Rethinking Wholes and Parts:

Reflections on Reduction, Holism, and Mereology

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The excerpts in this document are from the ebook version of the author's book *God, Son of Quark* (© 2008 Mark F. Sharlow). A preliminary print edition of the book was released in 2006.

About This Ebook

This ebook is a set of excerpts from one of my early books. In these excerpts I discuss the relationship between whole objects and their parts, with special attention to the type of reductionism that claims objects are “nothing but” their parts.

There are two page numbers at the bottoms of most pages. The upper number is the page number in the original book; the lower number is the page number in the present document.

Comments added after the publication of the original book are in blue and in a different font.

- MFS, 2011

[First paragraph omitted]

Much of the work I will do in this book consists of developing, and supporting with evidence, some new ideas about wholes and parts. These ideas differ from the ones that we usually use when thinking about objects and their parts. The new conception of whole and part that I will present requires us to think about material objects in a way that is slightly unfamiliar. This does *not* mean that I will propose any new scientific theories about the nature of matter. Everything I say will be compatible with existing scientific theories and facts, and with any reasonable new theories that may someday replace the existing ones. What I am going to propose is not a theory of matter or of ultimate particles, but a new view of the *logic of the whole-part relationship*. This view will not be a sweeping theory about what material objects "really are." Instead, it will be an attempt to overthrow certain long-standing ways of thinking about wholes and parts, and to replace those ways with new concepts that may lead to less confusion.

The new view I am proposing may seem unfamiliar. It does not always agree with our everyday thinking about wholes and parts. Yet despite its novelty, this view has many points of contact with previous philosophy. Some of the pieces of the new view already exist in the philosophical literature. A few of the most important ideas

appeared earlier in the work of Donald L.M. Baxter[1] and of David Lewis[2]. Some of the ideas that I will explore in later chapters began in the writings of ancient Greek philosophers, especially Aristotle. Most of my credits to previous authors are in the book's many numbered endnotes, though a few of these credits are in the text. (The spirit of Baxter's and Lewis's approaches to whole and part has influenced the book more than specific credits can show.)

To begin the project, I will point out some of the intuitive beliefs that people normally hold about objects and their parts. Usually we do not think about these beliefs. These usual ideas may play an important role as background to our actions, but they seem so transparent and obvious that we do not reflect on them consciously. Here I will try to bring these ideas into the light, and will suggest that some of them are wrong despite their "obviousness." While doing this, I will lay the groundwork for a new view of the relation between wholes and parts. Although I will offer arguments for this view, the main argument in its favor is its impact on other topics. Once this view is in place, several extremely knotty philosophical issues will become much less tangled.

[1] Baxter, "Identity in the Loose and Popular Sense."

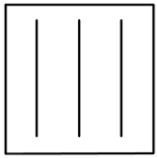
[2] Lewis, *Parts of Classes.*

Three Thought Experiments[3]

To kick off this project, I will present three *thought experiments*—that is, experiments performed in thought instead of in a laboratory. These experiments contain nothing dramatically new. They use familiar objects and actions; they even lead to the outcomes that you would expect. (Only the last experiment needs any scientific background, and I will try to provide that on the spot.) But despite the ordinariness of these experiments, when you think about their outcomes in the right way, you will see that these "ordinary" results are not so ordinary after all. The outcomes of these experiments run counter to some of our commonsense views about wholes and parts—and suggest that those views leave out something important.

Experiment 1. The Interloping Triangle

Think about this box with some line segments inside:



[3] This section informally introduces several new ideas, including some general ideas about the whole-part relationship discussed (either favorably or unfavorably) in the previous literature. See in particular: Lewis, *Parts of Classes*, pp. 81-87, and Baxter, "Identity in the Loose and Popular Sense." Also, I should credit Minsky, in *The Society of Mind* (p. 27), for mentioning the question "*What makes a drawing more than just its separate lines?*"

Now answer the question: "How many things are in the box?"

To simplify this task, forget about the fact that the line segments are divisible. Just count things consisting of at least one whole line segment. (A mathematician might say, "Since a line segment contains an infinite number of points, there are an *infinite* number of things in the box." But that isn't the answer we are after here.) Also, don't count sets of detached items, with no point of contact, as "things." (Usually we wouldn't think of a pair of unconnected lines as a thing or object.) Just count the things in the box in a naive, intuitive way—that is, count only complete, internally connected things.

If one follows these precautions, the answer to the question is obvious. It is "three."

Now rearrange the line segments a bit, without adding anything at all to the contents of the box.

How many things are there in the box now?

Again, we ignore partial line segments and count the things in the box. Clearly, the three original line segments are present; they now touch one another, but they haven't

gone away. We also notice that there is a *triangle* in the box. A triangle is as legitimate a geometric figure as a line segment, as anyone who has studied geometry knows. It would be silly to count the line segments as things, and then to refuse to count the triangle (which is just another whole plane geometric figure made of points!) as a thing. To avoid such arbitrariness, we count each line segment, and then count the triangle.

Counting in this way, we decide that *there are four things in the box.*

It would be more correct to say that there are *at least* four things in the box. One can argue that there are things in the box besides the line segments and triangle. For example, any two adjacent sides of the triangle make up a V-shaped figure, and these V's, though parts of a triangle, are themselves legitimate geometric figures. But this is beside the point. The point is that there are *at least* four things in the box. We have gained an object—the triangle—that was not there before the rearrangement. *Yet we put nothing new in the box.* We brought a perfectly legitimate geometric object into existence by arranging the line segments in a suitable way. And we did it using *nothing but* the line segments. The triangle has no parts in it above and beyond the lines.

Of course, there is nothing mysterious about this outcome. No magic trick has happened here; we did not pull the triangle rabbit-style out of a hat. Everyone knows that when you arrange line segments as we did, you get a triangle. This is obvious because a triangle is just a figure formed from three lines arranged in a specific way. We placed nothing new into the box—yet we were able to get a new object in the box. Although this new object has the

line segments as parts, *the new object was not there at the beginning of the experiment.*

Obviously, we did not bring anything new into the box. But this experiment also brings out another fact, equally obvious but less often noticed: *when we arrange parts to make a whole, we don't just end up with the original parts. A new object comes into being.* Normally, we might dismiss the idea that anything really is "created" here. We might do this by saying that the triangle is only an assembly of line segments. And this statement is correct: the triangle indeed has no parts beyond the line segments—except, of course, the three V shapes that the line segments form (and the parts, which we decided to ignore, that we can get by subdividing line segments and V's). But we also can shift the emphasis, and note that by rearranging the line segments, we can create a real geometric object that did not exist before. We can create a real entity—a fourth entity—simply by arranging the entities that already are there.

The triangle is not among the entities that we had at the beginning of the experiment. It can be counted separately and distinguished from the line segments; it has its own unique properties. It is a new item created by the assembly of the lines. The fact that the triangle is made up entirely of line segments does not change the fact that the triangle is *new*. It is not any of the line segments. Nor is it all the line segments together (note that all the line segments existed together *before* there was a triangle). By rearranging the line segments, we have managed to create a whole new object, without having to add any new "stuff" to the box!

People sometimes have a feeling that a composite

object, like the triangle, is "nothing but" its parts in a certain arrangement.[4] In a way, this is true; the triangle has no parts *but* the line segments, the V shapes (made of line segments), and the parts that we get by dividing up and combining these parts. Also, the properties and relations of the line segments may, for all we know, completely determine and explain the properties of the triangle. But this "explainability" of the triangle in terms of its parts does not do away with the arithmetical fact that there is a *thing* in the box that was not there at the beginning. If you don't believe it, count. Arithmetic and logic tell us that *there is something in the box besides the line segments.* This conclusion is inescapable once we grant some rather simple facts of plane geometry.

The lesson of this experiment is that when parts come together to form a whole, that whole is an object distinct from the parts.[5] The parts may explain the whole, yet one

[4] David Lewis has taken this position, or one close to it, in his philosophical writings. In *Parts of Classes* (pp. 81-87), Lewis argues that a whole just *is* its parts—in a slightly extended sense of the word "is." Donald L. M. Baxter, in "Identity in the Loose and Popular Sense," has discussed the view that the whole is identical to the parts—which he calls "the Identity view"—and has compared it to other competing views of whole and part. The position that Baxter calls "the Non-Identity view" is essentially the view of whole and part that I am advocating in this book, though I will take this position several steps further. Later in the book I will argue against some of the "whole-is-parts" ideas.

[5] Bertrand Russell stated a similar thesis about part and whole, though he was thinking of certain mathematical and logical senses of "whole." See Russell's *The Principles of Mathematics*, par. 137 (p. 141).

can count the whole separately from the parts. Normally we think of a whole as being, in some vague sense, "nothing but" the parts that make it up. That is, when we arrange the parts and hook them together properly, those parts are the whole. But this is not quite true. It is more correct to say that there are all the parts, and also there is the whole. To borrow a comparison from Baxter, if there are N parts, then once we build the whole from those parts there are N+1 things, not just N things.[6]

Are we right to think of the whole as nothing but its parts? Would it not be better to think of the whole as a *new* object, whose existence depends on the existence of the parts but which is not the same as the parts? Shouldn't we think of the whole as an object *brought into being* when the parts are hooked together the right way?

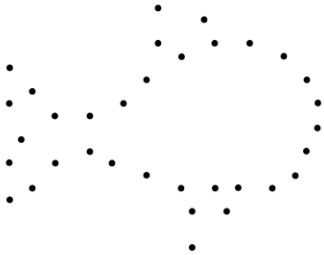
Or should we just look for a new way to count?

Experiment 2. Follow the Dots

Many readers will remember the "follow the dots" pictures on which they worked as children. Despite their simplicity, follow-the-dots pictures can teach us an important lesson about wholes and parts.

Examine the follow-the-dots picture on the next page.

[6] This observation is discussed in Baxter's article "Identity in the Loose and Popular Sense." See p. 579 in that article.



The objective of the puzzle is to draw lines connecting the dots, and end up with a drawing of a recognizable object. (Don't do it yet, though.) Normally, follow-the-dots pictures have numerals that show which lines to draw first. Here I have omitted the numbers to avoid cluttering the picture—and because the lines to draw are pretty obvious.

I want to ask a question about this picture. The question is: "Is there an outline of a fish there?" The answer is obvious: Yes, there is. Most people can see the fish immediately.

Even without thinking about which creature the diagram resembles, you can say that the diagram shows a geometric figure, or shape. This much is clear. But when you look more closely at the picture, *there's nothing there but dots.* Indeed, if you viewed the picture in the right way (from very, very close in), you would find that there are only dots there, and no fish. An ant crawling on the page could not see the fish. At any given time, it would see only a dot. Even if the ant somehow got the ability to think and reason, it would not be able to see the fish. One can imagine what the picture would look like to a human

observer with a severe case of tunnel vision, whose visual field is only big enough to scan one dot at a time. Such an observer would not see the fish, but would be perfectly capable of seeing all the dots (one at a time).

It seems clear that there is nothing on the page above and beyond the dots. What does this say about the fish?

"There are only dots on the page. Since there are *only* dots on the page, and nothing else, it follows that there is no fishlike pattern there at all. Therefore, the fish design is not really there." Are you willing to stand up for this argument? If so, are you willing to stand up for it *in public*?

The geometric design—which appears fishlike to most of us but is just a geometric figure—really is there on the page. To say that it is not there is to say something plainly false. Yet at the same time, it seems correct to say "there is nothing on the page other than the dots." We have arrived at an intriguing pair of seeming truths. There is a fish design on the page—yet there are only dots on the page. Is there a contradiction here?

The obvious answer to this "contradiction" is that the fish is made entirely of dots, so there is nothing special about the fish being on the page even though nothing is there besides the dots. Of course, this answer is right. But despite being right, this answer is rather fishy. This trivially true answer serves to hide an important fact about the fish and the dots. This is the fact that when the dots are put together to form a fish, there *really is* a fish design on the page. There is another recognizable physical object, made of ink, *that is not the same as any of the dots.* By putting together 34 dots, which are simple objects, we have created a new, more complex object—*a thirty-fifth thing.*

This thirty-fifth thing is made entirely of dots. Its presence on the page can be explained by the presence of the dots at certain positions on the page. Despite all this, the thirty-fifth thing really is there—and it is not one of the dots. Before the dots were drawn on the picture, there were no things in the picture. But after someone drew the thirty-four dots, there were thirty-five things in the picture (or even more things, if one counts the fish's fins and other such pieces of the drawing, which are things made of dots).

Of course, the fish is made solely of dots. Once the dots come together in the right pattern, the fish is there. Nothing else is needed to make the fish come into existence. No extra spark, no imposed property of "fishiness" or of "paternness," must be added to make the dots into a geometric pattern that looks like a fish. The dots can give rise to those properties by themselves, without any outside help. Nor does the fish have any mysterious extra parts, such as extra dots hidden on the other side of the page. Nevertheless, once the dots come together, a fish design begins to exist. If the dots were separated and scattered, the fish design would cease to be. And as long as the picture on the page remains intact, *there is something in that picture besides a dot.* There is the fish. If you don't believe that, just count.

It is possible, of course, to claim that this argument is misleading because, after all, the fish is only the composite of the dots. Why should we worry about the fact that there is a thirty-fifth object on the page when that object is *only* the sum total of all the neatly arranged dots?

If you feel an urge to argue in this way, think carefully about what you are saying. You say that the fish is only the sum of the dots—or, to use other words, the composite, or

assembly, or whole, formed by the dots. And what does "the sum of the dots" mean? If it just means all the dots, then you are stating a falsehood. The fish is not any of the dots, nor is it simply all the dots collectively (a scissors can make the dots exist without the fish). But if "the sum of the dots" means something *besides* "the dots" or "all the dots together," then you are admitting that there is *something else* on the page besides the dots. In that case, what you are calling "the sum of the dots" is the same thing that I have been calling "the thirty-fifth object." You have simply given the extra object another name without making it go away.

This experiment, like the previous one with the triangle, reveals a fact we already know. This is the fact that when things are put together to form a larger whole, the whole is itself a thing. No fact seems more trivial and less noteworthy. Yet if we begin to think about this fact instead of just taking it for granted, we also begin to see how puzzling this fact really is. Here are three lines; rearrange them, and now there are four things. Here are thirty-four widely separated dots; rearrange them, and now there are thirty-five things. By rearranging existing things, *we bring new things into being.* We literally create new objects. And those new things exist *in addition to* the things we started with. *The act of assembling parts is a genuine act of creation.*

Normally, we might feel that because the fish is made of dots, we do not need to assume the existence of anything but dots to understand what the fish is. This example suggests a different view: we cannot fully understand what the fish really is without assuming the existence of *the fish*

itself, as well as the dots. If we took an inventory of all things that really exist, we would find both the dots and the fish on our list. Listing the dots would not excuse us from listing the fish itself on a separate line of the list—for the existence of the dots is not equivalent to the existence of the fish.

