As we will see shortly, the claim that a part is the measure of the whole can come in a stronger and a weaker version. It may mean that all the parts together make up the whole. That is to say, that the sum of parts measures the whole. Or it may mean that one part can measure the whole in the sense that a number of things having the *same* measure as the part exhaust the whole. According to the weaker version, the ten has the two and the eight as parts, because the two and the eight make up the ten. According to the stronger version, the two is a part because if you take the two five times you can exactly measure the ten. But the eight is, in this stricter sense, not a part, because it is not a divisor of the ten.

For our purposes, however, it is most important that both of these senses are senses of what it is to be a part:

We call a part (1) that into which a quantity can in any way be divided; for that which is taken from a quantity qua quantity is always called a part of it, e.g. two is called in a sense a part of three. (2) It means, of the parts in the first sense, only those which measure the whole; this is why two, though in one sense it is, in another is not, a part of three.[142] (*Metaph.* V.25 1023b12–17)

These characterization of parts, especially the second, have, of course, their primary application in the field of mathematics.[143] But, as I said, for our purposes it is most important that boundaries are in neither of these two senses parts. Thus, in denying that boundaries are parts the notion of 'part' must be understood in either of these two formulations.[144] Choosing the weaker formulation, a part, if taken away from the object, makes the whole smaller and, if added to the whole, makes the whole bigger. It is convenient to think of parts in this sense as pieces of matter that can be taken away from the whole magnitude. A material and extended object is made up of its parts in the sense that the matter or extension of the parts makes up the matter or extension of the whole. If we take all the parts of an object, then the sum of the parts measures the whole. The whole is neither bigger nor smaller than the sum of its parts. The whole must be composed of (*συγκεῖσθαι ἐκ*) the parts, as Aristotle says in *Physics* IV.10.[145]

But it is precisely this requirement, that the parts compose the whole, that boundaries do not satisfy. In other words, it is impossible to construct lines out of points,

[142] *Μέρος λέγεται ἕνα μὲν τρόπον εἰς ὃ διαιρεθείη ἂν τὸ ποσὸν ὁπωσοῦν (ἀεὶ γὰρ τὸ ἀφαιρούμενον τοῦ ποσοῦ ᾗ ποσὸν μέρος λέγεται ἐκείνου, οἷον τῶν τριῶν τὰ δύο μέρος λέγεταί πως), ἄλλον δὲ τρόπον τὰ καταμετροῦντα τῶν τοιούτων μόνον· διὸ τὰ δύο τῶν τριῶν ἔστι μὲν ὡς λέγεται μέρος, ἔστι δ' ὡς οὔ.*

[143] Thus, it comes as no surprise to find the second definition listed in Euclid: 'A magnitude is a part of another magnitude, the lesser of the greater, when it measures the greater' (Euc. V Def. 1).

[144] It is, of course, possible to understand 'part' in another sense such that boundaries would count as parts. My argument here is not a lexical point. Rather I want to show that there is an important difference between magnitudes and their limits when we consider questions of composition.

[145] This has led commentators to believe that Aristotle relies on what is nowadays called the principle of super-additivity. Cf. Skyrms 1983. White doubts that this is a good interpretation of Aristotle 'because of the lack of adequate means in antiquity for formulating anything like the principle' (White 1992, 9). Formulating the principle would involve 'extending the notion of addition to cases involving an infinite number of addenda' (White 1992, 9). But, as White points out, there is little evidence that Aristotle had this extension.

surfaces out of lines, or bodies out of surfaces.[146] As Aristotle notes with respect to points and lines:

It is absurd that a magnitude should be constituted from non-magnitudes.[147]
(*GC* I.2 316b4–5)

Notice that Aristotle again relies on the idea that an object is composed by (expressed with a singular 'ἐκ' this time) its parts. The sum of the parts has the same measure as the whole. Since it is impossible that a whole is constituted by parts of lower-dimensionality, lower-dimensional items are not parts. These considerations suggest the following two propositions:

Proposition 19. *If x and y are magnitudes, then: if x is a part of y and y is an n-dimensional magnitude, then x is an n-dimensional magnitude.*

Proposition 20. *If x and y are magnitudes, then: x is a part of y only if x is not a boundary of y.*

If this is correct, it suggests an answer to the question why Aristotle can say that everything that comprises an object lies within its boundary. 'Everything' refers to any part of the object one may 'take'. But one cannot 'take' just the boundary of an object. Boundaries are not independent parts of an object. Whatever you take of the object is itself extended in the same number of dimensions as the object.

