; (ii) secondly, the thesis that the material components of a whole are among its proper parts points the way towards an attractive account of the striking similarities between wholes and their material components, namely one which traces this sort of property inheritance to the more general case of mereological supervenience or dependence, according to which (certain of) the characteristics of a whole derive from (certain of) those of its parts; (iii) finally, the spatio-temporal coincidence between wholes and **(p.179)** their material components can now be assimilated to the benign, mereological manifestation of this phenomenon exhibited, say, by a man and his forearm.

§VII.2.7.2 Formal Components as Proper Parts

There are thus good reasons for wanting to view at least the material components of the table as proper parts of it. But now suppose that it is possible to create a new object out of just a single pre-existing ingredient. A possible illustration of such a scenario may be drawn from cases which exhibit the relation commonly referred to as *constitution*, viz., the relation which is said to obtain between a thing and what it is made of. Suppose, for example, that the

world contains objects which belong to the kind, *lump of clay*, and objects which belong to the kind, *statue*; then, nothing seems to stand in the way of creating, for example, a new statue out of just a single pre-existing ingredient, a lump of clay, merely by rearranging the clay's parts. Since a change of this sort is compatible with the persistence conditions we ordinarily attribute to lumps of clay, there is no reason to think that the lump ceases to exist merely as a result of having been rearranged.[16]

What *more*, then, could there be to the statue besides the lump of clay which constitutes it and with which it shares a single region of space-time? It is of course tempting simply to identify the statue and the lump of clay which constitutes it, given that the objects in question occupy exactly the same region of space-time and are strikingly similar to each other in many other respects, such as their weight, shape, texture, color, chemical composition, and so on.[17] On the other hand, we also know that, whenever two objects are constitutionally related,[18] there are some properties with respect to which they appear to differ; e.g., certain modal properties (such as the property of being able to survive squashing) and, typically, certain temporal properties (such as the property of having come into existence after the lump of clay came into existence or before the statue came **(p.180)** into existence). Among the characteristics apparently not shared by the statue and the lump of clay is also the property of being constituted by a lump of clay, which, intuitively, is a property had by the statue but not the lump of clay. By Leibniz's Law, then, we seem to arrive at the conclusion that objects that are constitutionally related must be numerically distinct, since they do not share all of their properties.[19]

Suppose that this Leibniz's Law-style argument for the numerical distinctness of constitutionally related objects is cogent; then, in the case at hand, in which a mereologically complex object consists of just a single material component, the following explanation of their numerical distinctness is actually *dictated* to us by our endorsement of the Weak Supplementation Principle, which was earlier taken to be partially constitutive of the meaning of “is a proper part of”: by WSP, we know that the *something extra* which distinguishes the statue from the lump of clay that constitutes it must in fact be an additional *part*; for, according to this principle, an object which has a proper part must consist of *other* proper parts in addition, which supplement the first.[20] Since there is overwhelming evidence **(p.181)** 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 and the cogency of Leibniz's Law-style arguments for the numerical distinctness of wholes and their material components, we arrive at the conclusion that the formal components of a whole as well must be counted among its proper parts; on the basis of this reasoning, then, I propose the

following Neo-Aristotelian Thesis (NAT) concerning the dichotomous nature of mereologically complex objects:

> (NAT) Neo-Aristotelian Thesis: The material and formal components of a mereologically complex object are *proper parts* of the whole they compose.

In the more general case, in which a whole consists of more than just a single material component, NAT is not forced upon us directly by our acceptance of WSP in conjunction with the Leibniz's Law-style arguments for the numerical distinctness of wholes and their material components. However, given that we have taken the relation between a whole and 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: for there is no good reason to treat the relation between a whole and its formal components any differently, depending on the number of material components of which it consists. Moreover, the extension of NAT to the general case has, among other things, the following advantage.

By means of NAT, we may arrive at an attractive *mereological* solution to the so-called “Grounding Problem”, which challenges those of us who believe in numerically distinct, spatio-temporally coincident objects to say what *grounds* the differences between objects that are otherwise so alike.[21] For, given the dichotomous nature of wholes, the differences between a whole and its material components, on this account, may in general be explained by pointing to additional *parts* which distinguish the whole from its material components, viz., its formal components. Without the availability of this sort of explanation for the numerical distinctness between a mereologically complex object and its spatio-temporally coincident material components, it is not clear how else this difference may be grounded; it is not surprising, then, that the Grounding Problem has proven to be quite intractable to those who allow for numerically distinct, spatio-temporally coincident objects which share *all* of their parts (see especially Bennett 2004b for useful discussion of this point).

(p.182) To illustrate, consider again the table. According to the present mereological solution to the Grounding Problem, the numerical distinctness between the table and its material components can be traced to the fact that the table has associated with it additional, formal components, which are not shared by the material components and which act as a sort of recipe in specifying the range and configuration of material components eligible to compose a whole of this kind. The formal components of a table, for example, speak to both the variety of material components from which a whole of this kind may be composed as well as their manner of arrangement: as a result of the process of assembly, which is required to bring the table into existence, the table's material

components come to bear an array of functional relational characteristics which they did not exhibit before the assembly, and which they *need* not exhibit, given the persistence conditions we ordinarily attribute to these objects; for example, the legs come to be arranged with respect to the top in such a way that they can now stably suspend the top above the ground, with the result that objects deposited on the newly created table are at a comfortable reaching level for the table's users. The fact that these relational characteristics come to obtain among the table's material components is the most minimal, relevant difference between the state of the world *just before* the table comes into existence and the state of the world *just after* the table comes into existence.[22]

As a consequence of the assumptions already endorsed up to this point, it now *follows* that the world does not contain numerically distinct, spatio-temporally coincident wholes which share exactly the same parts: for NAT, in conjunction with the assumption that objects of distinct kinds have distinct formal components, yields the result that there could not be two or more numerically distinct, spatio-temporally coincident objects which belong to *distinct kinds* and which share all of their parts: rather, it is predicted that such objects will always **(p.183)** differ with respect to some of their proper parts, viz., their formal components.[23] In other words, violations of the truth of the *Uniqueness of Composition* are ruled out as a consequence of the presupposed ontology of kinds, in conjunction with the hybrid conception of mereologically complex objects:

> Uniqueness of Composition: It never happens that two numerically distinct wholes have exactly the same parts.

It is therefore not necessary, given our other commitments, to assume the stronger Uniqueness Principle as Axiom 3 in place of the weaker WSP.

To summarize, then, this section has presented further arguments in favor of a thoroughly mereological conception of composition, based on the following assumptions: (i) that, by Leibniz's Law, wholes are numerically distinct from their material components; (ii) that there is overwhelming evidence in favor of taking the material components of a whole to be among its proper parts; (iii) that it is possible, as in cases of constitution, to create a new mereologically complex object out of just a single material component; and (iv) that the Weak Supplementation Principle is partially constitutive of the meaning of “is a proper part of”.[24] On the basis of these assumptions, I argued that the relation between the formal components of a whole and the whole they partially compose must be the same as that between a whole and its material components, viz., that of proper parthood. In the special case described in assumption (iii), in which a mereologically complex object is composed of just a single material component, this conclusion follows directly from the remaining assumptions, (i), (ii) and (iv). The extension to the general case, I suggested, is recommended, first, by considerations of symmetry; secondly, it is recommended by the fact that this

strategy may yield an attractive mereological solution to the so-called Grounding Problem, which challenges us to say what grounds the differences between numerically distinct, spatio-temporally coincident objects. On the basis of these considerations, then, I conclude that the dichotomous nature of wholes is correctly captured by NAT. The Uniqueness of Composition is preserved within this system, without having to be assumed as an axiom in place of WSP.