Of course, the fish is made of the dots, and the fact that the fish exists is "explained" entirely by the existence and arrangement of the dots. Normally, we take this to mean that the fish is, in some sense, "just dots." But should we think this way? "All the dots" means thirty-four things. The fish is the thirty-fifth thing. When we arranged the dots, the universe proved to be big enough to make room for one more thing.

Perhaps our thinking about wholes and parts needs enlargement too.

Experiment 3. The Philosophy of the Surf

Ocean waves are examples of an interesting and beautiful natural phenomenon. They are of interest to the physicist, the marine biologist, the geologist, the surfer, and the artist. Philosophers also have much to learn from ocean waves, though they do not always realize this. The following experiment shows that ocean waves can give us an important clue about the nature of the whole-part relationship.

A water wave results from the motion of matter on and near the surface of a body of water. Water waves happen when some force (usually the wind) pushes the molecules of the water around and starts them moving back and forth. The moving molecules push against other water molecules

near them, making the disturbance move across the water. Wherever the wave goes, molecules in the water move to and fro. If the wave is not too large and meets no obstacles, the pattern in which the molecules move is roughly circular.[7]

A water wave has energy. It can transfer energy to objects in the water, making them rock and bob, or to objects on the shore, causing erosion and other geological effects. The sound of crashing surf comes from the release of some of the waves' energy as sound waves.

Physical science has shown that molecules of water carry the energy of a water wave. Much of this energy is the *kinetic energy* associated with the motion of the molecules. A moving molecule, like a moving train, has energy that it can pass on to other things. The molecules also have *potential energy* because of the Earth's gravity (an interaction between the molecules and the Earth) and because of the molecules' interactions with other molecules through electrical forces. All the energy in the wave results from the motion and interactions of the wave's molecules.

[7] This idea is well-illustrated in Serway's text, *Physics for Scientists and Engineers with Modern Physics* (p. 347).

The fact that the wave has energy is explained by the fact that the molecules moving within the wave have energy. We do not need any mysterious energy source, besides the energies of moving molecules and of the forces that connect them, to explain the effects of the surf on the shore. The energy of the impact *is* the energy of moving molecules—that is all.

Physicists have established these facts about water waves. Yet they have not, to my knowledge, fully addressed a certain subtle point about the nature of the energy in the wave. This is the fact that the energy in the wave is the energy of water molecules in motion, but also is the energy of the wave as a whole.

We know that physical objects have energy. If you and I throw baseballs at the same moment, your baseball will have a certain amount of energy and so will mine. Each of the baseballs has its own quantity of energy, which (according to a well-known principle of physics) can be lost to other objects but never can be destroyed. Once we choose a scale for measuring energy, we can assign every material object a number that is a measure of the total energy of that object. A water wave has a certain amount of energy. Yet the energy of the wave, it seems, is not *just* the energy of the wave. It also is the energy of the molecules that move inside the wave.

There is a simple reason why the energy can belong to the molecules and still belong to the wave. The reason is that the molecules are in the wave. The argument about water waves is a lot like the fish experiment. I am pointing out that the wave is a real, physically significant thing, with its own energy, despite being "just" a product of molecules. But this is not all that I am driving at, for the wave is *not*

simply a composite of molecules. The molecules are not permanent parts of the wave; the wave can move from one area of the water to another, leaving behind one set of molecules and picking up another set. The wave is more like a *motion*, first of this water here, later of that water there. It is best to think of the wave as a process, or prolonged event, that happens to water molecules.

The point of this water-wave argument is not that the wave as a whole is a new item (though that is true). Rather, it is a point about the wave's *substance.*

Einstein's special theory of relativity, with its famous equation $E = mc^2$, implies that energy can be converted to matter and vice versa. This implies that energy is a form of substance; matter and energy are the two expressions of the substance of the physical world. Some philosophers have argued that a single substance which manifests as matter and energy, rather than matter or energy standing alone, is *the* true substance of the physical world.[8] One often hears the alternative suggestion that matter is simply a form of energy. But it would be arbitrary to regard matter as a substance while failing to regard energy as a substance. Indeed, the special theory of relativity implies that all energy has mass, just as matter does.

The water wave, then, carries some substance with it as it goes. When the wave moves from one part of the water surface to another, it might not carry along one single molecule of the water in which it originally traveled. Yet it carries along much of its original energy—its original substance. This energy is the kinetic and potential energy

[8] For example, Haeckel. See Reck, p. 123.

of water molecules. The wave is a real, concrete, substantial item with its own energy and mass—yet all of that energy and mass *also belongs to other things*, namely the water molecules currently inside the wave. The wave is a physical phenomenon that *shares the substance* of other physical entities. It gets its substance only through this sharing; it has no energy apart from the energy of water molecules.

In a certain sense, the existence of the wave is independent of the existence of the water molecules that revolve within it. Although the wave cannot exist without *some* water molecules, those molecules don't need to be the particular ones that now happen to be in the wave. Other water molecules, elsewhere in the sea, would do as well. It does not quite make sense to say the wave is "just" the motions of the molecules within it, since other motions of other molecules can make the wave exist just as well.

The lesson we learn from this is that something may have a real existence, and its own substance, even though all of its substance belongs to something else. The wave has no energy that is solely its own—yet as any surfer knows, it has loads of energy. The wave "lives on credit," as it were—smashing into the shore, or rocking the boat, with energy that also belongs to a bunch of tiny, invisible molecules.

Another lesson is that when many parts begin to act together in an organized way, this can create real wholes of a kind *fundamentally different* from the parts. In the triangle and fish experiments, we created more complex geometric figures from simpler geometric figures. In other words, simple what's-its gave rise to complicated what's-its of the same kind. But in the wave experiment, *objects* gave

rise to a *process*. The molecules gave rise to the wave, yet a wave is an item of a sort fundamentally different from water molecules. The wave is not really a "thing" at all, but a prolonged event. In this case, we could say the what's-its didn't just result in fancier what's-its; they resulted in thingamabobs instead.

This type of creation, which creates fundamentally new *kinds* of items, happens all the time. Most processes and events in the physical universe are "non-objects" that result from the activity of objects.

Common sense about wholes and parts says that when we put together bits of stuff, the most we will get is a bigger piece of stuff of the same kind. According to this view, the worst we can possibly get is a bigger piece with shockingly fancy properties—like a computer chip, made of silicon atoms but having the ability to perform calculations. But the wave example suggests there are exceptions to this rule. If we put together enough water molecules in the right arrangement, we may get a wave—but a wave is a process instead of a proper object. Like the molecules, it exists, but it exists in a way different from the way that molecules exist. A water wave differs from a molecule in other respects besides its physical properties—though the differences in some of these properties (especially size) are obvious. Apart from these differences in physical properties, the wave has a strikingly different kind of being or existence. Using some long-standing philosophical jargon, we can say that a water wave and water molecules belong to two different *ontological categories*. (Later I will have more to say about ontological categories.)

The thought experiments in this chapter do not prove anything rigorously. They do not pretend to be formal philosophical arguments. These experiments only point out some features of the part-whole relation that people (including scientists and philosophers) don't often think deeply about. These features run counter to some of our usual intuitions about wholes and parts. The three thought experiments presented here make these features seem more intuitively reasonable, and challenge the commonsense view that the whole is in some sense "just its parts." In the next few chapters I will challenge this view more systematically, and will begin to lay the foundations for a new understanding of the wholes and parts that we find in the natural world.

Chapter 2.
Is Reality Holistic?

The urge to think about the connection between whole and part is nothing new. Scientists usually use the ideas of whole and part without analyzing them, but philosophers have tried to understand these ideas in a more general and penetrating way. The best-known philosophical problem about whole-part relations is the famous question "Is the whole more than the sum of its parts?"

People have written a great deal about this question over the centuries, and have proposed several answers. Most, if not all, of these answers belong to one of two main groups. Some thinkers have said that an object with parts is, in some sense, nothing more than all of its parts. This line of thought is called *reductionism.* (There also are other ideas called "reductionism," but I won't discuss all of them here.) Other thinkers, equally qualified, have argued that an object with parts is something more than just its parts—that bringing the parts together results in a whole that is something more than just the parts. This line of thought is known as *holism.*

Note added later: The type of reductionism that I critique here is the ontological view that an object is "nothing but" its parts. I am not critiquing intertheoretic reduction or other notions of reduction. Similarly, the type of holism I am discussing here is only one variety of holism.

Reductionism: Method or Ideology?

In science, the reductionist approach has long been in favor. Scientists try to explain the behavior of a complex object in terms of the behavior of its parts. The supreme example of scientific reductionism is the biologists' explanation of life in terms of chemical and physical events. Modern biologists believe the chief features of living organisms result from the behavior of large numbers of physical particles (such as atoms and electrons) organized in a mind-bogglingly complex way. Today, the physicochemical view of life is the one that scientists accept.

If scientists ever explain the human mind in terms of atoms, molecules, and electrons, that would be a reductionistic accomplishment even greater than the physical explanation of life. We do not yet have a full physical explanation of mind, though scientists have made progress in that direction. Some of the simpler features of the mind (and even some complex ones) can be simulated by computers. This suggests that those simpler features may have physical explanations that are not too hard to find.

Many scientists think that a physical explanation of mind is possible. This confidence comes partly from evidence that some features of the mind are physical. But the chief motive for this belief might be other than scientific. Some scientists and philosophers seem to believe that if we cannot explain the mind in terms of the brain, then we will have to leave the mind without a

rational explanation.[9] The idea that there is something unexplainable is taboo to many thinkers, who believe this idea amounts to accepting superstition. Those who think this way trust that a physical explanation of mind will be discovered, because the absence of an explanation threatens the scientific worldview. Thus, although the proponents of reductionism sometimes hold themselves out as advocates of reason, reductionist belief often is a matter of emotion as much as of science. (Of course, this is true of some holistic belief, too.)

Some thinkers who believe in a brain-based explanation of mind still feel that the mind is more than a machine. To develop this view, such thinkers often turn to a holistic interpretation of mind. According to the holistic view, the mind is a product of the activity of the brain—and yet there is something more to the mind than the simple, mechanical firings of neurons. When the neurons come together into the complex pattern known as the human brain, the whole brain develops properties for which the properties of individual neurons cannot account. This is the gist of the holistic view.

Holism is not only an idea about the human mind. One also can take a holistic view of other happenings and objects in the cosmos. Living organisms form the chief target of holistic theorizing. In living things there are many properties, processes and functions that do not have any counterpart in the tiny material parts that make up living things. Living organisms digest other objects; atoms

[9] Daniel C. Dennett takes a position close to this in *Consciousness Explained* (p. 37).

cannot digest anything, and there is nothing that an atom can do that is much like digestion. Even the simplest "automatic" muscular motions of animals, or the water-pressure-driven movements of plants, are far too complex to be carried out by an atom or a quark.

There are different brands of holism, and some of them are not exactly like what I have described here. A serious holist might regard my description as a mere caricature of holism. Nevertheless, my description captures the essential point of holism: that a complex system has features that are not fully explained by the properties of that system's parts.

Reductionists have offered their own caricatures of the holistic school of thought. One of these caricatures is in Marvin Minsky's book, *The Society of Mind*. Minsky presents what he calls a "parody of a conversation between a Holist and an ordinary Citizen."[10] I will summarize this conversation here (the italics in the quotes have been changed). The Holist sets out to show that "no box can hold a mouse." First the Holist claims that a box really doesn't have a property of "'mousetightness' or 'containment'" at all. To prove this point, the Holist points out that "no single board" in the box "contains any containment," and concludes on this basis that "the box can have no mousetightness at all." Instead, the holist contends, "a good box can 'simulate' [mousetightness] so well that the mouse is fooled and can't figure out how to

[10] Minsky, *The Society of Mind*, p. 28. I should mention that Minsky uses the term "Reductionist" in sense slightly different from mine (see *The Society of Mind*, p. 26).

escape."[11]

It is good that Minsky admits that this conversation is a parody, for the ridiculous doctrine put forth by Minsky's "Holist" has little to do with real holism. A real-life holist would not claim that the mousetightness of the box is only simulated. Such a holist would not disagree with a reductionist over the fact that the box really is mousetight. After all, to say that the box is mousetight is just to say that it is able to keep mice in—and both sides agree that it does that. The disagreement between the holist and the reductionist lies in their accounts of *what this mousetightness is.* A reductionist might say that although the box really is mousetight, there is nothing to this mousetightness besides certain features of the individual boards. In other words, the box doesn't need to have a separate property of mousetightness to keep the mouse in. The boards, when properly arranged, can do it by themselves. (This seems to me to be Minsky's view—that there is nothing to the mousetightness of the box besides the separate abilities of the individual boards to block the mouse's movement.[12]) But a holist might claim that the mousetightness is not quite the same as the impenetrability of the individual boards. Instead, it is a new property *which the box itself has*, and which comes into being when one nails together the boards into a box. Mousetightness is not the same as any property of the boards, or as any set of properties of boards. A holist might concede that the

[11] Minsky, *The Society of Mind*, p. 28 (italics changed in quotes).

[12] See Minsky, *The Society of Mind*, p. 28.

properties and arrangement of the boards are what cause the box to be mousetight. However, the holist would say that the mousetightness itself is a new property which the boards do not have—a property of the box, not of the boards. Since the mousetightness belongs to the box and not to any board, it is not a property of boards at all. No part of the box has mousetightness or anything close to it—yet the whole manages to have this property nonetheless, and therefore is more than the sum of its parts!

The holist in Minsky's story is a dupe. The "parody of a conversation" which Minsky discusses is indeed a parody; it makes holism appear to be silly at best and intellectually dishonest at worst. Actually, it is Minsky's parody that lacks credibility. Obviously, no serious holist would claim that a box that can confine a mouse isn't really mousetight, or would make the ridiculous claim that the reason the mouse can't escape the box is because the mouse is fooled. Minsky's argument substitutes ridicule for reasoned debate. In reality, many first-class thinkers, both ancient and modern, have embraced holism of one kind or another.

The founder of holism as a systematic philosophical outlook was the nineteenth- to twentieth-century philosopher J.C. Smuts. In his book *Holism and Evolution*, Smuts set forth a well-reasoned view of nature as a system of wholes, each of which may have certain properties quite different from those of its parts.[13] My view of whole and part is not the same as Smuts's view. Later I will mention some of the key similarities and differences between these

[13] Smuts, *Holism and Evolution*; see particularly chapters 5 and 6.

two views. (Mostly I will do this in footnotes.)