6.4. The Matter of Body

Aristotle calls the limit of a body its form. Similarly, he calls its interior or extension its matter. In this section I will discuss the question: What is extension? A good starting point for this question is found in Aristotle's discussion of place:

Now if place is what primarily contains each body, it would be a boundary, so that the place would be the form or shape of each body by which the magnitude, and the matter of the magnitude, is determined; for this is the boundary of each body. If, then, we look at it in this way the place of a thing is its form. But, if we regard the place as the extension of the magnitude, it is the matter. For this is different from the magnitude: it is what is surrounded and determined by the form, as by a surface and boundary. Matter and the indeterminate is of such a kind; for when the boundary and attributes of a sphere are taken away, nothing but the matter is left.[148]
(*Ph.* IV.2 209b1–11)

[146] I will review the arguments that Aristotle presents for his conclusion in Section 6.4.5.2.

[147] *ἄτοπον ἐκ μὴ μεγεθῶν μέγεθος εἶναι.*

[148] *εἰ δή ἐστιν ὁ τόπος τὸ πρῶτον περιέχον ἕκαστον τῶν σωμάτων, πέρας τι ἂν εἴη, ὥστε δόξειεν ἂν τὸ εἶδος καὶ ἡ μορφὴ ἑκάστου ὁ τόπος εἶναι, ᾧ ὁρίζεται τὸ μέγεθος καὶ ἡ ὕλη ἡ τοῦ μεγέθους· τοῦτο γὰρ ἑκάστου πέρας. οὕτω μὲν οὖν σκοποῦσιν ὁ τόπος τὸ ἑκάστου εἶδός ἐστιν· ᾗ δὲ δοκεῖ ὁ τόπος εἶναι τὸ διάστημα τοῦ μεγέθους, ἡ ὕλη· τοῦτο γὰρ ἕτερον τοῦ μεγέθους, τοῦτο δ' ἐστὶ τὸ περιεχόμενον ὑπὸ τοῦ εἴδους καὶ ὡρισμένον, οἷον ὑπὸ ἐπιπέδου καὶ πέρατος, ἔστι δὲ τοιοῦτον ἡ ὕλη καὶ τὸ ἀόριστον· ὅταν γὰρ ἀφαιρεθῇ τὸ πέρας καὶ τὰ πάθη τῆς σφαίρας, λείπεται οὐδὲν παρὰ τὴν ὕλην.*

We are already familiar with this passage from the discussion of limits. There I argued that 'form' has to be understood as the topological limit of a body. It is what topologically defines the body. Now I want to turn to what Aristotle calls 'matter'. The matter, Aristotle says, is what is contained by the form. In this sense, matter is the extension or interior of the object.

6.4.1. Two meanings of 'matter' distinguished

Before I come to a discussion of extension or matter, we need to make a distinction similar to the distinction we made with regard to the notion of form. As I said, what Aristotle calls 'matter' should be understood as the extension of an object. Calling the extension 'matter', however, is potentially misleading because it might make us believe that extension is the matter of ordinary objects in such a way that ordinary objects are *made out* of extension. According to Aristotle, the matter of a brazen sphere is bronze and not extension. The extension of the brazen sphere is, as I will argue, a feature of the bronze of the sphere.

Part of the reason why Aristotle calls the extension 'matter' might come from the immediate context of the quotation from *Physics* IV.2. As a matter of fact, Aristotle ascribes to Plato the position that the extension is literally the matter of objects. For, Plato argued in the *Timaeus* that the extension of the object is its ultimate matter.[149] The matter of a brazen sphere, according to Plato, is ultimately the extension of the sphere. Aristotle explicitly mentions this view:

> This is why Plato in the *Timaeus* says that matter and space are the same; for the 'participant' and space are one and the same thing.[150] (*Ph.* IV.2 209b11–13)

Thus, from Aristotle's perspective, Plato thought generally that the matter of something is its extension.[151] Although Plato might agree that the bronze is the matter of a brazen sphere at one level of analysis, ultimately extension is most properly regarded as the matter because it is the ultimate subject of predication. But, as I said, this is not a position that Aristotle took. Aristotle did not believe that extension is the matter of a brazen sphere. The matter of a brazen sphere is bronze. If matter is that out of which something comes into being,[152] then the matter of a brazen sphere is bronze. According to Aristotle, nothing comes into being from extension.

Nevertheless, I think that calling the extension 'matter' is not solely due to the dialectical context. For, in the passage in *Physics* IV.2 Aristotle speaks of magnitudes.