§VII.2.7.3 Material and Formal Components as Proper Parts

In addition to the advantages already cited, the following considerations provide further support in favor of NAT. First, a uniformly mereological conception of composition helps to *clarify* the nature of the relation which obtains between a whole and its formal and material components.[25] Our inquiry into the part/whole **(p.184)** properties of ordinary material objects has led us towards a structure-based theory of parthood and composition; given this mereology, the question now arises of how each object is related to its structural component as well as to those of its components which exhibit the structural characteristics in question. Since our overall aim is to give an *account* of ordinary material objects, and to do so without commitment to a proliferation of distinct notions of composition, the relation between a whole and its material and formal components ideally should not be taken as an unanalyzed, non-mereological primitive.[26]

Moreover, the thoroughly mereological approach to composition outlined in NAT contributes to the solution of a long-standing problem in metaphysics, the so-called “Problem of Constitution”, which challenges us to give an analysis of the relation that holds between an object and what it is made of, e.g., a statue and the lump of clay which constitutes it. The relation of constitution has resisted straightforward analysis because it confronts us with the following dilemma.[27]

As noted earlier, whenever objects are constitutionally related, the objects in question share a striking number of properties; e.g., a statue and the lump of clay which constitutes it occupy the same region of space-time and they have the same weight, texture, chemical composition, color, and so on. Given the striking similarity between constitutionally related objects, it is tempting simply to identify them. If constitution is identity, then no further explanation for the striking similarity between constitutionally related objects is called for; rather, the difficulty now becomes to explain the apparent differences between them. For whenever objects are constitutionally related, there are also some properties which they appear not to share; for example, certain modal properties (e.g., the property of being essentially a statue) and, typically, certain temporal properties (e.g., the property of having come into existence before the statue came into existence). As noted earlier, among the characteristics apparently not shared by the statue and the lump of clay is also the property of being constituted by a lump of clay, which, intuitively, is a property had by the statue but not the piece of clay. Thus, a satisfying account of the apparent differences between constitutionally related objects must also make room for the powerful intuition

that constitution, in the sense in which this notion is of interest to us, is an *asymmetrical* relation, while identity is of course symmetrical.

If, on the other hand, the statue and the lump of clay constituting it are viewed as numerically distinct objects which occupy the same region of space-time, we should expect some elucidation of the intimate relation which holds between these objects. After all, since numerical identity is not a relation that admits **(p. 185)** of degrees, the statue and the lump of clay constituting it, according to this approach, are as distinct from one another as, say, the Eiffel Tower and the planet Jupiter. How, then, is it that two numerically distinct objects can be so closely related and share so many fundamental properties? Moreover, since distinctness is of course as symmetrical as identity, the thesis that constitutionally related objects are numerically distinct by itself is not enough to account for the asymmetry of the constitution relation.

The Problem of Constitution thus challenges us to provide an analysis of the constitution relation which accounts for both the striking similarities as well as the apparent differences between constitutionally related objects. With the help of NAT, we may offer the following attractive *mereological* analysis of constitution:

> (MAC) Mereological Analysis of Constitution: Some objects, $m_1, \ldots, m_n$, *constitute* an object, O, just in case $m_1, \ldots, m_n$ are O's *material components*, i.e., $m_1, \ldots, m_n$ are those among O's *proper parts* which satisfy the constraints dictated by O's *formal components*, $f_1, \ldots, f_n$.

Following MAC, constitution now becomes a *species* of the mereological notion of composition, which in turn is just the reverse of parthood: for constitution, on this approach, is analyzed as the relation which a whole bears to certain *specific* ones among its proper parts, viz., its material components; the relation of composition, on the other hand, holds more generally between a whole and all of its parts, including its formal components: all of its proper parts together *compose* a whole, but only its material components *constitute* it. Among the useful consequences of this approach is that it immediately gives rise to a very straightforward account of the *asymmetry* of the constitution relation: constitution, according to the present approach, is asymmetric because the relation of *proper parthood* is.[28]

The mereological solution to the Problem of Constitution outlined in MAC addresses both the striking similarities as well as the apparent differences between constitutionally related objects in a satisfyingly symmetrical manner. The similarities between constitutionally related objects, on this account, are due to the fact that wholes derive some of their characteristics from their material components. The differences between constitutionally related objects, on the other hand, are due to the fact that wholes inherit other characteristics from their remaining **(p.186)** proper parts, viz., their formal components.[29] In both cases, however, the presence of certain characteristics within a mereologically complex object can be explained by appeal to a supervenience-

like dependence principle of a particular *mereological* variety: according to the present account, the characteristics of a mereologically complex object in general derive either from its material components or from its formal components. In this way, NAT explains in a nicely symmetrical way why mereologically complex objects in general have the characteristics they do, both those which they share with their material components and those with respect to which they differ from their material components. This concludes my case for a thoroughly mereological conception of composition, according to which the material and formal components of a mereologically complex objects are proper parts of the whole they compose.

§VII.2.8 The Hierarchical Nature of Composition

Given that we have assumed a single transitive part-relation for the domain of material objects, it is a consequence of NAT that mereologically complex objects are hybrid all the way through. Consider once again the table which, we said, is composed of some material components (the legs, top and hardware), arranged in the manner dictated by the table's formal components; it is the job of these latter components to specify the variety and configuration which must be exhibited by the material components out of which a whole of this kind may be composed. Consider now a proper part of (a proper part of . . .) one of the table's material components, e.g., a single molecule which might be, say, a proper part of (a proper part of . . .) one of the table's legs. By the transitivity of parthood, the single molecule in question is a proper part of the table as well.

If tables are hybrid objects, consisting of formal and material components, then so are molecules, since the same considerations apply in both cases. For the relation between a molecule and the particles which constitute it is exactly the same as that which holds between a table's material components and the table itself: the molecule and the particles that constitute it occupy the same region of space-time, but they do not share all of their properties (e.g., the particles might exist before or after the molecule exists; they need not constitute the molecule in question; etc.); moreover, it is integral to the existence and identity of the molecule that the particles which constitute it are of a particular variety **(p. 187)** and exhibit a particular configuration associated with objects of this particular kind. The same considerations which motivated us to recognize within the table a certain amount of structural complexity, which we traced to the presence of additional components within the table over and above its material components, therefore apply with the same force to molecules as well. More generally, the material components of mereologically complex objects, as well as their material components' . . . material components, can themselves be expected to exhibit the same dichotomous nature as the wholes of which they are part.

Only objects (if there are any) which lie at the very bottom of the compositional hierarchy, i.e., objects which are not themselves constituted by anything, would present us with an exception to this generalization: if there are any such things, they would be non-hybrid; or, at least, the considerations which led us to ascribe a hybrid nature to such objects as tables would not apply to this special case. For the job of an object's formal components is to specify the variety and configuration that must be exhibited by an object's material components in order for a whole of this kind to exist; but an object that is not constituted by anything has no material components, and hence no proper parts that must be of a certain variety and configuration.