The reductionist approach to the problems of life and mind is indispensable for scientific work. If we refuse to admit the possibility that the properties of the parts account for the properties of whole, then we have a much harder time understanding the properties of the whole. Worse yet, we will lose the possibility of learning about such an explanation if one happens to exist. The philosopher Daniel C. Dennett has pointed out a problem of this sort with mind-body *dualism*—the commonly held view that there is a nonphysical mind apart from the brain. In a book describing his reductionistic theory of consciousness, Dennett once wrote that "*accepting dualism is giving up*"[14] (italics in original). Part of what this means, I think, is that if we assume that the mind does not have a physical explanation, then we are stopping inquiry before we know whether such an explanation is possible. Unlike many current philosophers, I do not believe that a dualistic explanation of mind has to be antiscientific. (That does not imply that I am a dualist; more on that topic later.) But Dennett's remark can just as well be applied to the refusal to try to explain the properties of a whole in terms of those of the parts. If such an explanation is possible, then the seeker of truth wants to know it, and the only way to find out whether there is such an explanation is to try to make one. Assuming in advance that a reductionistic explanation is impossible cuts us off from the possibility of learning something potentially interesting. Therefore we should try to find such explanations, whether or not we have faith in

[14] Dennett, *Consciousness Explained*, p. 37.

the scientific worldview.

Reductionism is useful as a methodological assumption for scientific inquiry. Its usefulness, however, does not settle the question of the truth of the reductionist view of the whole-part relation. It is logically possible that the whole is not reducible to the parts, and that there is something to a whole object that is not encompassed in any of that object's parts. The fact that scientists must pretend to be reductionists while working does not remove this possibility. The well-established usefulness of reductionistic methods in science does not prove the reductionist viewpoint in philosophy. Nor can philosophical holism be used to attack the use of reductionist methods in science. It is important not to confuse the reductionist *method* that scientists follow, with the reductionist *worldview* that certain philosophers and scientists embrace. It is possible to follow the method without buying into the ideology.

Emergent Properties

One criticism often leveled against holism is that it is vague. Some reductionists have pointed out that holists say things like "the whole is more than the sum of the parts" without saying exactly *how* the whole is more than the sum of the parts. Holists claim that there is something more to the whole than the individual parts and their properties. Yet often they decline to say what this "something more" is. This coyness comes from the fact that the holists don't always know what the "something more" is. They have found clear signs that there is something to the whole besides the parts, but they do not know exactly what those

signs point to—what the difference is between a whole and a "mere" sum of parts.

The holists' inability to say exactly how the whole differs from the parts has led some reductionists to claim that holism is unscientific or that it embraces mystification.[15] There are two glaring mistakes in this reductionistic claim. First, there is nothing unscientific about claiming to know something is real without knowing exactly what that "something" is. Most natural phenomena, including radioactivity, meteorites, and life itself, were known, and even studied scientifically, before their true nature was understood. The holist is in much the same position as an early scientist studying meteorites. Such a scientist might have said "The evidence points to the existence of stones that fall out of the sky—but we don't know where those stones come from." Similarly, the holist notes that there is a difference between whole and parts, but does not yet know what that difference is. The reductionist, on the other hand, is more like those early scientists who believed that reports of meteorites simply *must* be wrong.[16] Of course, this loose analogy doesn't prove reductionism wrong. But it should teach the reductionist a lesson in caution.

The other reason that holism is not mystifying is that we *do* know, at least in part, how an object can differ from

[15] Minsky, in my opinion, comes close to this view in *The Society of Mind*, where he suggests that the word "holistic" acts "to anesthetize a sense of ignorance" (p. 27).

[16] Even some very smart scientists once held this view. See Pearl, *Rocks and Minerals*, p. 165.

the sum of the parts. Philosophers (holistic or not) who have thought about these issues have come up with one definite answer to the question "What is the difference?" That answer is *emergent properties.*

Philosophers have thought of emergent properties in different ways,[17] but at bottom, the idea of an emergent property is simple. An emergent property is simply a property that an object has, but that the parts of that object do not have if the object is divided into sufficiently small parts. The mousetightness of Minsky's box (which I discussed earlier) is one example of an emergent property. No piece of wood used to make the box can confine a mouse—yet the box, taken as a whole, can. The shape of the triangle I discussed in Chapter 1 is another example. None of the parts used to make the triangle is triangular—yet the triangle, as a whole, is triangular. The triangle also has the emergent property of *closure*—it is a closed figure; one cannot get out of the figure without crossing a line or leaving the plane of the page. No part of the triangle has this property. Removing any part of the triangle will make the triangle lose the property of closure. Thus, the property of closure depends on the "cooperation" of *all* the parts of the triangle.

Emergent properties are called "emergent" because they emerge when things are put together into larger things.

[17] The way that I define emergent properties does not necessarily agree completely with the way that some other authors have defined these. Also, I should mention that I do not necessarily agree with the philosophical position known as "emergentism"—at least not in all of its forms. In this book I am going to ignore some of the larger issues surrounding emergence and reduction, because these issues are not crucial to my point.

Note added later: The "emergence" I am discussing here is a rather weak version of emergence. This should not be confused with stronger versions found in the literature, which may make emergent properties practically unpredictable or unexplainable.

They are not present in the smaller things—but when the smaller things are assembled into a more complex whole, the emergent properties pop up.

Emergent properties are all around us. You notice this when you begin to look for them. The *page count* of a book is a legitimate property of the book. Yet the individual fibers of paper and splotches of ink that make up the book do not have page counts. The *color* of any colored object is a real physical property. Yet none of the atoms that make up the object is, by itself, colored. An atom by itself is invisible and colorless. The *shapes* of objects are emergent properties; they are results of the arrangements of the parts of objects. The atoms that make up an object have shapes different from that of the object.

Most of the properties that we deal with every day of our lives are emergent properties. We call the world that we perceive with our senses the "physical world." Would it not be almost as correct to call it the *world of emergent properties?*

Some of the most interesting emergent properties occur in the science of chemistry. I am thinking especially of the properties of *solidity* and *liquidity*. Everyone knows intuitively what solids and liquids are. Solids are substances that have definite shapes and do not flow visibly, while liquids assume the shapes of their containers and seem "wet." Physical chemists have more precise definitions of these notions. Scientists know that solids are substances in which the atoms or molecules making up the substance fall into repeating, lattice-like patterns. (Some familiar "solids," such as ordinary window glass, are not true solids but "amorphous solids," which act like solids in many respects.) Liquids are materials in which the atoms

or molecules move freely around one another, yet stick together enough that they do not quickly go flying off into space. Liquids evaporate when this stickiness of the molecules is overcome by something—usually by the energy of heat.

Liquidity, philosophers have noted, is an emergent property.[18] When one looks at the molecules or atoms that make up a liquid, one finds nothing at all that is liquid. Individual atoms do not flow: they can fly through space or be still, but they do not pour or slosh. A sloshing atom is as silly an idea as a flowing baseball. Yet an unimaginable number of atoms, clustered together and stuck to their neighbors by electrical forces, forms a mass of stuff that can flow. We call that a liquid.

It seems clear that emergent properties, as I have defined them, exist. They are as real as any other properties of objects. (Philosophers have long debated the question of whether properties really exist at all; some have argued that properties are mere fictions, and that only plain old objects are real.[19] So perhaps I should say that emergent properties exist insofar as any properties exist.) A box that is mouseproof (to exploit Minsky's example again) really does have the property of being mouseproof, even though all of its small parts lack that property. A pond really is liquid; hence it really does have the property

[18] Searle notes this in *The Rediscovery of the Mind*, pp. 111-112.

[19] I am referring, of course, to the nominalists. For discussions of this and other positions on the problem of universals, see Loux (ed.), *Universals and Particulars.*

of liquidity. To deny that emergent properties are as real as other properties is to deny that a pond is liquid and that a solidly closed box is mouseproof. Do you really want to claim that water, at room temperature and pressure, isn't liquid?

Some people are afflicted with the mistaken view that philosophers don't believe in the physical world. Those who hold this view think that philosophers have somehow denied the existence of the perceptible world around us. Some people find this alleged denial of reality to be amusing. This allegation against philosophers has little basis in fact, but there seems to be a fairly common popular belief that philosophers think that way. Now, would a philosopher who claimed that water isn't wet be in a less ridiculous position than a philosopher who claimed that my chair doesn't exist? If we do not want to fall into skepticism about the existence and basic features of the world around us, then we should not try to deny that water is wet! The case for the reality of emergent properties like wetness is as strong as the case for the existence of tables and chairs. If any properties exist in the world, then emergent properties exist in the world.[20]

Despite all this, the mere existence of emergent properties does not completely settle the holism vs. reductionism debate. To settle that, we still must answer

[20] Often I will speak of a property as *existing* if it is instantiated or exemplified. A Platonic realist might dislike this usage on the grounds that existence and instantiation of an abstract object aren't the same thing. A nominalist might dislike it on the grounds that no properties really exist. I am dodging these questions here and am using "exist" in the more intuitive sense I have just described.

the question I posed at the beginning of this chapter. Is the whole (with all its emergent properties) just the "sum of its parts," or is there something more to the whole than there is to the parts taken together?

If some emergent property of the whole cannot be explained in terms of the properties and relationships of the parts, then there would seem to be grounds for believing in a form of holism. In this chapter I will not ask whether all properties can be explained in this way. Instead, I want to draw attention to a point of logic about emergent properties. The point is this: if we look at sufficiently small parts of the whole, then an emergent property of the whole is not identical with any property found in those parts. Maybe an emergent property can be explained by (or reduced to) simpler properties of the parts. But even if it can, we are stuck with the fact that the emergent property *is not* any of those simpler properties. The mouseproofness of Minsky's box is not the hardness of the box's north wall, or the squareness of the box's ceiling. If it were any of these properties of the parts, then at least one of the smaller parts would itself have the property of mouseproofness—and we know it does not. We know that the mouseproofness of the box is real, and that it is not the same property as any property of a board in the box. To know this, we do not need to know whether the mouseproofness can be explained in terms of the properties of the boards. Even if the mouseproofness can be "explained away," it still is undeniably real. (If you doubt this, ask the mouse!)

The fact that the emergent property is real, and is not identical to the properties of the parts, has an interesting consequence. This is that if we count the properties of the

box and of its parts, we will find at least one more property after we assemble the box than when we started. Before the box is built, each part has a certain set of properties; by uniting all these sets into one big set, we find that the separate parts, taken collectively, have a certain set of properties. After the box is built, another property springs up: that of mouseproofness. Of course, many other properties might come into play too, and some properties of the parts, like their independent movability, are lost as well—so the total number of properties (if one actually counted them!) might go up or down or remain the same. But the important fact is that there is at least one new property, a property that did not exist before the box was built. This property came into being when the box did. By building the box, *we created this property*.[21] The box has a real property that, for all we know, was not present in the world at all before the box was built.

We now see that emergent properties are in much the same position as the triangle and fish depicted in Chapter 1. An emergent property of an object is something that exists *in addition to* all the properties of the object's small parts. To assemble an object having such a property is to *create* that property—to bring it into being, or to bring an example of it into being. To have a full accounting of all the properties involved with the box, we must list the emergent

[21] Some philosophers (a subset of the Platonic realists) might want to maintain that properties really exist always, and are not literally created. If that is so, then we should say that the property was not *exemplified* before the box was built, and began to be exemplified when the box was built.

property as well as the properties of the parts. It may well be that the emergent property can be explained in terms of the properties of the box's parts. But even if it can, this does not change the fact that the emergent property is something real, and something quite apart from any of the properties of sufficiently small parts.

The position I have reached here is similar, though not identical, to certain ideas of the philosopher John R. Searle. Writing about mind and consciousness, Searle has argued that "consciousness is a causally emergent property of systems"[22], and that mental states are caused by physical goings-on in the brain.[23] Taken together, these two claims of Searle's imply that a property (consciousness) of a whole (the brain) can be an *effect* of the presence of certain properties in the parts, instead of *being identical* to properties of the parts.

The implications of Searle's line of thought show up in his discussion of the philosophical idea of *supervenience*. Supervenience is an idea that often surfaces in discussions of complex wholes such as brains. The word itself is somewhat vague; Searle distinguishes more than one meaning for it.[24] On one of these senses, to say that a phenomenon (like thought) supervenes on some other phenomenon (like brain activity) is to say, more or less, that there is nothing to the first phenomenon besides that

[22] Searle, *The Rediscovery of the Mind*, p. 112.

[23] Searle, *The Rediscovery of the Mind*, p. 125.

[24] Searle, *The Rediscovery of the Mind*, p. 125.

other phenomenon. On the other sense (which Searle calls "causal"), the supervenient phenomenon is merely *caused* by the other phenomenon, and is completely controlled by it. Searle points out that "[t]he solidity of the piston is causally supervenient on its molecular structure."[25] This implies that the solidity of the piston is an effect of the state of the molecules in the piston. The solidity isn't a property of any of the molecules themselves, but is something that comes into being when the molecules come to be arranged in a certain way. Searle's views on supervenience come close to, and perhaps imply, my thesis that an emergent property has an existence separate from that of the properties of the parts of the object that has it.

A scientific explanation of the mouseproofness of the box, or of the liquidity of water, may well explain those properties in terms of simpler characteristics. Once the scientific explanation has done this, it is done with the mouseproofness or liquidity; it has nothing more to say about what these properties are. But if we want to understand what the box or the water *really is*, then we *must* count the mouseproofness or the liquidity as real properties, along with the simpler properties used in the scientific explanation. We cannot excuse ourselves from this duty by claiming that mouseproofness or liquidity is not a separate property or has a scientific explanation. Complex properties are real. They are just as real as simple properties. We may know that the emergent properties depend for their existence on other properties, but this does not imply that they are "just" those other properties, or that

[25] Searle, *The Rediscovery of the Mind*, p. 126.

they lack an existence of their own. If you don't believe it, just count!

Emergent properties exist whether or not they are scientifically "reducible" to other properties. Using a bit of philosophical jargon, we can say that emergent properties belong to the *ontology* of the physical world. An ontology is a theory about what exists, or an inventory of the kinds of items that exist. If we want to describe the ontology of a body of water, we must include in our account both the *properties of the molecules* and the *liquidity of the whole*. If we leave any properties at all in our ontology, we must leave in the liquidity too. To do otherwise would be arbitrary and unjustified. The only possible reason for leaving liquidity out would be to support a philosophical prejudice: that things explainable in terms of other things are not quite real. But does anyone—even an intelligent reductionist—want to claim that water is not really wet?

