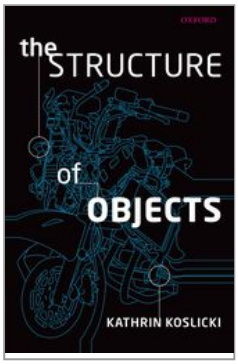

The Structure of Objects
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Introduction

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The 2003 Honda VFR 800 Interceptor is an intricately designed motorcycle and, in the minds of the motorcycle community, a very successful piece of engineering. It consists of literally hundreds of parts, most of which have been given explicit names. Among these parts are the gauges, indicators and displays (e.g., the tachometer, right and left turn signal indicator, digital clock, etc.); the controls and features (e.g., the ignition switch, start button, engine stop switch, etc.); and the components (e.g., the coveted fuel-injected V-Tech engine, the seat, battery, fuses, generator, drive chain, side stand, center stand, gear shift pedal, fairing, fuel tank, air filter, throttle, clutch, suspension, transmission, brakes, wheels and tires, catalytic converter, etc.). These parts are described in some detail in the owner's manual and in much greater detail in the sort of documentation that would be handed to a Honda mechanic in training or to a worker at the Honda factory. Such documentation also specifies exactly which part must go where in the assembly of the motorcycle and how each part is connected to the parts surrounding it.

It is completely obvious to those not in the grip of a philosophical theory that there is a vast and important difference between a heap of disassembled motorcycle parts, piled up, as they might be, at the Honda factory or in someone's garage, and the motorcycle in running condition that results from assembling these parts in a particular, fairly constrained, way. Anyone who is at all mechanically inclined or who is interested in actually riding their motorcycle will attest to the importance of the distinction between a motorcycle in running condition and its disassembled parts. Surprisingly, this vast difference, which must strike the uninitiated as both trivial and nevertheless crucial, has been de-emphasized, almost to the point of completely disappearing, in much of the

philosophical theorizing about parts, wholes and objects that has taken place in metaphysics during the last one hundred years or so.

How can this be? Part of the story, as outrageous as this might sound to the outsider, is simply historical accident. As one learns by working through Peter Simons' excellent book, *Parts: A Study in Ontology* (Simons 1987), the most popular and well-worked-out theory of parts and wholes, which came to dominate this corner of metaphysics in the 20th century, just happened to be designed by people who were not particularly interested in the distinction between, say, a motorcycle in running condition and its disassembled parts. **(p. 4)** Rather, for various theoretical reasons, their theory of parts and wholes was intended primarily for the purposes of replacing set theory, and, as we all remember from learning elementary set theory, it makes no difference to the existence and identity of a set how its members are arranged; in this way, wholes came out looking as much like sets as they possibly could, without carrying with them set theory's commitment to an infinite hierarchy of abstract objects. Since the founders of this most popular theory of parts and wholes were not inclined to assign any importance to the distinction between, say, a motorcycle in running condition and its disassembled parts, they built their theory in such a way that it lacks the resources to recognize this distinction. (The theory in question, which I call “standard mereology”, will be laid out and discussed in detail in Chapter I.)[I]

Standard mereology is an attractively simple, elegant and powerful theory; as we shall see below, it requires only a single primitive notion and in its standard formulations consists of a mere three axioms. However, from the point of view of those interested in characterizing the relation between, say, a motorcycle and its parts, this system also has some counterintuitive consequences. For example, it follows from one of the axioms of standard mereology, commonly known as the Uniqueness of Composition, that there is no difference between a heap of unassembled motorcycle parts piled up in someone's garage and the motorcycle in running condition that results from assembling these parts in a particular way: for the heap and the motorcycle, by hypothesis, have the very same parts and, according to the Uniqueness of Composition, objects with the same parts are numerically identical. Thus, standard mereology cannot tell the difference between the motorcycle in running condition and the heap of disassembled parts; from the point of view of theory, they are the very same thing.

Moreover, it also follows from another one of the axioms of standard mereology, commonly known as Unrestricted Composition, that *any* plurality of objects, no matter how disparate, dissimilar or gerrymandered, itself counts as an object, even if these objects fail to exhibit interesting similarities, internal unity, cohesion or causal interaction amongst each other. Thus, according to this axiom, the American President's left hand together with the Eiffel Tower compose a further object, their mereological sum, fusion or aggregate, which is

partially located in the White House and partially located in Paris. This object is just as real and respectable from the point of view of standard mereology as the President's left hand or the Eiffel Tower taken individually; from the point of view of the theory, there is no difference in ontological status between them.