As long as we confine ourselves to the case of mereologically complex objects, however, the considerations which motivated us to adopt NAT are general: they apply to such microscopic objects as molecules just as much as they apply to such macroscopic objects as tables. By NAT, the formal and material components of a molecule are proper parts of the whole they compose; and, by the transitivity of parthood, the molecule's formal and material components in turn are also proper parts of the table which they help to compose. But it is implausible to think that the *molecule's* formal components are among the structural features that are associated with object that belong to the kind, *table*, since considerations involving for example relations between protons, neutrons and electrons and the physical and chemical characteristics that go along with these relations play no role in the primarily functional requirements set on potential table ingredients. For this reason, a distinction between two different sorts of formal components suggests itself: (i) those that are directly associated with the kind to which a whole belongs, which we may term *formal components simpliciter*; and (ii) those that are the formal components *simpliciter* of some of a whole's material components, which we may term *derivative formal components*. Only formal components of the first variety play a role in specifying how the material components of a table, say, must be put together in order for there to be on object of this particular kind; thus, only formal components *simpliciter* are relevant to the Restricted Composition Principle, leading to the following reformulation of RCP:

> (RCP) Restricted Composition (Third Version): Some objects, $m_1, \ldots, m_n$, compose an object, O, of kind, K, just in case $m_1, \ldots, m_n$, satisfy the **(p. 188)** constraints dictated by some formal components *simpliciter*, $f_1, \ldots, f_n$, associated with objects of kind, K.

Thus, the formal constraints operative among the proper parts of a mereologically complex object cannot in general be assumed to transfer to the formal components *simpliciter* associated with the wholes of which they are proper parts, though there may be special cases in which the parts and the whole are structurally isomorphic; nevertheless, by NAT and the transitivity of parthood, both sorts of structural features are among the proper parts of the whole whose material components they organize. In

this sense, then, mereologically complex objects, according to the present approach, are hybrid through and through: each mereologically complex object consists of formal and material components, which in turn, if they are themselves mereologically complex, display the same dichotomous structure as the whole they help to compose.

§VII.2.9 Change over Time

Ordinary material objects plainly are capable of persisting through change over time with respect to some of their characteristics. Thus, Socrates may at one time be sitting and at another time standing; and he may have less hair at one time than he does at another. The phenomenon of change over time has turned out to be difficult to account for: it appears to present us with violations of Leibniz's Law, viz., scenarios in which (what looks to be) a single object both has and does not have (what looks to be) a single property. The “Problem of Change over Time” thus consists in the demand for an account of where to locate the obvious sensitivity to time that is manifested in these sorts of property attributions.

The two main rival approaches to the Problem of Change over Time are *three-dimensionalism* (also known as *endurantism*) and *four-dimensionalism* (also known as *perdurantism* or *the doctrine of temporal parts*).[30 , 31] According to the four-dimensionalist, the Problem of Change over Time is solved by conceiving of objects as themselves relativized to time: our familiar concrete objects of common sense, on this approach, turn out to have a temporal dimension in addition to their three spatial dimensions. Thus, when one and the same persisting object, O, changes over time with respect to a property, F, it does so by having a temporal part, O_1, at one time which instantiates the single property in question and a **(p.189)** distinct temporal part, O_2, at another time which fails to do so; since O_1 and O_2 are numerically distinct objects, there is no contradiction involved in O_1's having F and O_2's lacking F. The three-dimensionalist, on the other hand, builds the sensitivity to time into the property, F, or O's instantiation of it: thus, when a single three-dimensional object, O, changes over time with respect to (what appears to be) a single property, F, the single object in question, according to the three-dimensionalist, has-F-at-t and fails to have-F-at-t′; but for a single object both to have-F-at-t and not to have-F-at-t′ is as non-contradictory as, say, being both large and not blue. (There are different ways for the three-dimensionalist to build the sensitivity to time into the property, F, or O's instantiation of it; but I will not at present enter into the details of this debate.)

Suppose that some three-dimensionalist solution to the Problem of Change over Time is feasible.[32] Then, we may think of the structured wholes at work in the current analysis as enduring, three-dimensional objects which may change over time in various respects without threat of contradiction. One of the ways in which a structured whole may change over time is by tolerating the addition, alteration or loss of some of its material components. The table, for example, given the persistence conditions ordinarily ascribed to objects of this kind, need

not be constituted of the same legs, the same top or the same hardware throughout its career; the legs, top and hardware in turn need not be constituted of exactly the same wood and metal throughout their career; and so forth. (Of course, there is a certain amount of fuzziness, brought out by Ship-of-Theseus-style puzzles, in just how dramatically an object can change with respect to its material components; but the difficulties raised by the apparent indeterminacy in an object's criteria of identity over time need not concern us here.)

Similarly, there is of course an endless variety of ways in which the *general* formal requirements that come with wholes of a specific kind may be manifested in particular objects at particular times; and, depending on the persistence conditions which characterize the objects in question, one and the same mereologically complex object may well tolerate a fair share of structural change in this regard. Thus, the material components of which an H_2O molecule consists, viz., the two hydrogen atoms and the single oxygen atom, must always exhibit the relation of chemical bonding, for as long as they compose an H_2O molecule; but the *specific way* in which they exhibit this configuration of chemical bonding may vary over time, without affecting the existence or identity of the whole in question.[33] In light of these considerations, then, we ought to think of the formal components, as they have been described up to this point, as something **(p.190)** closer to *determinables*, of which particular *determinates* are represented in a mereologically complex object at each time at which it exists. To what extent structural change is permitted either with respect to the determinable or the determinate manifestation of an object's formal components depends on the persistence conditions that are operative in the particular case at hand.

Given that this discussion is set in a three-dimensionalist framework, we will follow the three-dimensionalist's general strategy of accommodating the phenomenon of change over time by relativizing property instantiation to time in some fashion: in this particular case, the specific instance of this general strategy calls for relativizing the part relation to time. Since we assumed parthood as our single mereological primitive, a temporalized part relation has the effect of temporalizing all other mereological notions that are defined in terms of it as well, e.g., those of composition and constitution. In the following reformulations of the relevant principles, our new primitive relation, $<_t$, is to be read as “is a proper part of at time t”; similarly, $\wr_t$, reads “is discrete from at time t”; the superscript “^{T}” indicates that the principle in question has been temporalized:

Axiom 1 ^{T} (Asymmetry):	$x<_t y \rightarrow \sim(y<_t x)$
Axiom 2 ^{T} (Transitivity):	$(x<_t y \ \& \ y<_t z) \rightarrow x<_t z$

Axiom 3 ^{T} (Weak Supplementation): $(x<_t y) \rightarrow (\exists z)\ (z<_t y\ \&\ z \wr_t x)$

(RCPT) Restricted Composition (Fourth Version):Some objects, $m_1, \ldots, m_n$, compose an object, O, of kind, K, at a time t just in case $m_1, \ldots, m_n$, satisfy at t the constraints dictated by some formal components *simpliciter*, $f_1, \ldots, f_n$, associated with objects of kind, K.

(NATT) Neo-Aristotelian Thesis: The material and formal components which compose a mereologically complex object at a time t are at t *proper parts* of the whole they compose at t.

Uniqueness of Composition^{T}: It never happens that two numerically distinct wholes have exactly the same parts at a single time t.

(MACT) Mereological Analysis of Constitution: Some objects, $m_1, \ldots, m_n$, *constitute* an object, O, at a time t just in case $m_1, \ldots, m_n$ are at t O's *material components*, i.e., $m_1, \ldots, m_n$ are at t those among O's *proper parts* which at t satisfy the constraints dictated by O's *formal components*, $f_1, \ldots, f_n$.