The Triangle and Fish Revisited

The real existence of emergent properties also has another interesting result. It leaves no doubt that a composite object is more than just its parts. If liquidity exists in the physical world, then there must be something to have the liquidity. The property of liquidity that we find in the world is not some free-floating property, exemplified by nothing. Liquidity is a property of *objects*—for example, of certain masses or blobs of water molecules. Such a blob can have a property of its own; therefore, the blob is not "just" the water molecules—that is, it is not all the molecules taken together. Rather, the blob must be a distinct entity—presumably, an entity that comes into

existence when water molecules are arranged in a suitable way. Otherwise the blob could not have a real property.

Take a zillion isolated water molecules, and you just have a lot of water molecules. Put them together in roughly the same place, and let them stick together as they naturally do. Then you have a sample of liquid. Of course, you still have the zillion water molecules. *But now you have a zillion and one things.* The extra thing—the liquid sample—is different from its parts because it has a property—liquidity—that none of the parts can have. Take the beaker in which the water molecules sit, and try to pour from it. If something pours or glugs (instead of just flying through space as a collection of independent molecules, like so many minuscule billiard balls), then it is safe to infer that there is something in the beaker besides the molecules. After all, a molecule can't glug. Of course, what's in the beaker is made of molecules. But that doesn't mean that what's in the beaker *is* just molecules. Without the molecules, the stuff that pours would not be able to pour, would not have any of its other physical characteristics, and would not exist at all. Nevertheless, that sample of stuff is not just molecules.

The water sample, like the wave in Chapter 1, shares all of its substance with the molecules that exist within it. It can have no properties except those to which a zillion molecules, acting together, can give rise. Normally, we would think of the water sample as somehow *being* its molecules; we might think that in some ultimate sense, there is nothing there *but* molecules. As I have argued here and in Chapter 1, it is more correct to say that the water sample is a thing *in addition to* its molecules, but which owes every bit of its substance to the molecules. If we

condense this water sample out of isolated water molecules, *we literally create a new object.* We also create properties that were not there before—properties that we must tally up if we want to count all the real properties of the water sample.

This view of the water sample may seem contrary to the scientific approach to the study of liquids. A little thought will show that it is not. The scientific explanation of liquidity and the molecular model of water will remain verifiable and correct, whether the sample is a new object or is identical to the molecules that make it up. Neither of these two views of the sample can contradict any scientific prediction about the behavior of the water or of its molecules. The question of whether the water sample is an extra object is not a scientific question. We cannot settle this question by doing experiments or making measurements. (This is true of all genuinely philosophical questions.) To settle these questions, one also must worry about the logical consistency and coherence of the different possible answers. As we have seen, some rather simple observations about the logic of properties, and about ways of counting objects, suggest that one view is logically neater than the other.

Elimination vs. Reduction: A Technical Note

Philosophers of science sometimes distinguish between *reduction* and *elimination* in scientific thought.[26] To

[26] The distinction between eliminative and reductive forms of materialism is outlined in Cornman and Lehrer, *Philosophical Problems and Arguments: An Introduction*, p. 282.

reduce an object or phenomenon is to show that it is "nothing but" something else. A classic example of reduction, often mentioned in discussions of the philosophy of science, is the claim that water is nothing but the chemical compound H_2O. To *eliminate* something is to show that we can dispense with it altogether in our thinking, and can get by without claiming that it exists. An example of elimination is the argument that we need not believe a drop of water exists, because if we just assume that the water molecules are there we can explain all the measured properties usually ascribed to the drop.

If we wish to use these terms, we can restate our most recent conclusions as follows. First, it is impossible to eliminate any composite object, if "eliminate" is defined as above. Even if the existence and properties of the object's parts completely explain the existence and properties of the object, it still is the case that the object is there. Also, the object is not the same as any of its parts, or as several of its parts together. Second, a reduction of a composite object may be correct, but only if that reduction does not involve elimination of the object. Instead of saying that reduction of the whole to its parts is possible, we must first be sure we know what we mean by "reduction." If "reduction" means explaining the properties of the whole in terms of those of the parts, then we have not ruled out a reduction. If "reduction" means showing that the whole is nothing but a composite of its parts (that a water drop is nothing but a composite of molecules), then we have not ruled that out. The "composite" of the parts is, after all, just another name

for the whole. But if "reduction" means showing that there really is nothing there except the parts, or that the whole somehow is the parts and nothing more, then such "reduction" is out of the question. It is elimination in disguise, and it is logically untenable.

Of course, it may be convenient to ignore the whole and consider only the parts—for example, in a scientific calculation where we treat a macroscopic thing as a set of atoms. But that way of thinking is a practical convenience, and says nothing about the reality of the whole. If the whole is real but its parts control its properties, then a calculation that substitutes the parts for the whole may yield correct results. But even if we can ignore the whole in our calculations, that whole still is there—and is not the same as its parts.

Some scientists, and other scientifically oriented people, seem unclear about the difference between reduction and elimination. They seem to think that just because physical objects are made of atoms or particles, there really is nothing in the physical world besides atoms or particles. Many scientists would deny that a stone (for example) is unreal—yet when they discuss the nature of physical reality, they state or broadly imply that a stone "really is only atoms." Occasionally one reads statements like this in the literature of science and philosophy.[27] More often, one hears them in conversation—with scientists,

[27] The *locus classicus* is perhaps Democritus' well-known statement that "atoms and Void *(alone)* exist in reality" (p. 93 in Freeman (ed.), *Ancilla to The Pre-Socratic Philosophers*; italics unchanged by me).

academic philosophers, or others. The classic example is the old chestnut about a person really being a few dollars' worth of chemicals. But all such statements rest on a mistake. The universe as portrayed by science does not contain only elementary particles of matter. It contains those particles, *plus the composite objects built up from those particles*. To speak as though the particles are all there is—as though once you've counted the particles, you've counted everything there is—is a grave logical error. The composite objects are not redundant. To get a full inventory of things in the physical universe, you must list not only the electrons, quarks, and so forth, but also the larger things built up from them. If you count all the particles in a stone and then count the stone containing those particles, you haven't counted up the same thing twice.[28] The stone may be made of the particles, but the stone is not the particles. The stone is an additional entity—one more thing, distinct from the particles that make it up.

The view that the physical universe really is only particles, or that human bodies really are only atoms, sometimes gets stated explicitly. Far more often, this view lurks behind other viewpoints as an unstated assumption or an underlying attitude. A psychobiologist might laugh at the view that people don't exist—yet in practice, he might think of the human organism as though its only "real" properties were molecular ones. A physicist might feel that

[28] The concept of "double counting" also is used by Lewis (*Parts of Classes*, p. 81). Lewis, however, draws a conclusion opposite to mine.

the discovery of a "theory of everything"—resulting in a complete physical description of elementary particles—would reveal to us what the physical universe "really is." A materialist philosopher might deny that chairs and tables are illusory—and yet might privately picture the material world as a set of interacting elementary particles. Each of these attitudes rests on an unstated view that the ultimate parts of objects are somehow more important or fundamental to our picture of the world than are the objects themselves.

Epilogue

Nothing I have said in this chapter settles the entire holism-reductionism controversy in its usual form. At every step in my argument, I have allowed for the possibility that the properties of wholes can be explained in terms of the parts. Also, I have allowed for the opposite possibility. I have asserted that when water molecules come together, new properties can appear that do not belong to the individual molecules. However, I have neither asserted nor denied the strict holistic claim that some of these properties *cannot* be explained by the behavior of molecules. I have merely pointed out that when the molecules come together, they may form a new object with new properties. Also I have shown that the new properties that this object has are as real as any other properties in the world. If believing that the whole object exists and has properties is a form of holism, then of course I am arguing for holism. But this label would be unfair, since a reductionist does not have to give up all forms of reductionism to believe that a glass of water exists. (I

suspect that most reductionists do believe this, especially when thirsty.)

Some of my observations about whole objects may seem like small technical points, or like restatements of commonplace truths. One might want to ask whether such modest results have any real relevance to the holism-reductionism controversy. In the coming chapters, I will show that people (including scientists) often forget about these "small" points when thinking about wholes and parts. If we revise our usual thinking about parts and wholes while always keeping in mind that the whole is real, we will arrive at a view of the world and of human existence surprisingly different from our usual views. This new view will make several long-standing philosophical problems much easier to think about. Indeed, we will find that some of the knottiest problems in philosophy were partly illusions, created by our failure to grasp the implications of the separate existence of the whole.

Chapter 3.
Walls, Bricks and Logic

Earlier I said that scientists often ignore the larger questions about the connection between whole and part. This indifference is strange when we consider how much of science is about this connection. As I pointed out earlier, the physicist's search for the final building blocks of matter is just an attempt to answer a question about wholes and parts. But the scientists' unconcern with the general problem of wholes and parts becomes even more ironic when we learn that there already is a precise, "scientific" method for the study of these ideas. This method is called *mereology*—a word of Greek origin meaning the science of parts.[29]

Mereology is both a mathematical and a philosophical subject. Mereology is not a science in the same way that physics and biology are sciences; it does not depend on experiments and scientific observations to prove its conclusions. Like any part of mathematical logic, it is a

[29] Mereology is discussed in a number of sources, including Woodger, *The Technique of Theory Construction*, and Lewis, *Parts of Classes*.

formal science—one that uses the methods of deductive reasoning to analyze old ideas and make up new ones. It is best to regard mereology as a branch of philosophy rather than of science, though it belongs to the more "scientific," or rigorous, end of philosophy.

Mereology as a mathematical discipline was founded by the Polish logician Lésniewski in the first half of the twentieth century.[30] (Mereological thought existed before that time,[31] but earlier mereology did not yet take the rigorous form that Lésniewski gave it.) Other philosophers have extended mereology further and have applied it to various scientific fields. David Lewis, perhaps better known for his innovative ideas about "possible worlds," has shown that one can use mereology to better understand the foundations of the mathematics of the infinite.[32] Joseph H. Woodger used mereology to set up a precise theory of the main ideas of biology, including cell division and even the origin of life.[33]

[30] Lésniewski's work is discussed, and references are given, in Lewis, *Parts of Classes*, p. 72. Lésniewski's original papers on mereology are in Polish.

[31] Medieval mereological thought is discussed in Henry, *Medieval Mereology*.

[32] Lewis, *Parts of Classes*. Lewis's ideas about possible worlds are discussed in his books *Counterfactuals* and *On the Plurality of Worlds*.

[33] For an introduction to Woodger's ideas, see his book *The Technique of Theory Construction*. See p. 64 for a mereological version of the idea of abiogenesis (the origin of life from nonliving matter).

In this chapter I am not going to go into the mathematical depths of the subject of mereology. Instead, I am going to examine a few of the guiding ideas that have played important roles in shaping that field. My aim is to review briefly (and non-mathematically!) this study of whole and part, and then to point out some unsolved problems about mereology that may point the way to a new understanding of the entire part-whole business.

The Crucial Relation

The central idea of mereology is that of the relation between a part and a whole. When we say something like "This brick is part of the wall," we refer to two things—a brick and a wall—but not only to two things. We also refer to a *relation*—the abstract object or concept to which the phrase "is part of" refers.[34] The first trick of mereology is to treat this relation in the same way that mathematicians and logicians treat all other relations. Arithmetic deals with relations between numbers, especially the relations represented by the phrases "is greater than," "is less than," and "is equal to" (or "equals"). Mereology deals with a relation between *objects*—the relation referred to by the phrase "is part of."

Like any mathematical discipline, mereology uses symbols for its basic notions. I will not use symbols here,

[34] Some philosophers of language will question my use of "refer" in this sentence and elsewhere. Their point, though worthy of consideration, does not affect the subsequent argument.

since I am not going to set up any complex mereological proofs. I will be able to do what I want to do using words alone, plus a few stray letters. Mereology also uses axioms, or basic principles, as starting points for proving more complex results. These axioms do not legislate in advance the answers to any questions; one always can revise the axioms if they do not hold true in the real world. Two principles of mereology that are useful as axioms are the following:

Principle of irreflexivity. Let x and y be things. If x is a part of y and x is not the same thing as y, then y is not a part of x.

Principle of transitivity. Let x, y, and z be things. If x is a part of y, and y is a part of z, then x is a part of z.

These axioms are just ways of restating truths that seem obvious in everyday life. If a brick is part of a wall, then the entire wall cannot be part of the brick. If a page is part of a chapter, and a chapter is part of a book, then the page is part of a book. One can, of course, ask whether there could be exceptions to rules like these. But I will not do this here, since my goal is to do something else.

Mereology takes the relation expressed by "is part of" to be another relation, on the same logical level as other relations like those expressed by "is greater than," "is longer than," and "existed earlier than." The relation of *being greater than* can hold between two numbers. The relation of *being longer than* can hold between two physical objects. The relation of *being a part of* also can hold between two physical objects, and perhaps (as Lewis

has argued[35]) between two mathematical objects as well. When we do mereology, there are two things we have to think about: the objects that make up the world, and the whole-part relation that links some of them together.

Mereology is about the realm of things—a realm that contains at least physical objects, and (for all we know) perhaps other items as well. Mereology begins with a domain of things or entities, and describes a relation—that of *being a part of*—which holds between some pairs of things and not others. I take it for granted that this general view of the world is correct, at least for most practical purposes. There really are a lot of things in this world (unless one wants to be an utter skeptic and claim that things are illusory). Philosophical accounts of what things really are cannot change this practical fact. Further, it is true that some of those things are related to each other in the way that we call the relation between whole and part. As long as one accepts the existence of a physical world and the fact that some things have parts, one should have no trouble with the basic way that mereology describes the world. One might doubt the particular assumptions that mereologists sometimes use, but there would be no reason to doubt that the world contains things, and that things stand to one another in the relation of part to whole.

A Shift of Viewpoint

My aim here is not to go into mereological theory in detail. Instead, I want to use mereology as a jumping-off

[35] Lewis, *Parts of Classes*; see especially pp. 3-4.

point for an argument about the nature of wholes and parts.

Consider the statements I made two paragraphs ago about the world as portrayed by mereology. This view of the world—which is the view almost everyone uses without thinking about it—is logically sound. However, this view does not fully agree with another view that some scientists seem to use. The conventional scientific picture of the world regards the world as a world of parts. According to that view, the smallest parts of the world explain everything in the world; once we have a description of the ultimate particles, we have, in principle, an explanation of everything in the universe. All else is almost incidental; since a galaxy is nothing but elementary particles, we do not need a theory of what galaxies "really are," apart from our views on elementary particles and their forces. But common sense and mereology both portray the world as a world of *objects*, not just of invisible particles. The ultimate particles may be among the objects, but are not the only objects in the world. The world of objects is not the world of ultimate particles, for although everything is made of ultimate particles, the larger objects in the world are neither more nor less real than the particles.