How could a theory which has these counterintuitive consequences have become the most widely used theory of parts and wholes among metaphysicians **(p.5)** today? The other part of the story, at least for the last few decades, is due to the philosophical genius and charisma of David Lewis. David Lewis believed that insofar as we have any understanding of the notions of part and whole at all, this understanding derives from the theory I have been calling “standard mereology”: for Lewis, there is no other mereology besides standard mereology.[II] This conception of parts and wholes, despite its austerity, or rather precisely because of it, proved to be a perfect fit with Lewis' more general ontological outlook. Together, standard mereology, combined with Lewis' four-dimensionalism and his way of thinking of necessity and possibility, gave rise to something akin to a “movement” among contemporary metaphysicians, an approach to many of the classical problems in metaphysics that has proven to be simply irresistible to several generations of philosophers.[III]

My project in this book is to help reverse this trend in contemporary metaphysics and to put the notion of *structure* or *form* squarely back at the center of any adequate account of the notions of part, whole and object.[IV] To this end, I propose in what follows a conception of ordinary material objects as *structured wholes*: it is integral to the existence and identity of an object, according to this approach, that its parts exhibit a certain configuration or manner of arrangement.[V] For example, in order for there to be an H_2O molecule, the two hydrogen atoms and one oxygen atom that compose it must be arranged in the particular manner of chemical bonding, which requires the atoms in question to share electrons. Moreover, in what is perhaps the most radical feature of my view, I argue below that the structure which dictates how the remaining parts of a whole are to be arranged is itself, literally and strictly speaking, *part* of the whole it organizes.

(p.6) The main historical inspiration for this view is, of course, Aristotle and, as it turns out, Plato as well, though, for reasons that will be spelled out in detail below, to a somewhat lesser extent. In Aristotle's view, an object, such as a bronze sphere, consists of two components, its *matter* (the bronze) and its *form* (sphericity); as I read him, both the matter and the form of an object are taken by Aristotle to be strictly and literally *part* of the object, just as my hand is part of my arm. Something counts as an object, on this view, only if its material components display a certain kind of *unity* which is imposed on the matter by the form. Thus, not every collection of objects itself qualifies as a single object; the Eiffel Tower and the President's left hand, for example, fail to exhibit the necessary unity required by these stricter criteria, since they lack a single form.

Similarly, the heap consisting of disassembled motorcycle parts would be strongly distinguished by this theory from the motorcycle in running condition.

Although the richness of Aristotle's views is of course beyond dispute, contemporary metaphysicians have found it difficult to make sense of his notions of form and matter. Thus, one of the main challenges for any neo-Aristotelian approach is to develop a conception of what it means to be an object which divorces itself from those elements of Aristotle's system which would now strike us as puzzling, foreign or unmotivated, in particular his strong normative and teleological commitments. To this end, I attempt to show below that the notion of structure or form, far from being the mysterious and causally inert philosophical invention ridiculed by Descartes and numerous thinkers since then, in fact lies at the very center of many scientific and other rigorous endeavors, such as mathematics, logic, linguistics, chemistry and music.

Once we realize that an object is more than simply the sum of its material parts, arranged any which way, much that has so far puzzled us about the nature of objects themselves as well as their interaction with one another can be seen to fall into place. One of the advantages of the neo-Aristotelian conception of objecthood is that it answers certain long-standing questions in metaphysics; in particular, it provides a solution to a classical problem in metaphysics known as the *Problem of Constitution*. The Problem of Constitution concerns the nature of the relation which obtains between an object and what it is made of, e.g., a statue and the clay which constitutes it. Metaphysicians are puzzled by this relation, because, on the one hand, the statue and the clay are sufficiently similar to one another to make it tempting simply to identify them; on the other hand, there are sufficient differences between them to make us think that we cannot simply be dealing with a single object. The neo-Aristotelian thesis that objects are compounds of matter and form yields a solution to the Problem of Constitution: the clay now turns out to be merely a proper part of the statue (viz., its matter); the “remainder” of the statue is made up of those of its formal or structural components which distinguish it from the clay. But the fact that the clay and the statue are two distinct objects which occupy the very same region of space-time, **(p.7)** according to this view, is no more worrisome than the fact that, say, my hand occupies a region of space-time also occupied by my arm: in both cases, one of the objects in question is a proper part of the other.

Moreover, my account also helps to generate a solution to what I call the *Problem of the One and the Many*, the problem of how an object that has many parts can nevertheless be one.[VI] The search for a response to this problem was one of the driving forces in ancient accounts of parts and wholes, and it has recently been revived by Peter van Inwagen under the heading “The Special Composition Question” (van Inwagen 1990a). I argue that the Problem of the One and the Many actually dissolves once we recognize that the notion of unity is conceptually separate from that of indivisibility into parts: far from posing a

threat to its unity, the presence of parts in an object is in fact a requirement to building a unified specimen of a kind. To illustrate, there could be no H_2O molecule, unless two hydrogen atoms and one oxygen atom entered into the particular configuration of chemical bonding. Objects of this kind are unified in the sense that they are one specimen of the kind in question, precisely because they are composed of the right sorts of material components arranged in the manner required by the structural components associated with the kind in question.