These temporalized formulations of the relevant principles are only intended to show *that* the phenomenon of change over time can be straightforwardly accommodated by the present analysis in the standard three-dimensionalist **(p.191)** fashion; the question of what sorts of changes are possible for particular objects is of course one that cannot be answered without appeal to the persistence conditions specific to the case at hand.

§VII.2.10 Synchronic and Diachronic Identity

If a whole may tolerate changes in both its material and, to some extent, its formal composition, we may wonder what then accounts for its *diachronic* identity, i.e., the identity of an object with itself *over time*. The analogous question concerning an object's *synchronic* identity, i.e., its identity *at a time*, can be answered simply by appeal to the Uniqueness of Composition, which yields one half of a biconditional whose other half is supplied by Leibniz's Law:

Synchronic Identity:
An object, x, and an object, y, are *synchronically identical* at some time t iff x and y share all of their parts at t.

But it is not true that an object, x, and an object y, that are *diachronically identical* must share *all* of their parts *over time*, since the object in question may have changed with respect to its parts in the intervening time. Moreover, the identity of an object with itself over time also cannot be traced simply to the fact that at every time at which the object exists it exhibits some particular manifestation of the same general formal components, since the same will be true of other objects which belong to the same kind.[34]

Since the current approach is not addressed directly to the question of how to account for the identity of an object with itself over time, the resources provided by it by themselves do not yield an account of diachronic identity. Surely, in Aristotelian terms, this phenomenon must in some fashion involve the manner in

which each manifestation of a given set of formal components is passed on from one collection of material components at one time to another such collection at another time. If the correct analysis of identity over time is one that appeals to *spatio-temporal continuity*, then this idea may be invoked here as well to account for the connection that must obtain between an object's material components at one time and the same object's material components at a different time. If, on the other hand, spatio-temporal continuity is rejected by the three-dimensionalist in favor of another account of diachronic identity, then presumably we have maintained a sufficient degree of neutrality to be able to make room for such an alternative account.

(p.192) §VII.2.11 Composition as Non-Identity

In the previous sections, we have already aligned ourselves explicitly with the Platonic and Aristotelian models of parthood and composition with respect to feature (iii), the *restricted* notion of composition, as well as feature (iv), the *dichotomous* conception of wholes as composed of *structure* or *form*, on the one hand, and *content* or *matter*, on the other. Next, we similarly follow these ancient mereologies with respect to feature (ii), the *ontologically committing* conception of wholes.

Like Plato and Aristotle, the present approach opposes the Eleatic/Lewisian Composition-as-Identity model and takes composition to be genuinely committing: wholes are in no way to be identified with their parts; rather, a commitment to wholes is a commitment to entities numerically distinct from their proper parts. Moreover, since the present approach does away with standard mereological sums and rules out violations of the Uniqueness of Composition, any given collection of objects composes, if anything, only a single whole; this precludes an allegedly ontologically innocent conception of composition which identifies wholes with the *sums* of their parts, as construed in the standard sense.

The evidence in support of this ontologically loaded conception of wholes is two-fold. First, on the negative side, it is supported by considerations which count against the Composition-as-Identity Thesis.[35] Secondly, on the positive side, the case for an ontologically loaded conception of wholes turns on the cogency of Leibniz's Law-style arguments in favor of the numerical distinctness of wholes and their parts: by Leibniz's Law, wholes and their parts are numerically distinct, because they do not share all of their properties (e.g., for one thing, the parts typically do, but the whole does not, exist prior to the creation of the whole). Arguments of this sort have played a pivotal role in the preceding sections and have been defended separately in Chapter III.

§VII.2.12 The Unified Nature of Wholes

Finally, I want to comment on feature (i) of the Platonic and Aristotelian model of parthood and composition, viz., the genuinely *unified* nature of wholes. As was brought out in our discussion of these ancient mereologies in Chapters V and VI, among the most central concerns of Plato's and Aristotle's mereological writings is the desire to provide a satisfying response to what we have termed the "Problem of the One and the Many", which challenges us to say how an object **(p.193)** that is mereologically complex, i.e., has *many* parts, can nevertheless be *one* or *unified* in some fashion. Following some early flirtations with the Pluralizing Parts Principle and the ontologically innocent Eleatic/Lewisian Composition-as-Identity model, Plato's more mature mereology takes wholes to be unqualifiedly one, despite the fact that they have many parts; the element present in the whole which holds together the many parts and which bestows on the object in question its normative and teleological character is "structure" or what is expressible in mathematical terms (number, measure, ratio, proportion, and the like). Despite the rich and suggestive detail the Platonic account offers in terms of which to *describe* particular cases of composition, however, we were reluctant to credit this account with a fully general *solution* to the Problem of the One and the Many, since it does not explicitly address the question, except insofar as it invokes a centralized and seemingly theological teleology, of why particular mathematical relations, when they obtain among pluralities of objects, give rise to genuinely unified wholes, while others apparently do not.

Aristotle goes further in this respect and proposes, first, to *relativize* the notions of unity and plurality, so that a single object can be both one (i.e., indivisible into parts) and many (i.e., divisible into parts) simultaneously and without contradiction, relative to different measures; moreover, wholeness (being a species of oneness), in his view, comes in *degrees*, depending on the strength of the principle of unity operative in particular cases. Aristotle's answer to the question of how something that has many parts can nevertheless be one thus in effect yields a hierarchy or ranking of objects, ranging from the least unified (viz., the so-called "totals", e.g., liquids and numbers) to the most unified (viz., Aristotelian forms); matter/form compounds, heaps and universals comprise the intervening cases. Depending on the ontological category to which an object belongs, the principles of unity at work in holding the parts of these objects together correspondingly differ widely: for example, the principle of unity holding together the parts of a heap may be anything that enforces physical contact, i.e., the sharing of boundaries, among its parts (e.g., a band holding together some wooden sticks); the parts of a universal (e.g., animal or living thing) are held together by the qualitative similarity under which these objects may be grouped; finally, the strongest principle of unity of all is form, which unifies matter/form compounds (e.g. Socrates or the shoe) to such an extent that these objects have no parts at all *actually*, but do so only *potentially*.

Despite the amazingly subtle and ambitious mereology with which this account presents us, we also noted that Aristotle in some ways backs himself into a corner by accepting certain assumptions which he thinks are needed to solve the Problem of the One and the Many. First and foremost among them are the following two: (i) the conceptual connection he sets up right from the start between *unity* and *indivisibility* into parts; and (ii) the principle that a mereologically complex object must always derive its unity from some *source*, which in turn must be unified to a *higher degree* than the object it unifies. These two assumptions together **(p.194)** threaten to lead to a never-ending demand for further principles of unity and in the end launch Aristotle on his search for the ultimate mereological atom: for only something that is indivisible relative to every conceivable measure, by claiming to have its unity in a primitive and underived manner, could ever put to rest the potential regress to which (i) and (ii) appear to give rise. I argued in Chapter VI that, with some ambivalence, Aristotle takes form to play the role of the ultimate mereological atom within his system, on the basis of the general principle that things that have no association with matter (and hence are pure actuality) are not divisible into parts by any measure, though this strategy conflicts with other central metaphysical commitments that are dear to him, most notably the association between form and definition, the latter of which is generally assumed by Aristotle to be mereologically complex.