This last view is the one that actually underlies science—if we consider science as scientists really do it, instead of confusing science with some philosophical attitude that is supposed to be "scientific." Scientists working on problems of complex physical systems (like crystals or liquid drops) treat those systems as real objects. Such objects contain their own mysteries, perhaps as deep and difficult in their own way as the mysteries of subatomic particles. Some scientists may *say* that the world is nothing but quarks and the like, and that a theory of quarks and

similar particles would explain everything. But in their work, scientists *act* as if larger objects were exactly as real as quarks—that is, as if the physical world were a world full of *objects,* and not just a set of tiny pieces.

Apart from mereology's correct picture of objects, there is something else about mereology that is equally right. This is mereology's treatment of the whole-part connection as a *relation*. The physical world is full of relations that link one physical object to another. Among these relations are the spatial relations, such as relations of distance. The phrase "is one mile away from" expresses a relation that can hold between two ordinary material objects, and perhaps even between two atoms or quarks. Relations like these are important in scientific theories. The relations of distance between two objects control the ability of those objects to collide with each other, or to push or pull on each other through gravity or other forces. Mereology forces us to recognize that the link between a part and the whole also is a relation. From a logical and mathematical standpoint, whenever we say "A is a part of B," we are expressing the same general kind of fact as when we say "A is a mile away from B."[36] We are saying that A and B stand in a certain *relation* to one another.

The observation that the whole-part connection is a relation seems obvious if you think about it long enough.

[36] The philosophers who hold that the whole is somehow identical to the parts must deny this, and instead must hold that the whole-part relation is different from ordinary relations like that of being a mile away from. See Lewis, *Parts of Classes*, pp. 84-85, for a position like the latter.

Yet in some respects, this observation runs counter to the usual ways of thinking about parts and wholes. Normally, we do not think of the bricks in a wall as simply items *related* to the wall, in the same way that Chicago is related to Atlanta by the relation "is north of." We think of the bricks (together with any other wall-parts, like mortar) as somehow *being* the wall. We do not think of the wall and the bricks as separate objects. Instead, we think of the wall on the one hand, and the bricks and other wall-parts on the other hand, as the same piece of stuff—the same substance. The suggestion that the bricks are simply objects related to the wall seems to leave something out—the fact that the bricks and mortar are the same piece of stuff that is the wall.

Now I am going to suggest a slight change in our way of thinking about material objects. Normally, we think of the brick as related to the wall in a certain way, and we also feel that all the bricks and other parts in the wall, taken together, somehow *are* the wall. The relation of "being a part of" seems different from all the other usual physical relations. This is the way it seems: if A is a part of B, then A, together with all the other parts of B, just *is* B. This does not hold true for other physical relations, like "is north of" or "weighs more than."

In place of this usual view, let us think of the brick as being related to the wall—*period.* That is, once we have said that the brick stands in the is-part-of relation to the wall, there is nothing more to say about the relationship between the brick and the wall. Of course, there still are a lot of details to settle, like exactly where the brick is located in the wall or how much mortar was used to attach it to the wall. But there is nothing fundamental left over. It

is not necessary to state the additional fact that the brick isn't merely related to the wall, but also somehow makes up the wall—because *there is no such additional fact.* To say that the brick is a part of the wall is to say that this object, the brick, stands in a specific relation to this other object, the wall. That is all.

According to the normal, intuitive view of the relation between part and whole, the bricks in the wall are what the wall is. On this view, each of the bricks shares part of the existence of the wall, as it were, and there is nothing to the wall besides the bricks hooked together in a certain way. According to the new view I am proposing, the bricks in the wall simply are related to the wall, just as a tree *to the north* of the wall is related to the wall. Of course, the relations involved are different; the tree is linked to the wall by the relation *is north of,* and the brick is linked to the wall by the relation *is part of.* But to pretend that the bricks *are* the wall in some way, while the tree *is not* the wall, is to miss the point. Once we have said that the wall and the brick are objects, and that the relation is-part-of holds between them, we have said all there is to say about the relation between brick and wall, except for incidental details. It is unnecessary to add something like, "But the wall really is just the bricks; it isn't a different object." Such a statement would not merely be redundant; it would be false.

This conclusion is the one to which the thought experiments in Chapter 1 pointed us. There I pointed out that a whole must be an object logically distinct from its parts. When we reflected on some simple wholes, we found that it does not make sense to regard the whole as being nothing but the parts. Even the arithmetic told us

that! Someone might have misunderstood my purpose in Chapter 1. The triangle, fish, and wave examples could be taken as arguments for a conventional holism which says that the behavior of the whole has no explanation in terms of the parts. But those examples are not arguments for that doctrine. Instead, they support the milder view that the whole is an object that exists in the world *in addition to the parts.* The question of whether the parts explain all the properties of the whole remains open. But the question of what kind of object the whole really is—an object in its own right, not identical to the parts that make it up—has been answered. The whole, whether or not it has a scientific explanation, is something other than its parts.

This new view of wholes and parts does not beg the question of the reducibility of the whole's behaviors to those of its parts. It is not a thesis about the behavior of the whole, but about what philosophers would call the *ontology* of the whole—that is, what kind of an entity, or being, the whole is. Regardless of whether the parts explain the whole, the whole is not the same object or being as any of its parts, or as all of its parts collectively.

There is a possible technical exception to this conclusion. This exception will not affect any of my future arguments, but I should mention it for the sake of completeness. Mereologists sometimes define the word "part" in such a way that an object is a part of itself. That is, the brick wall as a whole is part of the brick wall. If one chooses to define "part" in this way, then of course there is one part of the wall that *is* the wall; that part is the wall itself. But usually, when we speak of "parts" we mean parts that are not the whole. Throughout the book I will use the word "part" in this conventional way. I will not call

the whole a part of itself. I will have only one more occasion, much later, to mention the technical sense of "part" which makes an object its own part.

"The Sum of Its Parts"

This is a good time for some further comments on one traditional form of the holism-reductionism question: "Is the whole more than the sum of its parts?" The argument of the last section underscores the well-known fact that this question is too unclear to be answered as it stands. It is not clear what "the sum of its parts" really means.

Sometimes people who claim that the whole is the sum of its parts may mean that the whole is just the parts. In other words, if we have the parts, and arrange them properly, then that's all there is to the whole.[37] If this what we mean by "Is the whole the sum of the parts?", then I already have given the answer: no, the whole is not just the sum of the parts. The view that the whole is all of its parts collectively is simply illogical. But this is not the most reasonable reading of the question. Arithmetic teaches us that the sum of a series of numbers need not be the same as any of the addends that go to make it up. If we take the

[37] J.C. Smuts, the founder of holism whom I mentioned earlier, once wrote "the whole is not something additional to the parts: it *is* the parts in a definite structural arrangement and with mutual activities that constitute the whole" (*Holism and Evolution*, p. 104). Although Smuts assigned the whole a high place in the world, he would have disagreed with the view of part and whole that I am advocating. My view of wholes and parts neither implies nor excludes holism of a Smutsian sort, although my view might be regarded as holistic in a broader sense.

expression "sum of its parts" to mean, not the parts themselves, but the object formed by putting together the parts, then it is no longer implausible to regard the whole as the sum of the parts. Indeed, if the "sum of the parts" means whatever we get when we put the parts together, then the answer to the question is trivial. Of course the whole is the sum of its parts, for "the sum of the parts" is just another way of saying "the whole"!

If we read "the sum of the parts" to mean either just the parts, or what we get when we combine the parts, then the question "Is the whole the sum of the parts?" becomes easy. In one case, the answer is no; in the other case it is trivially yes. But these answers do not add up to holism or reductionism. We know that the whole is not identical to the parts, and we know that the whole is the object formed from the parts. But there still is plenty of room for holists and reductionists to disagree. They can debate whether the properties of the parts fully explain those of the whole. They can ask whether the whole contains any special factor or principle not foreshadowed in the parts. My claim that the whole is not the parts, and that it is an object existing in addition to the parts, may sound holistic. But my position does not rule out reductionistic explanations and does not settle all the pieces of the holism-reductionism controversy.

Substance Sharing

It seems as if the part-whole relation is "special" compared to other relations[38]—that there is something

[38] This intuitively appealing view has been well stated by Lewis. In *Parts of Classes* (p. 84), Lewis characterizes "mereological

radically different between it and, say, the relation of *being north of*. Some of our best established intuitions about reality suggest that the link between part and whole is more than just a relation—that somehow or other, the whole is just the parts. The source of these intuitions might be the fact that the parts contain all the matter contained in the whole. The bricks, together with the mortar (if any), contain all the matter that belongs to the wall; that matter is partitioned among these parts of the wall. Outside the bricks and other parts of the wall, the wall has no matter at all. But one must be careful before deciding that the wall *is* just the bricks and mortar, or that the being of the wall is just the being of the (properly arranged) bricks and mortar. In Chapter 1 I showed that two logically distinct objects can share the same energy and mass. Even if the bricks and mortar contain all the matter that is in the wall, this does not automatically imply that the bricks and mortar are the same as the wall. Instead, this may tell us that the bricks and mortar are distinct from the wall, but share substance with the wall. The wave example in Chapter 1 was one illustration of such *substance sharing*. To get an example of substance sharing which involves two objects of the same sort, visualize two water waves coming together and passing through each other. (Breakers may have trouble doing this without crashing to bits, but smaller water waves, like the ones in boats' wakes, do not.) At the moment of their overlap, the two waves encompass the same matter. Of course, the waves aren't just "things," they are processes. But the same kind of substance sharing happens with the wall and its bricks.

relations" as "something special".

The brick wall is not the bricks; the wall's existence is not the existence of the bricks, for the bricks could exist without the wall. The bricks are simply objects that share substance with the wall. This substance sharing is of the same nature as the substance sharing in the wave examples, here and in Chapter 1. Of course, the commingling of substance is more intimate in the wall. *All* the matter of the brick belongs to the wall, and *all* the substance of the wall is shared out among the bricks (plus perhaps a little mortar).

This sharing of substance by the part and the whole is what makes an object seem to be nothing but its parts. Early in life, we learn that every bit of stuff that makes up a physical object belongs to one or another of that object's parts. We learn that if you take away a part, you take away from the substance (and the mass) of the whole. If you take away all the parts, the whole vanishes. But this only shows that all the substance of the whole belongs to the various parts at the same time that it belongs to the whole. It does *not* imply that the whole is nothing more than the parts. The distinction between these two implications may seem subtle, but when one thinks about it, it becomes more and more blatant. The whole is there, and is not the parts—yet all the whole's substance happens to be the substance of the parts. (Perhaps this is part of the meaning of the idea of a part. To be a part of a thing X is, at very least, to "own" no substance except some of what X also "owns.")

The Stonemason's Argument

For an object to be a part, it is enough for that object to stand in a certain relation to a whole. No added equation of

the whole to the parts is necessary or possible. To make this claim more credible, I will point out that such an "added equation" could not be verifiable through experience. That is, once we know that the brick is a part of the wall, no extra observation could confirm that the wall is, or is not, just the bricks.

Consider a stonemason trying to build a section of a brick wall from a pile of bricks. Suppose that the mason is trying to restore a damaged wall that originally contained a single green brick as well as many of the usual red bricks. The mason asks himself "Is the green brick still in the wall?" He looks at the wall, and finds that the green brick still is there. Now he knows that the green brick is *part of* the wall. This knowledge enables the mason to do many things he could not do before. He can avoid building more green bricks into the wall if he wants to restore the damaged wall to its original color scheme. He can remove the green brick if he wants to make the wall more purely red.

Now suppose a reductionist philosopher comes along and tells the mason, "You already know that the green brick is part of the wall, and that the other bricks in the wall are parts of the wall. But there is another fact you should know: the wall is just the bricks and mortar. Strictly speaking, there is nothing there besides the bricks and mortar." Would this information enable the mason to do anything that he could not do before, when he only knew that the green brick was a part? Of course it would not! Once the mason knows that the green brick is a part of the wall, he understands the practical results of this fact (for example, that the wall will get more uniform in color if he removes the green brick). He does not need to worry about

the philosopher's claim that the wall is just the bricks. He can do the same things to the brick and to the wall, whether that claim is true or false. Nothing that he experiences will tell him whether the wall is just the bricks. All he ever needs to know is that the brick stands in a certain *relation* to the wall. And of course, there is no doubt for him that the wall and the brick both are legitimate objects—that both bricks and wall really exist. To work as a mason, he has to believe in the existence of the bricks and of the wall—or at least to behave as if those two facts were true.

Reflection on this example, and on other examples like it, will reveal that no sensory evidence can tell us whether the wall is or is not just the bricks. One can generalize this observation to all objects made of matter. All possible observations of parts of material objects are compatible with the belief that parts are objects related to the whole and sharing substance with it, instead of objects constituting the being of the whole. Even if the wall were just the bricks and mortar and nothing more, the mason would never find this out by doing masonry work. An experimental scientist studying the wall would not find this out either. Observations and experiments simply cannot answer the question of which belief is best.

I do not want to take up the old and well-known philosophical questions about verifiability and meaning here. For those who care, I will say that I am not a verificationist in any ordinary sense of that word. There are significant questions that sense experience cannot answer. Philosophy is full of questions of this kind. The argument about the stonemason shows that the question "Is the wall just the bricks?" is just such a question. We know, by inference from our observations, that the brick is a part

of the wall. We know, by inference from our observations, that the brick shares substance with the wall. If we assert in addition that the wall in some sense *is* its bricks and other parts, then we are asserting a metaphysical thesis that science cannot confirm or challenge. Also, we are adding a new relation—the identity relation between the whole and its parts—to the picture of what is happening.[39] We will never need this new relation to explain the observable behavior of the wall, since the existence of the ordinary whole-part relation, plus substance sharing, can do that. Neither the mason nor the scientist can bump into this identity relation, and the logic and arithmetic of whole and part (recall Chapter 1) suggest that this relation does not hold between whole and parts. It appears that there is no good reason to believe that this added relation of identity holds—and there are some good reasons not to believe it.

[39] Lewis holds that there is an identity of this sort; see *Parts of Classes*, pp. 81-85. D.M. Armstrong argues for a view in which the whole-part relation is a kind of partial identity (see *A Theory of Universals*, pp. 37-38).

Chapter 4.
Wholes or Just Parts?

Not everyone who thinks about wholes and parts arrives at the conclusions that I reached in the previous chapter. The philosopher David Lewis[40] has suggested a philosophical interpretation of mereology which is, in some respects, opposite to mine. Another philosopher, Donald L.M. Baxter, has discussed another version of the view that the whole is the parts.[41] Baxter also has discussed an opposing "Non-Identity view" of whole and part[42]. My conception of whole and part is a variation of what Baxter calls the Non-Identity view.

In this chapter I will discuss some of these philosophers' ideas about whole and part, and some of the arguments that philosophers have used to attack and defend these ideas. I will devote special attention to Lewis's view, as I understand that view. Then I will show where Lewis's interpretation of mereology goes wrong, and why his

[40] In *Parts of Classes*.