The following is a play-by-play description of what happens in each chapter. Chapter I gives an exposition of the basic concepts and principles of standard mereology; my main source for this chapter is Simons (1987). I also borrow from Simons his instructive gradual development of standard mereology, which shows how stronger and stronger principles may be added gradually to a minimal core, until we arrive at the full-strength theory of standard mereology.

In Chapter II, I consider the application of standard mereology to the case of ordinary material objects: my representative for the three-dimensionalist camp is Thomson (1983); my representative for the four-dimensionalist camp is Lewis (1986b) and (1991). I argue in Chapter II that neither the argument in favor of Unrestricted Composition in Lewis (1986b), which has recently been creatively adopted and elaborated in Sider (2001), nor the considerations in favor of the Composition-as-Identity Thesis in Lewis (1991), should persuade us to adopt standard mereology. My case against the Composition-as-Identity Thesis is further supported in Chapter III with a defense of the position that, by Leibniz's Law, wholes are in no way numerically identical to their parts.

Chapter IV continues my case against the thesis that ordinary material objects are mereological sums in the standard sense and begins my exploration of alternative systems. I turn in particular to the work of Kit Fine, who, in a series of papers, has provided powerful reasons for parting ways with standard **(p.8)** conception. In the later sections of the chapter, I discuss in detail Fine's own positive proposal, in particular his theory of embodiments as developed in Fine (1999), and indicate where I take myself to be departing from it.

The methodological and ontological concerns arising from Fine's theory of embodiments provide motivation to search for an alternative approach which preserves the neo-Aristotelian spirit of Fine's theory of embodiments while avoiding its troubling features. Since the kind of theory we are seeking has its historical roots in Aristotle, and as it turns out in Plato as well, I examine the rich and rewarding writings of these two ancient authors on parts and wholes in detail in Chapters V and VI, respectively.

Chapter VII states the main tenets of the view I have in effect been gradually assembling over the course of the previous six chapters: it provides a defense of

my main thesis that ordinary material objects are structured wholes and describes in detail the conception of parthood and composition to which I am committed. Since this conception is ultimately grounded in an ontology of kinds, I continue in Chapter VIII with a defense of this commitment for the special case of natural kinds.

Given the centrality of the concept of structure in what has come before, Chapter IX provides a general characterization of this notion and considers some of its most visible and instructive applications, in particular in the fields of mathematics, logic, linguistics, chemistry and music.

Notes:

(I) The word “mereology” literally means the study or theory of parts and wholes, deriving from “*meros*”, the Greek word for part, and “*logos*”, which in this context may be taken to mean study, theory, science or rigorous inquiry.

(II) See, for example, Lewis (1986a) for an expression of this sentiment; the passage in question is cited in Chapter I below.

(III) *Three-dimensionalism* (also known as “*endurantism*”) and *four-dimensionalism* (also known as “*perdurantism*” or “the *doctrine of temporal parts*”) are competing theories concerning the *persistence* of ordinary material objects over time, i.e., they aim to provide an answer to the question of how an object that exists at one time can be numerically identical to an object that exists at another time, as we say, for example, of the young Socrates and the old Socrates. According to the four-dimensionalist, objects persist over time by *perduring*, i.e., by having temporal parts, in addition to their ordinary spatial parts, at all those times at which they exist. The three-dimensionalist, on the other hand, holds that ordinary material objects persist by *enduring*, i.e., by being (as they say) “wholly present” at each time at which the object exists. For detailed discussion and references, see Sider (2001). The dispute between three-dimensionalists and four-dimensionalists will come up again below; it is, however, not one of the main themes of this book. The present inquiry is conducted within a three-dimensionalist framework; for discussion, see Koslicki (2003a) and (2003b).

(IV) The contemporary philosophers most sympathetic to this project are Verity Harte, Kit Fine and Mark Johnston (see the Bibliography for references); however, in each case, there are significant differences between my approach and theirs. Harte and Fine are discussed in detail below.

(V) In what follows, whenever I speak of “ordinary material objects”, I take myself to be including those objects to which our best scientific theories take themselves to be committed. For reasons of simplicity, I will not always explicitly

specify that I intend the phrase “ordinary material object” to be understood in this wide sense.

(VI) This name, “The Problem of the One and the Many”, or something close to it, is usually reserved for the question of how a *universal* like redness is related to the many *particulars* that instantiate it, e.g., the red roses, fire trucks and tomatoes, etc.; however, this latter problem is unrelated to the question about parts and wholes that is at issue here.