In response to the difficulties to which the Aristotelian account gives rise, I recommend that we ask ourselves, first, whether the assumptions in (i) and (ii) are even particularly plausible and, secondly, whether they are in fact necessary for a solution to the Problem of the One and the Many; once we realize that neither is the case, we will see that the Problem of the One and the Many does not require the drastic measures to which Aristotle finds himself driven. Consider, first, the conceptual connection Aristotle sets up between the notions of unity and indivisibility: according to this conception of unity, something's being *one* according to some measure (i.e., its being one *something-or-other*, where the concept used to fill the slot marked by the phrase “something-or-other” supplies the measure in question) is taken to amount to its being not further divisible into parts according to the measure in question; in fact, the lack of divisibility seems to be identified by Aristotle as the reason for the object's status as a unified thing with respect to the measure at hand. Thus, to illustrate, recall an example we used early on in Chapter VI: “ba” is taken to be *one* (syllable) because it is *indivisible* into parts relative to the measure “syllable”; it is *many* (letters) because it is *divisible* into parts relative to the measure “letter”.

And while oneness and indivisibility may line up in this way in very many cases, Aristotle's close conceptual connection between these two notions in fact runs into trouble when applied across the board.[36] For it is not difficult to think **(p. 195)** of cases in which it is perfectly natural to call something *a* or *one* something-or-other, even when the object in question is further divisible into

objects of the same kind: for example, a building may be composed of proper parts which are themselves buildings; a particular pattern may be composed of proper parts which are themselves patterns (in fact, the objects in question may even be instances of the *same* pattern, only on a smaller scale); many strings in the alphabet, {“a”, “b”}, are composed of proper parts which are themselves also strings in the same alphabet; a journey may be composed of smaller journeys; and so on.[37] In each case, the fact that an object is further divisible into proper parts which satisfy the same concept is no obstacle to its counting as *one* something-or-other, relative to the measure in question. Given the naturalness and intelligibility of cases of this sort, the connection between unity and indivisibility can at most be regarded as a useful rule of thumb, but not as a conceptual truth which correctly describes the domain of objects to which our practices of counting and individuation are directed.

Consider now the second crucial assumption driving the Aristotelian response to the Problem of the One and the Many, viz., the principle that a mereologically complex object must always derive its unity from some *source* which in turn must be unified to a *higher degree* than the object it unifies.[38] Again, there is at least in principle no reason why something that in itself has a relatively low degree of unity should not be able, when coming into contact with objects of the right kind, to unify these objects to a higher degree than the degree of unity possessed by itself or by any of the participating objects prior to this association. For example, imagine a particular kind of glue which is chemically quite unstable (i.e., in the sense that it has a high propensity to disintegrate into its components), except when it is brought into contact with particular substances, such as wood **(p.196)** or paper, in which case the glue and these substances together result in something whose parts hang together much more tightly than did the parts of either object taken by itself.

Thus, it seems that neither of Aristotle's two central assumptions represents a conceptual truth concerning the connection between the notions of unity and indivisibility into parts. Rather, an object apparently can be *one* something-or-other, relative to some measure, even when it is further divisible into proper parts which satisfy the same measure; moreover, there is no reason in principle to expect that the parts of a mereologically complex object must be held together by a principle of unity which possesses a higher degree of unity than that which it contributes to the whole it unifies. Given these results, then, we ought, first, to separate the notion of oneness or unity from that of indivisibility; and we ought, secondly, to abandon the expectation that principles of unity must themselves either be mereologically simple relative to any conceivable measure or that they be, for whatever reason, otherwise highly unified.

Once we realize that Aristotle's two crucial assumptions are in fact neither particularly plausible nor necessary for the solution of the Problem of the One and the Many, other strategies suggest themselves by means of which we may

address the challenge posed by this problem, viz., to say how an object can be *one* despite the fact that it has *many* parts. Among the central innovations introduced by the Aristotelian account of parthood and composition is the move to *relativize* the notion of unity (and, correlatively, that of plurality) to particular measures: to be *one* or *unified*, for Aristotle, is always to be one *something-or-other*, where the concept substituted for the phrase "something-or-other" supplies the measure which is applied to the object in question. Given the presupposed ontology of kinds, to be unified relative to some measure in effect simply amounts to being a particular specimen of a kind: to be unified with respect to the measure "syllable", for example, simply amounts to being *one* syllable, i.e., being *one* specimen of the kind *syllable*.

Now recall the earlier separation we induced between the responsibilities of the mereologist in particular and the ontologist at large: the ontologist at large, in conjunction with whatever other disciplines are relevant to this task, settles questions of ontological commitment, in particular the question, "What *kinds* of objects are there?"; the tasks of the mereologist proper, on the other hand, include that of devising an appropriate theory of parthood and composition which correctly reflects the characteristics of those objects to which we take ourselves to be already committed as part of our presupposed scientifically informed, commonsense ontology. In this and the preceding chapters, we have defended the thesis that the theory which best reflects the conditions of existence and spatio-temporal location as well as the part/whole structure of these **(p.197)** objects is one which attributes to them a dichotomous nature, consisting of both formal or structural components, alongside their more ordinary, material, components.

The more restricted conception of mereology, along with the presupposed ontology of kinds and the structure-based theory of parthood and composition, together now yield all the apparatus needed to solve the Problem of the One and the Many. For recall that ordinary material objects were taken to be both mereologically and ontologically complex, in the sense that they are composed of both material and formal components; the primary job of an object's formal components, moreover, is to act as a sort of *recipe* in specifying a range of selection requirements which must be satisfied by an object's material components, whose primary role was compared to that of the *ingredients* called for in the recipe. In a successful case of composition, then, a plurality of objects in fact satisfies the requirements specified by some formal components associated with a particular kind, K; the result of this convergence is a new specimen of the kind in question, i.e., an object that is *one* or *unified* relative to the measure supplied by the particular kind at hand.

Nothing more *needs* to be said or *could* be said to lay to rest the challenge contained in the Problem of the One and the Many. For the mereologist, after all, is not attempting to answer the question of *why* there are objects of a particular

kind; depending on the kind under discussion, this question, in any event, is more appropriately directed to some discipline outside of philosophy, such as cosmology.[39] Assuming, on the other hand, that, for whatever reason, there *are* objects of the particular kind in question, then it should come as no surprise that one of them has come into existence, when a particular plurality of objects satisfies the requirements for how to "build" an object of this kind. To illustrate, specimens of the kind *H 2 O molecule* come into existence when two hydrogen atoms and one oxygen atom enter into a particular configuration of chemical bonding: objects of this kind are *unified* in the sense that they are *one* specimen of the kind in question, i.e., *one* relative to the measure "H_2O molecule"; their material components hang together to the degree that hydrogen and oxygen atoms, which enter into the relation of chemical bonding, can be expected to do so. That an object which counts as *one* or *unified* relative to **(p.198)** the measure "H_2O molecule" has parts at all, poses no threat to its status as a particular specimen of the kind in question: rather, given what we know about the chemical composition of H_2O molecules, nothing could be one specimen of this kind or unified relative to this particular measure without having as parts at least two hydrogen atoms and one oxygen atom. Given that this is just what it means to be an H_2O molecule, there is nothing further that the mereologist proper or the ontologist at large can add to what the scientist has already told us about the chemical composition of objects of this kind. The mereologist *can*, however, be held responsible for the task of devising a theory of parthood and composition which is responsive to the fact that there can be no H_2O molecule, unless a particular plurality of objects satisfies the formal requirements as to number, variety and configuration associated with this kind of whole.[40]

§VII.3 Concluding Remarks

As I hope to have demonstrated in this chapter, a structure-based neo-Aristotelian mereology for ordinary material objects can be defended utilizing a single relation of parthood with relatively straightforward formal properties. A substantive restriction on composition can be derived from a comparatively minimal and metaphysically neutral ontology of kinds; this commitment to kinds, furthermore, is not expected to spring out of the mereology itself, but is to be justified using independent considerations from other disciplines within or outside of philosophy altogether. One of my central aims in this chapter concerned the thoroughly mereological conception of composition which, I have argued, recommends itself based on Leibniz's Law and the Weak Supplementation Principle. This thoroughly mereological conception of composition brings with it certain advantages: it yields the Uniqueness of Composition as a derived **(p.199)** principle; it generates a, to my mind, satisfying response to the Problem of Constitution; it indicates a promising direction to pursue with respect to the Grounding Problem; moreover, it clarifies the relation between a whole and both its material and its structural components, which otherwise remains opaque. Finally, I have tried to suggest

how, on the approach defended here, wholes can be thought of as both ontologically committing and genuinely unified, despite the apparent Aristotelian regress caused by a never-ending demand for further principles of unity.