[41] Baxter, "Identity in the Loose and Popular Sense," pp. 578-581.

[42] Baxter, "Identity in the Loose and Popular Sense," pp. 578-579.

objections to the opposite view do not hit my interpretation at all.

Lewis claims that the relation between whole and parts is one of *identity.* To understand this claim we must know what philosophers mean by "identity." Identity is the relation that holds between things that are the same thing. If Antarctica is the southernmost continent on Earth, then we can say that Antarctica is *identical to* the southernmost continent on Earth. We also can say that Antarctica stands in the relation of identity to the southernmost continent on Earth. The expressions "Antarctica" and "the southernmost continent on Earth" name the same object, so the object named by one of these expressions is related by identity to the object named by the other.

In mathematics, the relation of identity is called *equality.* It is the relation that mathematicians represent by the equals sign =. If 2+2 is the same number as 4, then the number 2+2 is identical to the number 4.

These examples point up the fact that identity is a relation that relates every object to itself. Unlike other relations, which can relate one object to a different object, the relation of identity can only connect objects that are the same. The fact that identity can never relate two *different* objects makes it an unusual relation. Some philosophers have doubted that identity is a relation at all.[43] But even if identity were not a genuine relation, this would not change the fact that identity acts like a relation and can be treated

[43] These doubts are mentioned by Armstrong in *A Theory of Universals,* pp. 37-38. Russell discusses identity as a relation in *The Principles of Mathematics,* par. 95 (p. 96).

as one in formal reasoning. Mathematicians and logicians usually represent identity with the equals sign, =.

Philosophers have thought a great deal about the relation of identity. One philosophical question about identity is whether there is any such thing as *partial identity*—that is, whether two objects can be distinct or different in some respects, and yet somehow or other be the same thing. Some philosophers, including the philosopher of religion Charles Hartshorne, have argued that partial identity not only is possible, but also plays an important part in the world. Hartshorne suggested that the notion of a partial identity among beings provides a fruitful way to think about the moral unity or interconnectedness which, according to some religious traditions, exists among persons.[44] Another philosopher, D. M. Armstrong, has argued that the relation of part to whole is a kind of partial identity.[45] Armstrong has used this conception of partial identity in the study of a classic philosophical problem, the problem of universals.[46]

Mathematicians often use a trick like partial identity when they need to equate things that are not identical but only resemble each other in some respects. The mathematical device known as "equivalence classes"[47] lets

[44] Hartshorne, *Omnipotence and Other Theological Mistakes*, pp. 99-110.

[45] Armstrong, *A Theory of Universals*, pp. 37-38.

[46] Armstrong, *A Theory of Universals*, especially p. 38.

[47] This device is discussed in introductory texts on abstract algebra.

mathematicians make such thinking rigorous. As the philosopher W. V. O. Quine has pointed out, in the foundations of mathematics it sometimes is practical to regard things as being equal even if those things actually are similar only in certain respects.[48] But one does not have to believe in partial identity to do this.

In this book, I am not going to argue for or against the reality of partial identity. I am discussing these relations mostly to point out that one can ask serious philosophical questions about the seemingly simple idea of *being the same*. I will look into a different problem about identity: the question of whether a *single thing* can be identical to *several things together*. This is the kind of identity that Lewis claims to exist between any whole object and its parts.[49] (I should mention that Lewis does not seem to deny the reality of composite wholes.[50])

In mathematical logic, statements about what exists are couched in the language of *quantifiers*. A quantifier is a phrase like "There is" or "For all" which tells us how many objects or entities have some property. For example, in the sentence "There is a brown dog," the phrase "There is" acts as a quantifier. Because of the presence of the phrase "there is," that sentence tells us that there is at least one

[48] See Quine's remarks on equality and identity in his book *Set Theory and Its Logic*, pp. 14-15.

[49] See Lewis, *Parts of Classes*, pp. 81-85.

[50] I think this is clear from his remarks in the footnote on p. 70 of *Parts of Classes*.

brown dog. In the (false) sentence "All dogs have tails," the word "All" acts as a quantifier. It tells us how many dogs have tails: they all do. (Of course, "All dogs have tails" does not tell us the exact number of dogs that have tails. Depending on how many dogs currently exist, there may be one tailed dog or a million. But it does tell us how many dogs do *not* have tails: zero. Thus it is a statement about quantity.) There are other quantifiers that are more complex, but I will not deal with them here. My aim is not to provide a lesson in mathematical logic, but to say enough about quantifiers to make clear the central idea of Lewis's argument.

Lewis points out that not all quantifiers say something solely about individual objects.[51] Quantifier phrases like "There is" and "All" say that there is an individual object of a certain sort, or that all individual objects have a certain property. But people often reason about groups of objects as well as about individual objects. For example, one could say "In this field, some dogs formed a pack." In this sentence (which is not Lewis's example), the word "some" acts as a quantifier. However, that word does not only say that individual objects exist. Instead, it says something about a *group* of dogs—a group that formed a pack. In this particular sentence, "some dogs formed a pack" means this: there are *several* dogs, which *together* have the property of having formed a pack. It does not mean that there is at least one individual dog that formed a pack. (After all, no individual dog, considered alone, can form a pack.)

In "Some dogs formed a pack," the word "some" acts

[51] Lewis, *Parts of Classes*, pp. 62-71.

as a *plural quantifier*. That is, it is a word or phrase that declares the existence of a plurality of things, or of several things, which *together* have some property. This word or phrase does not simply declare the existence of individual things, *each* of which has some property.

Lewis's arguments imply that plural quantification is a legitimate part of logic that does not pose any fatal philosophical difficulties.[52] According to this view, it is legitimate to speak of *some* dogs having the property of having formed a pack, just as it is legitimate to speak of *a* dog having the property of having *joined* a pack. This subtle and technical thesis in philosophical logic has a great impact on our view of the relation between wholes and parts. As Lewis knew, it suggests that there may be a logical way to regard a whole as being nothing more than its parts.

Consider the claim that a particular dog is just some dog-parts in a certain arrangement—that there's nothing else to the dog beyond that. This is a claim that a reductionist might love. But just what could a reductionist mean by this? Mainly that a dog is identical to its parts. This claim implies that once we have listed the dog-parts, we do not also have to list the dogs themselves to get a thorough inventory of everything alive in the kennel. However, we cannot truthfully say that the dog *is* just the parts unless the parts can have the property of *being a dog*. This particular reductionist claim cannot possibly be true unless the parts can literally be the whole dog.

It is plenty clear that the dog cannot simply be identical

[52] Lewis, *Parts of Classes*, pp. 62-71.

to any one of its parts.[53] But it is equally clear that identity of the ordinary sort, which is mentioned in sentences like "2+2 is identical to 4," cannot hold between the dog and all of its parts together. For the dog-parts (as distinguished from the dog they make up) are many things. The dog is one thing. Ordinary identity or equality links objects which are the same—or, more correctly, it links an object to itself. But the relation between the dog and its parts does not link an object to itself. It links an object which is a dog to many objects, none of which are dogs. Therefore, the relation between the dog and its parts cannot be the ordinary relation of identity.

Some philosophers already have made this objection to the identity of whole and parts. The objection takes various forms in their writings.[54] The objection seems airtight, but Lewis's position shows a possible way around it. Lewis has proposed that we think of the relation of whole to parts as a genuine relation of identity, but one different from the simple relation of identity that holds between 2 + 2 and 4. The relation between the dog and the parts is one of plural identity. This relation relates a thing to *some things*, not simply to another thing. And this is where Lewis's ideas about plural quantification come to bear on the problems of whole and part. If plural quantification is a legitimate part

[53] Except itself, if one counts the dog itself as a part of the dog. As I said earlier, I elect not to count an object as a part of itself, though the opposite choice is commonly made and is just as logically sound.

[54] Baxter describes a similar, though different, objection in "Identity in the Loose and Popular Sense," pp. 578-579. Lewis (*Parts of Classes*, p. 84) mentions another similar-though-different objection.

of logic, then statements like “Some parts are a dog” make sense. It is possible to say “Some parts are a dog” and mean that the dog is *all* the parts, instead of meaning (absurdly) that each part is a dog. If we use plural quantification to describe the world, then we can describe the relation of plural identity between a whole and all its parts. Therefore, if we allow logic to include plural quantification (as Lewis suggests that we do), we can easily extend it slightly further to allow for plural identity (as Lewis does).

The use of plural quantifiers makes it easier to state the claim that the whole is just the parts. If we can say that all the dog-parts collectively have a certain property, then we can say that those parts collectively are the whole.

Of course, the fact that it is possible to make such a statement without contradicting oneself does not imply the that statement is true. The statement “The earth is a cube” is not obviously self-contradictory, but it happens to be false. And even if we accept Lewis’s views on the nature of plural quantification, this does not automatically imply that the dog really is its parts. To see whether this further conclusion is true, we must examine in more detail Lewis’s views about mereology.

On Lewis’s view, the whole-part relation of mereology is a relation of partial identity. In other words, the dog-parts taken together are identical to the dog. Each of the parts is, as it were, credited toward the being of the dog; the dog’s being is nothing more than the being of all its parts, considered simultaneously. On this view, the whole-part relation is a kind of identity.

Lewis’s work shows that it is possible, using plural quantification, to speak of the whole-part relation *as if* it

were a kind of identity. But this, alone, does not imply that the relation *really is* a kind of identity. Lewis himself recognized this; he gave examples of ways to speak of other relations, which clearly are not identity, as if they were kinds of identity.[55] Lewis knew that even if we can talk about a relation in a way that makes it *sound like* identity, we cannot be sure that the relation really *is* a kind of identity. But Lewis also decided that the whole-part relation is a kind of identity. I am arguing for the opposite conclusion. Plural quantification may let us speak as if the dog were its parts, but it leaves open the possibility that the "are" in the sentence "These parts are this dog" does not express genuine identity. An opponent of Lewis could say "Yes, these parts 'are' this dog—but the 'are' in that sentence doesn't stand for identity."

On Lewis's view, the whole-part relation is one of plural identity, and is a legitimate kind of identity. But an opponent of this view remains free to argue that the relation of plural identity is not really a relation of identity at all, and should be called something else. Perhaps *plural* identity is not a kind of *identity*, just as a full house (in the poker sense) is not a kind of house. Perhaps so-called partial identity only resembles identity in certain key respects. (Lewis noted such a resemblance, but used it to support the view that partial identity is a type of identity.[56])

Mathematicians sometimes use relations that closely resemble identity but are not genuine examples of identity.

[55] Lewis, *Parts of Classes*, p. 84.

[56] Lewis, *Parts of Classes*, p. 84.

This lends weight to our suspicion about Lewis's view. As I mentioned earlier, mathematicians often treat objects that are not identical at all as if they were identical—and mathematicians do this without the slightest threat to the consistency of their reasonings. The trick is the method of equivalence classes, which uses the idea of an *equivalence relation.*[57] An equivalence relation has many of the algebraic properties of the identity relation—for example, it relates each object to itself. It also comes close to many of the logical properties of identity—for example, if two objects are equivalent, then they share some of their properties (though not necessarily all of their properties, as would happen with genuine identity). But there is no question that most equivalence relations are not relations of identity. Lewis has shown that the whole-part relation resembles identity more closely than we previously had suspected. But does that prove that it is identity?

This, then, is the first part of my objection to Lewis's position: our ability to treat the whole-part relation as an identity relation does not imply that it actually is an identity relation. But Lewis's argument for the identity of whole and parts does not rest solely on the fact that the whole-part relation is formally like identity. Rather, it rests on weightier philosophical considerations. What I take to be the crux of Lewis's argument is summarized in the following quotes from Lewis's book *Parts of Classes*. Speaking of "cat-fusions" (wholes built up from cats), Lewis argues that a cat-fusion is just identical to the cats it

[57] Equivalence relations are discussed in various texts on abstract algebra.

contains: "Take them together or take them separately, the cats are the same portion of Reality either way[...]." Lewis then goes on to say that in an accounting of all there is, "it would be double counting to list the cats and then also list their fusion."[58] These two quotes together express the view of wholes and parts that I have been trying to undermine throughout this book. By asserting that one does not need to count the cat-fusion as well as the parts, Lewis presupposes that the cat-fusion is its parts, in some sense of "is." But more importantly, the quote reveals a central intuition that appears to underlie Lewis's position. This is the feeling that the cat-fusion must be the cats because it is made of the *same stuff* as the cats. Add up all the cats, and you have the same portion of substance—or "portion of Reality" as Lewis puts it—that you find in the cat-fusion.

This intuition seems to support the view that the cat-fusion is just the cats that make it up. But this evidence is not so weighty if one recalls the idea of substance sharing, which I set forth in Chapter 1. Lewis used the phrase "portion of Reality," but another way of putting it is that the cats *share the same substance* as the cat-fusion. The substance of the cat-fusion is exactly the same stuff as the substance of all the cats together. And the fact that two objects share substance does not automatically make them identical. The water-wave experiment in Chapter 1 pointed to this fact.

The main reason Lewis's position seems plausible is, I think, the fact that the whole is made of the same stuff as the parts. Presumably, this is at least part of what it means

[58] Lewis, *Parts of Classes*, p. 81 (for both quotes).

to say that the whole is "the same portion of Reality" as the parts. But this fact does not support the identity of whole and parts. Our intuitions may make us *feel* that it supports this identity—but that feeling only shows that our intuitions about whole and parts are inadequate, as I argued in Chapter 1.

Using Lewis's cat-fusion example as a start, I will now set forth the rest of my objection to Lewis's conception of the whole-part relation. To do this, I will use the relationship between cat-parts and a whole cat rather than that between a cat-fusion (a less familiar object!) and a single cat.

The first point in my second objection is this: the claim that there is a separate cat, besides the cat-parts, is impossible to refute or confirm scientifically. I argued this point in an earlier chapter, using a brick wall instead of a cat as an example. But even if the assumption that there is a separate cat does not help us explain our experiences, it does help us to understand them properly. Indeed, we *must* make this assumption if we want to avoid falling into nihilism—the view that nothing exists at all.

The cat is the whole that exists when certain parts are united in a certain way. Once we have admitted that the cat-parts exist, and have admitted that those parts are hooked together as they are, we no longer can deny there is a cat. If we think that this denial is acceptable, then it would be sheer arbitrariness not to extend it to other composite objects besides cats. And if we do this, we have to deny that any object divisible into parts is real. In the next chapter I will show that this view is self-contradictory; for now I will simply point out that it is not a view that a sensible person should adopt. If there are no composite

objects, then there literally are no things other than the ultimate constituents of matter. This means no atoms, no bricks, and no human bodies. (As I will show later, this view also implies that if the subatomic structure of matter happens to be a certain way, then there is nothing at all!)