Notes:

(1) For an approach to mereology which also recognizes that material objects have non-material parts in addition to their ordinary material parts, see Paul (2002); in other respects, however, our accounts are quite dissimilar.

(2) Both presuppositions may fail, for example, in the case of kinds which are more appropriately conceived of along the model of Wittgensteinian *family resemblances*, rather than in terms of essences and/or necessary and sufficient conditions for kind membership. Although neither essentialism about kinds nor the across-the-board availability of necessary and sufficient conditions determining kind membership is *presupposed* by the current account, nothing I say here *rules out* that either of these features obtains in at least some cases. Moreover, the question of whether members of a single kind share an essence is of course independent of the question of whether mereologically complex objects in general have *other* sorts of essential properties, i.e., properties which may not determine their membership in a kind but nevertheless belong to them essentially (e.g., origin-related properties, haecceities, and the like). In what follows, I intend to remain neutral on both of these questions.

(3) Despite the fact that the conception of kinds presupposed here is relatively minimal in the respects just outlined, it may perhaps be considered philosophically loaded in other respects. For I do presuppose that the kinds to which we are committed include those that are familiar to us and that these are embedded within a conception of space-time which is similarly familiar to us. If both of these fixed points are varied too much, as they might be, for example, by the sorts of exotic cases presented to us in science fiction stories, then the mereology I am proposing may lose its foothold. In that sense, perhaps, my project may be considered to be conceptually local, in that worlds whose ontology of kinds and whose notion of space-time are very alien from the point of view of our world may require a different metaphysic. (Thanks to Elijah Millgram for bringing this point to my attention.)

(4) There is a debate within Aristotle scholarship as to whether Aristotelian forms are best conceived of as universal, i.e., as shared by members of the same kind, or as particular, i.e., as specific to each object. However, even the forms-as-particulars camp agrees that there are universal forms shared by members of the same kind; the controversy is only over the question whether these universal forms are to be thought of as *constructed* out of particular forms, e.g., via some sort of classification by similarity, or whether, instead, the universal forms are irreducible, and particular forms (if there are such things) are to be thought of

as constructed out of them. Since I earlier remained uncommitted on the question of whether each object has associated with it its very own body of essential properties that are specific to that particular object, I will similarly leave open, independently of how this matter is resolved in connection with Aristotle's texts, whether the formal components of objects are first and foremost particular and only derivatively universal.

(5) I take Aristotle's *position* requirement to be included within the manner-of-arrangement condition and will typically not list it separately: according to this requirement, wholes differ from the so-called “totals” in that the position of their parts matters to the existence and identity of the former but not the latter.

(6) Given the skepticism I have expressed above concerning the Homonymy Principle, we need not follow Aristotle in thinking that an ax made of, say, porcelain is an ax in name alone; another possibility would be to view such a thing simply as a *bad* or *useless* ax, relative to the purposes for which axes are created and compared to other axes that are available, but an ax nevertheless.

(7) Otherwise, we would be committed to the intuitively highly unattractive view that any given Home Depot store, say, contains among other things many actual houses, roofs, garages, bathrooms, sheds, and so on, simply because it contains all of the, as of yet unassembled, ingredients needed to build these objects. Whether objects, once created, remain in existence in a disassembled state depends on how the question of diachronic identity is resolved; as I point out below, in Section VII.2.10, the present account does not commit itself to any particular account concerning the identity of an object with itself over time.

(8) It is not necessary, in this context, to assume that the constraints dictated by any given formal components are altogether *unique* to the particular kind in question; a case in point might be the relation of chemical bonding which, when applied to distinct varieties of material components, yields wholes of distinct kinds. However, in such cases, the formal components in question will at least differ with respect to some of the *other* constraints they set, for example, concerning the variety or number of material components which may compose a given whole; otherwise, if the formal components of one object agreed in *all* respects with those of another, it is difficult to see on what basis these objects should be associated with distinct kinds at all.

(9) I say “*some* formal components”, rather than “*the* formal components”, since a given kind may be associated with different sets of selection requirements, e.g., if the kind in question falls into further subkinds or if the kind in question is best described along the lines of the Wittgensteinian family-resemblance model.

(10) The possibility of this simplified ontology is one of the advantages that comes with a non-teleological approach to form.

(11) Even such objects as heaps of sand or portions of rice, assuming they are in fact to be counted as part of our scientifically informed commonsense ontology, do not conform to the modally rigid profile of standard sums. While we would ordinarily consider a heap of sand which has gained or lost a few grains to be *the same* heap as the earlier one, we would *not* consider it to be the same heap, or a heap at all for that matter, if the sand were to be scattered. Thus, even such "low-level" wholes as heaps of sand or portions of rice exhibit a certain amount of structural complexity and hence deserve to have attributed to them a set of formal components, whose job it is to tell us how the remaining components must be arranged, for the same reasons that motivated us to do so in the case of axes and the like.

(12) More generally, the table and its material components do not share all of their properties and hence, as Aristotle remarks as well, cannot be viewed as numerically identical. This Leibniz's Law-style argument for the numerical distinctness between a whole and its material components is of course not completely uncontroversial and has been argued for separately in Chapter IV (see also Koslicki 2005a for a defense of this reading of Leibniz's Law-style arguments for numerical distinctness). By Leibniz's Law, I mean the following *metaphysical* principle concerning objects, properties and relations: for all objects, x and y, if x and y are numerically identical, then x and y are qualitatively indiscernible. This metaphysical principle is not to be confused with a *linguistic* principle concerning the substitutivity of co-referential expressions, which is often called by the same name and sometimes even taken to be the very same principle as that governing objects, properties and relations. The principle I am calling "Leibniz's Law" is also not to be confused with the much more controversial metaphysical principle known as the "Identity of Indiscernibles", according to which objects that are qualitatively indiscernible are numerically identical; I do not intend to commit myself to the truth of this latter principle and nothing I say forces such a commitment.

(13) This assumption would be disputed by Michael Burke; see note 16 for more details.

(14) The supervenience-like dependence principle that is at work here is explored in more detail in Koslicki (2004a).

(15) In fact, many accounts in the literature maintain that numerically distinct, spatio-temporally coincident objects, such as the statue and the clay which constitutes it, share *all* of their parts; see, for example, Thomson (1983, 1998) for a representative version of this widespread view. It is, however, puzzling how the thesis that spatio-temporally coincident objects share all of their parts can be combined with the view that such objects are non-identical, as it frequently is. For consider the relation which obtains, say, between the nose of a statue and the nose-shaped piece of clay which occupies the same region of space-time as

it. Surely, the relation between the statue-nose and the nose-shaped piece of clay is exactly the same as that which holds between the whole statue and the whole statue-shaped piece of clay of which they are part, namely just the relation known as *constitution* (i.e., the relation between a thing and what it is made of). But, in that case, it seems that someone who holds that the nose-shaped piece of clay is identical to the statue-nose (i.e., that this is a part they share) should, for the sake of consistency, take constitution generally to be identity. If the nose-shaped piece of clay and the statue-nose it constitutes are distinct, however, then it is not obvious why we should take the piece of clay to have the statue-nose (as opposed to the nose-shaped piece of clay coincident with it) as a part. After all, if the parts in question are distinct, their distinctness presumably has to do, at least in part, with the modal differences between them; but, in that case, it no longer seems plausible to attribute a part to the statue-shaped piece of clay which has the persistence conditions of the statue-nose, as opposed to those of the nose-shaped piece of clay coincident with it. The precise connection between the relation of constitution and the mereological relation of composition, which has been our main concern so far, will be elucidated further below.

(16) A possible example of the kind of case I have in mind from the realm of living things would be a zygote which constitutes a human being. As mentioned earlier, this assumption would be disputed by Michael Burke, who has, in a series of papers, argued for the thesis that the lump of clay which constitutes the statue is numerically distinct from the lump of clay which exists before or after the statue exists, since the first lump of clay is *also* a statue (and hence numerically identical with the statue with which it shares a region of space-time) while the latter is *merely* a lump of clay and not also a statue (see especially Burke 1992, 1994a and 1994b). However, I take it to be among of the most powerful objections against this view that it depends on attributing to objects persistence conditions which are radically different from those ordinarily ascribed to them; moreover, it is difficult to see how this shift in the attribution of persistence conditions could be motivated on independent grounds.

(17) Versions of the view that constitution is identity include the following: eliminativism (Unger 1979; van Inwagen 1990a); identity relativized to time (Gallois 1990, 1998; Myro 1986); identity relativized to sort (Deutsch 1998; Geach 1962, 1967; Griffin 1977; Gupta 1980); four-dimensionalism (Cartwright 1975; Forbes 1987; Heller 1984, 1990; Lewis 1983a, 1986b; Perry 1972; Quine 1950; Sider 1997, 2001); contingent identity (Gibbard 1975; Lewis 1968, 1986b); and dominant kinds (Burke 1992, 1994a, 1994b).

(18) An object, x, and an object, y, are *constitutionally related* just in case either x constitutes y or y constitutes x.

(19) Defenders of the thesis that constitutionally related objects are numerically distinct include the following: Baker (1997, 1999, 2000); Doepke (1982); Fine (1982); Johnston (1992); Locke (1975); Lowe (1989, 1995); Oderberg (1996); Simons (1987); Stone (1987); Thomson (1983, 1998); Wiggins (1968, 1980); and Yablo (1987).

(20) In Chapter IV, I cited the following objection to this use of WSP, due to Kit Fine (p.c.). Assume for the sake of the argument (very controversially, of course), that sets have their members (and nothing else) as *proper parts*; then, Socrates and his singleton set would present us with a violation of WSP: for Socrates' singleton set is numerically distinct from Socrates, has Socrates as a proper part, but has no proper parts besides this one. Now consider a set which does satisfy WSP by having more than a single proper part, e.g., the set containing Socrates and Plato. If, so Fine reasons, we found the relation between a set and its members puzzling to begin with, then this mystery presumably is not resolved by the presence of an additional member: for example, the presence of Plato in the two-membered set consisting of Plato and Socrates does not help us understand the relation between a set and its members any better than we already did by considering Socrates and his singleton set. For this reason, Fine suggests, nothing is lost by giving up WSP, which in his view should be rejected in any event on independent grounds (see the example involving continuous time-intervals, to which I reply that such a domain may very well require a partial ordering whose formal properties are quite distinct from those of the parthood relation which governs ordinary material objects).

But Fine's objection turns on the fact that Socrates and Plato are, by the standards relevant to the case at hand, objects of the *same kind*, viz., they are both *members* of the sets in question. I agree that adding more objects of the same kind does not elucidate the relation between a whole and its parts; this of course was also Aristotle's point in the regress argument of *Met*. Z.17. But, according to the present conception, the additional parts which help to explain the nature of the relation between a whole and its remaining proper parts belong to a *different kind*, viz., they are formal components which act as a sort of recipe in specifying the range and configuration of material components eligible to compose a whole of that particular kind. Thus, if the current theory were to be extended to the domain of set theory, it would predict that Socrates' singleton set does not violate WSP, since it has additional parts (though not additional *members*) besides Socrates, viz., its formal components, whose nature is presumably spelled out by reference to the axioms of set theory. Whether this kind of account does in fact properly characterize the mereological properties of sets is of course a difficult question, which would need to be pursued in much greater detail; it does, however, at least in principle hold more promise than to construe the formation of singletons as an utterly mysterious process (see Lewis 1991).

(21) The Grounding Problem is explored, for example, in Sosa (1987), Heller (1990), Burke (1992), Zimmerman (1995), Olson (2001) and Bennett (2004b).

(22) It might be objected at this point that my account is not really in a better position with respect to the Grounding Problem than those of my competitors. (Thanks to Karen Bennett and other members of the Princeton philosophical community for pushing me on this point.) For if the real philosophical challenge posed by the Grounding Problem is to account for the difference in the *modal profile* present in numerically distinct spatio-temporally coincident objects, then the verdict on whether the Grounding Problem has been solved is still out, until we know more about the formal components from which the mereological difference noted above is supposed to issue. For clearly the nature of an object's formal components, and hence its modal profile, is not dictated by its material components, since these are shared between numerically distinct spatio-temporally coincident objects whose modal profile is not the same. Thus, unless the formal components attributed to an object can help to *explain* why the object has the modal profile that it does (so the objection goes), the difference in parts pointed to above provides a response to the Grounding Problem only in letter but not in spirit. I concede that this objection raises a fair challenge for my account and ask that my readers defer their assessment of whether a difference in parts of the sort noted above can ultimately solve the Grounding Problem until the nature of the formal components has been further clarified in Chapter IX; to that extent, whatever advantage I now claim for my position resulting from its response to the Grounding Problem should be considered *conditional* on whether the promise of explaining the difference in modal profile at issue can be made good on below.

(23) I assume that the possibility of *same-kind* coincidence is in any case excluded on the basis of independent considerations (see, for example, Oderberg 1996 for discussion).

(24) Arguments in favor of assumption (ii) have already presented; assumption (i) has been argued for separately in Chapter III; assumptions (iii) and (iv) I take to be pretheoretically plausible.

(25) Recall, in this connection, that we raised a similar point in Chapter IV, in the context of Fine's theory of variable embodiments: unless we are explicitly told, by means of an additional postulate, what the relation is between a variable embodiment and its principle, Fine cannot claim to have met his goal of providing a “theory of the general nature of material things”.

(26) I am here alluding to the strategy taken by David Armstrong; see, for example, Armstrong (1989, p. 91 ff).

(27) My take on the Problem of Constitution is explained more fully in Koslicki (2004a).