Of course, Lewis does not adopt any of these conclusions. But these conclusions do follow from Lewis's view of identity, if we take that view to its logical endpoint. To escape these conclusions, we must stop short of that endpoint by changing Lewis's view to allow a whole *distinct* from the parts into our picture of existence. There are cat-parts—but we cannot fully understand the world until we admit that there is, in addition, a cat. However, once we have admitted the existence of the cat in addition to the existence of its parts, then the whole-part relation cannot be an identity relation of any ordinary sort. Whatever kind of relation this partial identity is, it is not the kind of identity that would let us say, "There—we've counted all the cat-parts. Now we don't need to count anything else to find out which entities just went up into that tree." Even if the parts in some sense *are* the cat, that sense of "are" cannot be one which excludes the additional existence of the cat.

Lewis's part-whole "identity" relation is not like what we usually call "identity." Antarctica is identical to the southernmost continent on Earth; thus, Antarctica does not exist *in addition to* the southernmost continent on Earth. To be complete, our ontology needs to contain only one of these continents. This is the hallmark of real identity: "two" things are identical if they really are one thing. But if our ontology contains all the cat parts, and those parts are arranged in a catly way, we still have left something out

until we let the cat in. The reality of the parts, plus the fact that the parts are connected in a suitable way, *implies* the reality of the cat. Nevertheless, the parts are not the cat.

The cat-as-a-whole helps us to interpret a certain fact in our experience. I am speaking of the simple and obvious fact that *cats exist.* The reductionist view may be "right" when used solely as a rule of scientific method. For practical reasons, we should try to explain the properties of wholes in terms of the properties of their parts, and often (perhaps always) we can do this. But even if the properties (including behavior) of the cat can be "explained away" in terms of cat parts, we still are stuck with the experienced fact that *there is a cat.* Only the existence of a real cat can make this fact true. If strictly speaking there is no real cat, then there simply is no cat at all—and adding the weasel words "strictly speaking" does not change the impact of the conclusion that *Tabby does not exist.* If we do not want to drop cats from our picture of the cosmos, and embrace a skepticism about cats as total as the skepticism with which Descartes contended, then we must admit that "There is a cat" is true. And once we have admitted this truth, we can assume just enough objects to explain why this fact is true. Only one object will do: a real cat.

The preceding arguments show that Lewis's view of the whole-part relation cannot stand up to the facts of experience and to the demands of logic at the same time. Lewis suggests that we regard the relation between the whole and its parts as a type of identity. This suggestion, if followed, would issue in the view that the whole is the parts, and that there is no whole at all beyond the parts. But we now know that we should not embrace that view. If we do decide that parthood is a kind of identity, we also

must concede that this kind of identity is quite different from what we normally call “identity.” In particular, this identity relation must leave room for the existence of a new object—the whole—as well as the parts. If we believe that Lewis’s whole-part identity relation is like this, then it is not really an identity relation, and Lewis’s position loses force. We can call this relation a very strange kind of identity, or if we prefer, we can call it not quite a kind of identity. But no matter what we call it, it must relate the parts collectively to a whole that exists in addition to those parts. If we count everything that’s up in the tree, we still must count all the cat-parts plus the cat.

Chapter 5.
The Vital Relation

The "parts as whole" view fails to capture some features of the part-whole relation. This failure supports my proposed view of that relation. Earlier I said that people often think wrongly about the part-whole relation. We do not normally think of that relation as a relation between distinct objects, like the other basic relations of physical science. We can see intuitively that spatial and temporal relations are relations between terms that may be distinct. If object A is one mile due north of object B, then A and B are distinct, but are related in a certain way. If event E is one second earlier than event F, then E and F are distinct but are related in another way.[59] If X is a part of Y, then X and Y are related in still another way—but we tend to feel that this is a "special" relation, different from the rest.[60] The spatial and temporal relations normally connect

[59] These examples ignore certain possibilities suggested by the general theory of relativity. In certain extreme examples of curved spacetimes, an object may be one mile north of itself, and an event may even be one second earlier than itself. The examples here hold good in any reasonably "normal" spacetime.

[60] As I mentioned earlier, Lewis characterized "mereological

distinct objects. For the whole-part relation, we feel that the whole is *not distinct* from the parts, that it is *not separate* from the parts. Sometimes we feel that the part-whole relation is not a relation of an object to another object, as much as it is a relation of an object to itself.

These intuitive feelings are inaccurate, but it is understandable that we have them. There is no point in denying that the part is just a piece of the whole, or that the part is not spatially separate from the whole. Spatially, the part is inside the whole (provided that the whole is an object located in space). And as I pointed out earlier, the substance of the whole is just the substance of its parts. The intuition that the whole-part relation is different from ordinary physical relations is well-motivated in this respect.

However, there is another respect in which our unschooled intuitions about wholes and parts go grievously wrong. We are in error if we feel that a whole object isn't anything but its parts. I have spent the last three chapters trying to demolish this seemingly natural view. But there also is another error—one that creeps into much of our thinking about wholes and parts. This is the feeling that the relation between whole and part somehow is *contained in* the whole or the part.

We are not normally aware that we have a feeling of this sort. Probably not everyone has this feeling. But the following thought experiment will show that it is easy to get this feeling if we think just a little about wholes and parts.

Imagine a ham sandwich. Now mentally lift the bread

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relations" as "something special" (*Parts of Classes*, p. 84).

off the top of the sandwich, and move the displaced piece of bread to the opposite side of the room. After this operation, the sandwich no longer exists as a whole; that is, the room contains no object that qualifies as a sandwich. (Of course, one could call what remains an "open-faced sandwich" plus a loose piece of bread, but this is not a sandwich in the strictest sense of the word.) Now bring the piece of bread back across the room, and shove it back down on to the rest of the sandwich. Presto—a sandwich is born.

Ask yourself this question about the last step in this experiment: When we brought the bread and the remaining part of the sandwich back together, what did we have to add to make sure they really formed a sandwich? Answer: Nothing! A sandwich consists of bread and other foodstuffs in a certain combination. And when we say that the top slice of bread is *part of* the sandwich, we are admitting that the top slice of bread, with the other materials, is arranged in a way that creates a sandwich. There is no special tie, no special relation or logical "glue," needed to make the bread part of the sandwich. The bread's being part of the sandwich is a consequence of the make-up of the sandwich—the way the sandwich is arranged. Once we have made up the sandwich, then we do not also need to create an extra *relationship* between bread and sandwich to make the bread part of the sandwich.

This simple kitchen experiment leads us to an interesting finding: the relationship between a sandwich and its parts can seem to be an aspect or facet of the sandwich itself. This relationship between bread and sandwich seems different from other relations, such as *being north of*. For a piece of bread to be north of a

sandwich, the bread and the sandwich must be arranged in a certain way with respect to the Earth (the bread must be closer to the North Pole). But for a piece of bread to be part of the sandwich, the Earth is not required, and neither is any other external object. All one needs is the bread and the sandwich. The relationship seems to be "in" the sandwich, not "outside" of it in the form of an extra, added relation.

This feeling that the sandwich-bread relation is "in" the sandwich is a mild version of an old and honorable philosophical idea. I refer to the traditional philosophers' distinction between *internal relations* and *external relations*.[61] Many philosophers have claimed that there are two kinds of relations. Some relations are "external": that is, things can have them, but they are not "built into" the things that have them. *Being north of* is an example of such a relation; it holds between two objects if those objects happen to stand in a certain relation to the Earth, and not simply because of what the objects are. Another example is the relation of *being older than*; this depends on the time elapsed between the moments when different things begin. The "internal" relations, on the other hand, are relations that are facets of the things themselves—relations that link things because of what the things are, or relations that are "built into" the things they relate.[62] An

[61] This distinction is discussed in (for example) Armstrong's book, *A Theory of Universals*, pp. 84-85.

[62] Armstrong gives a more precise and more adequate definition (*A Theory of Universals*, p. 85).

example might be the relationship between a printed road map and a road shown in the map. The map is a map of that particular road because of the characteristics of the map itself—namely, what is shown on the map. The map is related to the road because of the map's own internal characteristics.

Not all philosophers have believed there is a difference between external and internal relations. Indeed, many twentieth-century philosophers have ignored this difference. I am not going to take up this issue here. This much is clear: normally, *we think of the whole-part relation as if it were an internal relation*. That relation has the psychological "feel" of an internal relation. It seems to hold just because of what the whole is, and not because both whole and part are joined by some third factor, some "external" tie or bond.

The naive view that the relationship between whole and part is internal is one of several ideas that I am challenging in this book. I maintain that the whole-part relation is not internal; it is not just a side effect of what wholes and parts are. My earlier arguments against the identity of a whole and its parts should provide a clue to why I am making this claim. One cannot think of the whole-part relation as internal, because one cannot equate the whole to its parts. Instead, the whole is one object, and the parts are other objects; by arranging the parts correctly, one can *cause* the whole to come into being, but that is not the same as saying that the whole *is* the parts. Certainly the behavior of the whole is strictly regulated by that of the parts; if all the parts are moving east, the whole cannot simultaneously

move west.[63] But the whole is not simply the parts; it is a separate, distinct object, whose existence and properties happen to reflect the state of the parts. Thus the relation between whole and parts is more correctly thought of as an "external" relation between distinct objects. That relation is not a built-in facet of the objects' nature, but is a relation into which two objects may enter as a result of physical circumstances, and which ties those objects together in some way. In this respect, the relation *is part of* is like the relations *is north of*, *is older than*, and *is deeper in the ocean than*. If the relation holds between two things, it does so because those two things are joined or placed together in a certain way. The fact that the relation holds is not simply a side effect of the nature of the things involved.

There is another peculiarity of the external-internal relation distinction that suggests that if that distinction has

[63] Baxter ("Identity in the Loose and Popular Sense," p. 579) notes that there is something wrong with the idea that one can sell all the pieces of a parcel of real estate and still claim to own the parcel itself. Baxter suggests that this example supports the identity of the whole with its parts. But the view I am presenting can handle this example just as well as can Baxter's view. According to my view, the parcel is not identical to all of its pieces collectively. However, the *substance* of the parcel—the land, or earth materials, of which the parcel is composed—is shared out among the pieces. Because of this substance sharing, if one gives away all the pieces of the parcel, one has no land left. Hence the scam artist in Baxter's example, who claims to own the whole parcel and not its parts, is wrong in thinking that he still owns any land. Of course, it is thinkable that the laws of the country in which the land is situated might still allow him some kind of formal ownership of the parcel. But even if this were the case, he would not in fact have any *land* at all.

any force at all, we must put the whole-part relation on the external side of the divide. This is the fact that the whole-part relation, at least for physical objects, involves *space* in an essential way.[64] Most relations involving space—such as *is north of*, *is above*, and the like—seem to be external relations. But the whole-part relation, at least as it applies to physical objects, clearly involves space. A brick cannot be part of a wall unless its position in space is within the boundaries of the wall. This tells us that the whole-part relation cannot hold between two space-filling objects unless the relation of *being spatially within* also holds between those objects. If A is a part of B, then A is inside the spatial boundaries of B. Of course, there is more to being a part than just being on the inside. A brick in a box is inside the box but not a part of it, and a board driven through a tree by a hurricane is not a genuine part of the tree. But a physical object A cannot be a part of another physical object B if A is somewhere else besides where B is. Thus, the whole-part relation for physical objects depends on the presence of an external relation. It cannot be simply a byproduct of the nature of the whole involved, since that external relation is not a byproduct of anything's nature. So the whole-part relation cannot be just an internal relation.

[64] For an argument that this relation does not always involve space, see Armstrong, *A Theory of Universals*, p. 37. But physical objects' parts are related to them spatially in a certain way.

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In Conclusion

In the last three chapters, we began with a look at mereology and went on to do some experiments with wholes and parts. Along the way, we drew several conclusions that will be important in the rest of this book.

The first and most important conclusion is that an object made of parts is not identical to those parts. A brick wall is not just a bunch of bricks—though it is made of bricks. Rather, a composite object is a separate object, additional to and quite distinct from its parts. Of course, the whole is not independent of its parts; it comes into being when the parts are arranged and interconnected in the right way. The whole shares the substance of the parts, and its properties are largely (and perhaps completely) fixed by the properties and relationships of its parts. But this does not imply that the whole *is* its parts.

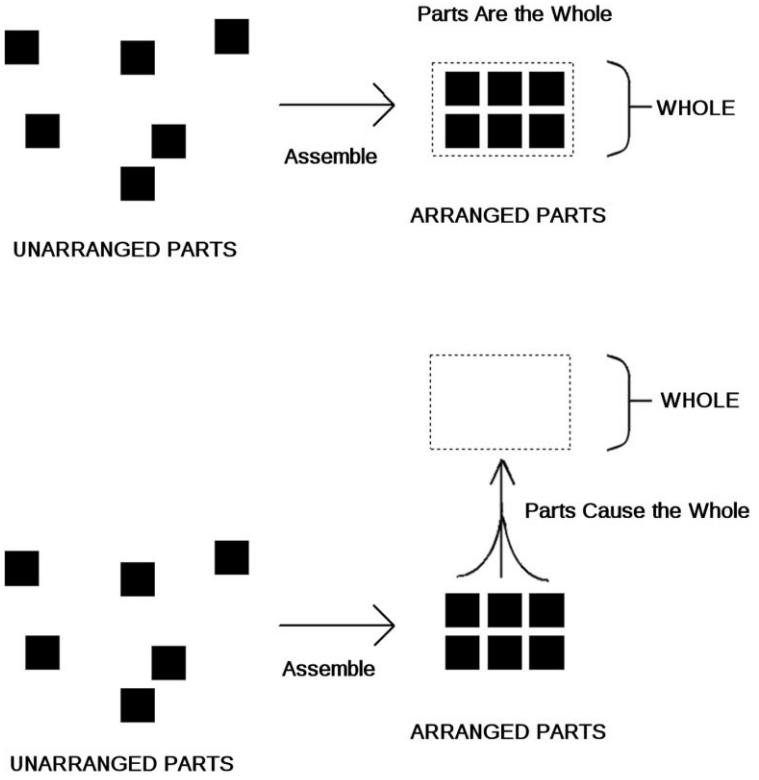
The relationship of parts to whole is not one of identity, but one of *causation*. The parts, by occurring in a particular arrangement and in particular states, cause the whole to come into being. If you start with N parts, and put them together in a suitable way, then (*bam!*) you have N+1 objects on your hands.[70] You create an extra object. This object is not created out of nothing, for all of the substance that makes up the parts also belongs to that extra object. After the extra object comes into being, the substance of a

[70] This is another variation on the comparison of N with N+1 objects that I earlier credited to Baxter ("Identity in the Loose and Popular Sense," p. 579).

part no longer belongs only to that part. Instead, that substance belongs to the part and also to the extra object. The substance is not divided among the part and the extra object. Instead, it belongs in full to both, in an arrangement that a lawyer might call joint ownership.