(28) Most extant solutions to the Problem of Constitution do not have the resources needed to capture the asymmetry of the constitution relation. The four-dimensionalist approach, however, fares even worse than that, since in many cases it in fact *reverses* the directionality of the constitution relation in the following sense (see, for example, Lewis 1986b; Sider 2001): whenever the lump of clay outlives the statue it constitutes, the space-time-worm associated with the statue is only a subportion of the space-time-worm associated with the lump of clay that constitutes it; in other words, four-dimensionalist solutions to the Problem of Constitution actually predict that, in such cases, the *statue* is in fact a proper part of the *lump of clay* which constitutes it, and not vice versa.

(29) Given my earlier assumptions concerning the formal components of a given whole, the properties that can be accounted for by means of the mereological-supervenience principle hinted at in the text similarly only include those which a whole shares with at least some of the other objects which belong to the same kind. In the event that an object has associated with it a body of particularized modal properties that are specific to that object, the notion of a formal component could be reconceived to accommodate those sorts of differences as well between a whole and its material components; however, these particularized modal properties of course could no longer have as their source the kinds to which the objects in question belong. I will not speculate as to what (if any) their source might be instead.

(30) For proponents of the four-dimensionalist position, see for example: Armstrong (1980b); Cartwright (1975); Heller (1984, 1990); Jubien (1993); Lewis (1983a, 1986b); Quine (1950, 1960); Russell (1914, 1927); Sider (1996, 1997, 2001). Proponents of the three-dimensionalist position include: Baker (1997, 2000); Burke (1992, 1994a, 1994b); Chisholm (1976); Haslanger (1985, 1989a, 1989b, 1994a); Johnston (1987, 1992); Lowe (1987, 1989); Oderberg (1993, 1996); Simons (1987); Thomson (1983, 1998); van Inwagen (1990b); Wiggins (1968, 1980); Zimmerman (1995). (A more complete list of reference can be found in Sider 2001, p. 3.)

(31) The distinction between “perdurance” and “endurance” comes from David Lewis (e.g., Lewis 1986b, p. 202), who attributes it to Mark Johnston.

(32) As noted earlier, the nature of persistence over time, which is at issue in the debate between the three-dimensionalist and the four-dimensionalist, is not among the main topics of the present discussion, which is cast within a three-dimensionalist framework (but see Koslicki 2003a for arguments in favor of this position).

(33) The quantum-mechanical state of an H_2O molecule is such that the bonds (i.e., the shared electrons) between the two hydrogen atoms and the single oxygen atom that compose the H_2O molecule are always vibrating, so that the

positions of the atoms in question are not fixed. (Thanks to my chemistry consultant, Andrew Loxley, for discussion on this point.)

(34) In Fine (1994c), we are confronted with the following sort of puzzle for the Aristotelian: suppose that (through some sort of process of migration) the matter of which Socrates is composed at a certain time, t, is exactly the same as the matter of which Aristotle is composed at a later time, t′. If forms are construed as universal, then Aristotle at t′ is composed of both the same matter and the same form as Socrates was at t; and yet, we nevertheless want to say that the two are numerically distinct. What, then, accounts for their distinctness? Fine's puzzle may be construed as an argument in favor of a particularized conception of Aristotelian forms.

(35) The contemporary, Lewisian, version of the Composition-as-Identity Thesis was briefly discussed in Chapter II; see also the references cited therein. The ancient, Eleatic, version of the same view is subjected to extensive scrutiny and criticism by Plato and was briefly discussed in Chapter V; see Harte (2002) for a more detailed treatment of what she terms the “negative mereological undercurrent” within Plato's writings.

(36) Examples of the sort that follow are also used in Koslicki (1997) and (1999a) to make related points as they arise in the context of the so-called “mass/count distinction”, a linguistic distinction marked by a wide range of languages which represents the difference between what we *count* and what we merely *measure*. Count nouns are almost universally regarded as being semantically different from mass nouns in that their referents are indivisible into further parts by means of the measure supplied by the count noun (or the concept associated with the noun): thus, the noun, “human being”, for example, which is standardly used as a count noun, applies to objects that are *a* or *one* human being; and, as in Aristotle's case, something's being *a* or *one* human being is taken to coincide with its being not further divisible into parts relative to the measure “human being”. The semantic properties in question are sometimes called “atomicity” (since the extension of a count noun is thought to consist of mereological atoms relative to the term in question) and “non-distributivity” (since it is not the case that *every* part of something that satisfies a count noun itself also satisfies the noun in question, i.e., the noun does not *distribute* over proper parts of what it applies to). For reasons similar to those brought up in the main text, I don't believe that properties like atomicity and distributivity can be used to mark the semantic contrast between mass and count nouns; see Koslicki (1997, 1999a and 2006a) for further discussion.

(37) The example, strings in the alphabet, {“a”, “b”}, comes from Cartwright (1994); the case of journeys was brought to my attention by Andrew Loxley;

thanks also to Leopold Stubenberg for helpful discussion in connection with the issues brought up in this and the next few paragraphs.

(38) Halper (1989, p. 154) cites in this connection the following passage from *Met*. α, as suggesting a general principle from which it follows that the cause of unity must be unified to a *higher* degree than the objects it unifies:

> Now we do not know a truth without its cause; and a thing has a quality in a higher degree than other things if in virtue of it the similar quality belongs to the other things (e.g. fire is the hottest of things; for it is the cause of the heat of all other things); so that that which causes derivative truths to be true is most true. (*Met*. α.1, 993b24–26)

This assumption incidentally is also reminiscent of a similar principle employed in Descartes' cosmological argument for the existence of God, according to which that which causes other objects to have a certain quality must always itself exhibit the quality in question to a higher degree than the objects which derive this quality from it; similar examples are used by Descartes to illustrate the principle in question (e.g., fire must be hotter than the objects which are heated by it, and so on).

(39) Why, for example, are there H_2O molecules? Presumably, the non-philosopher's answer to this question would make reference to the laws of nature, the Big Bang (or whatever other initial state of the universe turns out to be accepted by our best scientific theory) and the complex intervening processes that led to the formation of molecules. An answer of this kind is directed to the question of what conditions were required to obtain to make the formation of such objects possible and to sustain their continued existence. Neither the mereologist nor the ontologist at large can be expected to have anything of interest to contribute to this question.

(40) In addition to the neo-Aristotelian regress just discussed, one may wonder also whether my account is susceptible to what one may term a neo-Bradleyan regress of the following sort. Suppose a structured whole, X, consists of two material components, Y and Z, as well as a formal component, F. According to my account, then, Y, Z and F are all proper parts of X; the job of F is to unify Y and Z. But how is it that F is “linked”, so to speak, to Y and Z? Is there a need for two further formal components, F^* and F+, whose job it is to “link” F to Y and Z, respectively? But this is like asking whether, in order to make a quantity of glue, G, bind together two pieces of paper, P^* and P+, we need two further quantities of glue, G^* and G+, whose job it is to bind together G with P^* and P+, respectively; nothing of the sort is required, if the first type of glue is of the right kind to react chemically with paper. Similarly, to bind together a bundle of sticks with a rope, it is not necessary to bind the rope to each stick with another rope; one piece of rope will do just fine for the whole bundle. Moreover, whether or not the principles of unity are to be regarded as proper parts of the resulting whole, as they are according to my approach, does not in any way affect their power to bind together other elements composing the whole: for example,

assume that the screws holding together the four table-legs and the table-top are without question proper parts of the resulting table; their mereological status with respect to the table does not in any way lower their capability of holding together the remaining components of the table.