If one disbands the parts, the whole ceases to exist. As long as the whole exists, the properties of the whole are determined by the properties and relations of its parts. (A holist might amend the last statement to say that many, but not all, of the properties of the whole are determined by the properties of the parts. But the existence of the exceptions would not undo my point.)

To make the new picture of whole and part clearer, I have sketched this idea schematically on the next page, alongside a diagram of the conventional idea of whole and part. Visual metaphors for abstract concepts can be treacherous, but hopefully this drawing may be a little more effective than words in getting my point across. When parts come together to form a whole, something else happens besides the convergence of the parts. Specifically, a new object comes into being—an object that is logically distinct from the parts, and not identical to them in any reasonable sense of identity. This object is the whole. In many respects, it is a product of the parts; the coming together of the parts, in the proper arrangement, gives the whole its existence and its properties. But the whole is not the parts.



Classical (top) and new (bottom) conception of the whole-part relationship. Traditionally, the whole is regarded as being nothing but the parts in a certain arrangement. But it is more logically coherent to suppose that the whole is an object distinct from the parts, which comes into existence when the parts are properly arranged.

Note added later: The lower half of this diagram is meant to suggest that the whole is distinct from its parts, but not that the whole is independent of its parts. Read the text for details.

One consequence of this new picture of the whole is that the relationship between wholes and parts is not what is called an internal relation. The fact that something is a part of some whole is not merely a fact about the make-up of that whole. Instead, it is a fact about a relationship between two distinct objects—analogous to the fact that a certain object is to the north of another, or is older than another.

This picture of the whole-part relationship is radically different from the usual picture. According to the usual picture, the brick wall is nothing but the bricks that make it up, and the human body is nothing but the atoms of which it is composed. Our new view, despite its apparent oddness, is more logically coherent than the traditional view. The view that the whole is the parts raises problems about identity and difference—problems that we cannot solve without some serious fudging of the concept of identity. Also, the usual view makes it difficult to imagine how anything besides tiny particles could exist at all. The new view, that the whole is a separate object and is an effect of the parts, does not have these defects. The new view may seem repulsive to some intuitions and offensive to some philosophical positions. Actually, it comes closer to common sense than does the old view. In ordinary life, everyone assumes that there are brick walls and human bodies, ham sandwiches and planets. The discovery that these items can be broken down into atoms and particles does not lead people of common sense to decide that ham sandwiches don't exist after all. Our "new" view of whole and part agrees with the commonsense attitude that composite objects really exist. The opposing view is surprisingly difficult to reconcile with this attitude.

These considerations support the new picture of a whole distinct from its parts. There also is another, more important consideration: the new picture simplifies some of the major problems of philosophy. Some of the most important traditional philosophical riddles rest on subtle confusions about the whole-part relation. If we reread these problems with the new view of wholes and parts in mind, we will find that the problems look much less puzzling than they did at first. This is what I will do in the rest of the book.

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The Ultimate Reality of All Things

The second and third important points in our new view

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of the universe are ideas that have come up again and again throughout the book. These are the ideas that *wholes are not identical to their parts in any sense*, and that *all wholes are constituents of reality as fundamental and irreducible as the ultimate particles of matter*.

Scientists, philosophers and others sometimes speak as though the universe consisted of elementary particles and nothing else. This idea, which may have existed even before Democritus's view of the universe as "atoms and Void,"[141] crops up again and again in writings about philosophy and science, though usually in disguised or implicit forms. According to our new view of reality, this idea is completely and utterly wrong. If by "the universe" one means "the natural world," then the universe consists of many kinds of objects—not just elementary particles. It includes birds, and icicles, and silver crystals, and galaxies, and human brains—all of which are *just as fundamental*, and just as ultimately real, as the elementary particles. If you want an answer to the age-old question "What kinds of things really exist?", then one obvious answer, "Elementary particles of matter," is wrong. A more correct answer is: *all things*. All objects made of material particles are parts of the irreducible foundation of ultimate reality. All of them are constituents of the world and cannot be equated to simpler or more fundamental constituents. And this is the case *even though all of these things are wholes built up from elementary particles and from nothing else*.

An inventory of the ultimate constituents of reality—of

[141] Democritus, quoted in Freeman (ed.), *Ancilla to The Pre-Socratic Philosophers*, p. 93.

the ontology of the world—would have to include silver crystals, starfish, the Mona Lisa, and galaxies as well as leptons, quarks, and bosons. The doings of the leptons, quarks and bosons may *cause* those other items in the list to come into being. But that does not mean that the other items *are* just leptons, quarks and bosons at bottom, or that the other items are less fundamental or real than the so-called "fundamental" particles.

All this does not lessen the importance of the physicists' quest for the final constituents of matter. This quest, which currently takes the form of the search for a "theory of everything," is an important expression of the human spirit. The success of this magnificent endeavor would immeasurably deepen our understanding of reality, and would provide an answer to another age-old philosophical question: "What is the material world made of?" But no scientific theory can prove that a brain, a flower, or a piece of silver is only elementary particles.

Emergent Properties Again

The fourth major thesis in our new picture of reality is perhaps a corollary of the second and third. It is that *the emergent properties that belong to complex wholes are as real, and as central to reality, as the measurable physical properties of simple material particles.*

This is an important point for several reasons. With the second point, it enables us to find the place of *values* in the natural world. Values, such as goodness and beauty, are emergent properties. A situation or event is good because of its effects on people, and perhaps for other reasons as well. The goodness is not in any one of the elementary

particles that take part in the good situation. Instead, it belongs to the situation as a whole. A flower is beautiful because of the way its parts are arranged. Without that arrangement, there would only be atoms, not a flower. (An atom may be beautiful too, but that is a different kind of beauty, best known to scientists. Presumably, that kind of beauty is emergent as well.) Properties like goodness and beauty depend on the structure of complex wholes. This is not to say that values always are emergent properties; the smallest constituents of matter might, for all we know, have goodness and beauty. (My personal suspicion, which I won't try to defend here, is that they do. At very least, the final mathematical theory that describes these particles is likely to be beautiful.) But the goodness we find in everyday life, or the beauty we find in art and nature, belong to complex wholes. These values, in their present forms, would not be there if the wholes dissolved into particles. Therefore, those values are emergent properties.

One hears it said that the "scientific" view of the world—that of a world built from material particles—leaves no room for values. Our new conception of wholes and parts shows that this claim has no basis in fact. If emergent properties are ultimately real, and values are emergent properties, then values are ultimately real. *The goodness of a compassionate deed is as much a part of fundamental reality as the charge of the electron. The beauty of a wildflower is as much a constituent of the cosmos as the mass of the proton.* A worldview that leaves room for wholes and their emergent properties leaves room for values, which are, at least usually, emergent properties of wholes.

This does not mean that our theory of wholes and parts

can settle any specific moral or aesthetic controversies, either about the natural environment or about anything else. But it can put to rest the old saw that a world made of matter has no room in it for values.

Aesthetic Experience: A Road to Truth

This conception of value has another important consequence for our understanding of human experience and its relation to the world. This has to do with the nature of *aesthetic experience*. By "aesthetic experience," I mean experience centered on emotions and feelings produced by something a person is observing. This type of experience includes perceptions of beauty, such as the feelings produced by art and nature. However, it also includes other feeling-centered experiences that may not fall directly under the heading of "beauty." For example, there is the sensation of mystery that one sometimes has in the presence of a lowering dark sky. There is the distinctive sensation of "farawayness" that accompanies certain summer days. There is the unique emotional tone that one sometimes feels around *trees*—a tone different from the one that one feels around, say, flowers or grass. And there is the feeling, caused by some works of art, that there is more in the artwork than one sees—a feeling that one is about to discover something that is not visible at first glance. All of these subtle and elusive feelings are examples of aesthetic experience.

There is a common belief that aesthetic experiences are subjective—that they are "in the eye of the beholder," as the familiar saying about beauty goes. Many people think of aesthetic experience as something that lies entirely in the

mind of the observer, and does not accurately reflect any feature of the external world. According to this view, experiences of physical properties, like the size and weight of an object, may yield real knowledge about external objects, but experiences of beauty and emotional tone cannot. Those who hold this view believe that aesthetic feelings and experiences can tell us about our own states of mind, but not about things out there in the world. Real knowledge, on this view, comes from science, and perhaps from philosophy and theology, but not from art. The arts, it is believed, can reveal beauty, cause enjoyment, and even communicate ideas, but cannot supply us with any new truths or knowledge, except for some knowledge that we could obtain by other means. This view, at least in its simplest and less reflective forms, seems to be very widely held. Critics and philosophers have proposed more elaborate versions of the idea, arguing for example that poetry can have an "emotive" function but cannot reveal truths about the world as science can do.[142]

If aesthetic qualities are ultimately real, then this last view is wrong. Aesthetic experiences *do* teach us something new about reality—something that neither science nor philosophy can discover or verify. The

[142] I. A. Richards made a claim of this general sort. Richards's views are discussed briefly in the articles "Belief, Problem of" and "Pseudo-statement" in *Encyclopedia of Poetry and Poetics* (Preminger, ed.). Various ideas on poetic truth, and on the question of whether poetry can reveal or convey truth, are discussed in the following articles in that reference volume: "Belief, Problem of"; "Meaning, Problem of"; "Criticism" (especially pp. 161-162); "Poetry, Theories of".

qualities of feeling that we find in our aesthetic experiences are *real features of the world*—emergent features that are not reducible to the physical properties of material particles. And since emergent properties belong to ultimate reality (as we saw in earlier chapters), aesthetic experience is a form of experience of ultimate reality.[143]

There is an obvious rebuttal to the claim that the aesthetic qualities of the world are real. This comes from the fact that different observers get different experiences when observing the same object. This common observation is the root of the saying that "beauty is in the eye of the beholder." But actually, this does not contradict the reality of aesthetic qualities at all. This observation simply shows that an object can have more than one set of aesthetic qualities, and that an observer who interacts with the object may find any one (or more) of these sets of qualities. A poet who sees beauty in an apple tree is finding a particular set of aesthetic qualities in the tree.[144] Another poet may find different aesthetic qualities, seeing

[143] Some philosophers, including some Platonists, have regarded art as affording contact with ultimate reality (see, for example, the article "Platonism and Poetry" in Preminger (ed.), *Encyclopedia of Poetry and Poetics*). Most such philosophers seem to regard ultimate reality as something external to, or distinct from, the visible and tangible natural world. On my view, the natural world is ultimately real (whether or not anything else is), and the ultimate reality with which aesthetic experience connects us may lie entirely within that world. [part of footnote omitted]

[144] Those familiar with my previous writings may find this apple tree example familiar too.

the same tree as imposing rather than simply as beautiful. What the poet finds in the tree depends on the poet's state of mind—but that only shows that the tree has a diversity of aesthetic qualities, and that different qualities are obvious to observers in different mental states.

Aesthetic perceptions of external objects arise from the brain's interpretation of sense data. But the fact that aesthetic knowledge of the apple tree depends on sensations of the apple tree does not contradict the fact that the tree's aesthetic qualities are objectively real and extramental. The perception of the rectangular shape of a wooden door depends on the brain's interpretation of sensory information—but that does not change the fact that the door is rectangular. And the fact that this perception depends on the observer's mental state (if one is drunk enough, one may see the door's sides as a rhombus instead of a rectangle) does not imply that the door is not really rectangular. Similarly, aesthetic perception can reveal real qualities in objects, even though such perception depends on one's mental state and on one's reactions to sensations.

The observer-dependence of aesthetic perception is analogous to what happens when one photographs an apple tree through several different kinds of colored filters. What colors one finds depends on what instrument one uses to photograph them—yet from a physicist's perspective, all the colors of light that one can photograph really are there. The poet's mind may filter out some of the emotional "colors" of experience and record only one set of emotional tones. Another poet may record different tones. Yet all of these feeling "colors," or aesthetic qualities of the tree, are

equally real.[145]

Aesthetic experience is not simply a matter of enjoyment. It also is a *cognitive* process—a process of learning, in which we find facts of a special sort. The poet who sees beauty in an apple tree learns something new about the tree. This learning is not merely metaphorical; the poet actually learns *new facts* about the tree—facts that scientific methods cannot disclose. These are facts about certain aesthetic qualities—tones of feeling, or emotional "colors"—latent in the tree. Which of these tones one finds depends on one's state of mind. But these qualities are not "merely psychological," since they depend on the tree as well as on the poet's state of mind. Perhaps we should think of them as *potentialities* of the tree—products of the tree's ability to produce certain inner changes in an observer. Whatever they are, they are real emergent properties (perhaps relational properties) of the tree.

The idea that aesthetic experience yields knowledge of reality is not a new one. I wish to stress that I did not invent this idea. The view that aesthetic experience yields a special knowledge of reality is deeply embedded in the history of human thought. It crops up at many points in that history, from Platonism to the views of some modern poets, artists and critics.[146] Throughout most of humanity's

[145] Popular wisdom recognizes the parallels between emotional perception and seeing through colored glass. This insight lies behind the familiar expression "looking at the world through rose-colored glasses."

[146] Many of these views are mentioned in the above-cited articles in the *Encyclopedia of Poetry and Poetics* (Preminger, ed.). The relations between Platonism and poetry are described particularly in the

existence, people have recognized that art is a path to truth. Only in recent times have we largely forgotten this fact, under the influence of the so-called scientific worldview. Yet this fact is compatible with all that science has discovered. Nothing in the idea of aesthetic truth can contradict any of the claims of science. Aesthetic knowledge is gained through feeling experience, not through sensation and thought alone. Aesthetic knowledge does not deal with the same facts that concern science; therefore it cannot conflict with scientific knowledge. Yet aesthetic experience explores the inner nature of reality as deeply as do the discoveries of modern physics.

Some philosophers, notably some of the Platonists, have regarded art as affording contact, not only with reality, but also with the ultimate reality behind the visible world.[147] This is more or less the view that I am trying to revive here, but I want to give this view a new twist. Proponents of this view often regard ultimate reality as something purely spiritual—that is, something transcending the visible world, or lying outside the world of things made of material particles. On my view, the world made of matter *is* ultimate reality—or at least is one part or sector of that reality. The ultimate reality with which aesthetic experience connects us lies within the natural world, not outside it. Yet despite this, the realities we discover through aesthetic experience do belong to a different order

articles "Poetry, Theories of" and "Platonism and Poetry."

[147] See the article "Platonism and Poetry" in the *Encyclopedia of Poetry and Poetics* (Preminger, ed.).

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