[149] Cf. Pl. *Ti.* 48e–53c.
[150] *διὸ καὶ Πλάτων τὴν ὕλην καὶ τὴν χώραν ταὐτό φησιν εἶναι ἐν τῷ Τιμαίῳ· τὸ γὰρ μεταληπτικὸν καὶ τὴν χώραν ἓν καὶ ταὐτόν.*
[151] I will not go into the question whether this ascription to Plato is correct or not. For our purposes it suffices that Aristotle thought that Plato did believe those things. Generally speaking, I think that Morison successfully argues that 'Aristotle is absolutely right to say these things' (Morison 2002, 113). For his discussion cf. Morison 2002, 113–19.
[152] *Ph.* I.9 192a31–32.

Qua magnitude, the brazen sphere is a composite of a boundary and extension. That is to say, insofar as the brazen sphere is considered as a quantitative body its topological limit can be called its form and the extension its matter. To quote Mendell again:

> Crucial to a proper understanding of Aristotle's remarks is that the matter of which he speaks is not matter in the ordinary sense of the matter of a physical body. The passage is quite clearly drawing a contrast between the matter and the form of solid magnitude, i.e. of mathematical bodies. Matter here is the extension of a mathematical body. (Mendell 1987, 213)

For reasons given above,[153] I am reluctant to call it a 'mathematical' body, but Mendell is certainly right that Aristotle is not speaking about ordinary matter here.

That Aristotle is willing to apply the language of matter and form with regard to magnitudes is also suggested by his discussion of the infinite in *Physics* III.4–8.[154] Similarly, 'body' in the context of *Physics* IV.2 might very well refer to physical substance *qua* extended. The form–matter contrast in the sense of limit and extension does not apply to a physical substance *qua* such, but rather to the physical substance *qua* extended and movable body. Neither is the limit the form of a physical substance as such, nor is the extension the matter of a physical substance as such. Rather, the limit is the form and the extension the matter of extended magnitude as such. Thus, some scholars have argued that Aristotle's theory of place addresses in general the question what belongs to physical magnitudes *qua* movable and extended entities.[155] If we accept that Aristotle calls the limit of a body its form, we may similarly accept that he calls the interior its matter. This is a terminological point and, as long as we keep these two senses of matter distinct, there is no threat of confusion.[156] This, then, is the important difference to Plato. Whereas Plato believes that extension is the matter of a physical substance, Aristotle thinks it is the matter of a magnitude.[157]

This, however, raises what is, in my opinion, the real question: why Aristotle calls extension 'matter' at all. The answer is, as I will try to show, that the extension of an object has, according to Aristotle, features that bring it close to matter. In particular, the extension is akin to ordinary matter in being indeterminate and, moreover, extension is an abstraction from ordinary matter.

[153] See Section 6.3.2.2.
[154] See especially *Ph.* III.6 207a21–26. On the notion of magnitude involved in the discussion of the infinite see Hussey 1983, 73.
[155] On this point see Mendell 1987, 2005 and Hussey 1983, 73 and 104.
[156] Some interpreters do not keep these two senses of matter distinct. They employ the following line of argument. The passage in *Physics* IV.2 is close to the argument in *Metaphysics* VII.3. But in *Metaphysics* VII.3 Aristotle wants to discuss *his* version of prime matter. Prime matter in *Metaph.* VII.3 is extension, hence in *Physics* IV.2 Aristotle speaks of prime matter. Such an argument can be found, e.g. in Studtmann 2004; Sokolowski 1970. Each step of this argument can, as I have argued in Section 6.2.2, be challenged.
[157] As we will see in Sections 6.4.4.1 and 6.4.4.2 there is another important issue. For Aristotle the extension depends on the physical substance whose extension it is. Plato, by contrast, appears to have believed that extension is, in a sense, ontologically independent of the object, although, admittedly, Plato's account of the receptacle in the *Timaeus*, or Aristotle's understanding of it, is not clear on this point. For recent interpretations see Harte 2002; Johansen 2004; Sattler 2012; Beere 2016.

6.4.2. *An account of extension*

Before I address these questions, it is necessary to give a preliminary account and characterization of extension. Aristotle's characterization of the matter of bodies in the already quoted passage in *Ph.* IV.2 suggests a first answer. Aristotle says that place might be thought:

> to be the extension of the magnitude, the matter. For this is [i.e. the extension of the magnitude] is different from the magnitude; this is that which is surrounded and determined by the form, as by a surface and limit.[158] (*Ph.* IV.2 209b6–9)

We can ignore here why matter and extension might be thought to be the place of a thing. For our purposes, the assertion that the extension is what lies within the boundaries and as such must be distinguished from the body or magnitude is important. The extension or interval of a thing is that which is surrounded by and enclosed by the form and thereby given it its specific shape. In this sense, the extension of a sphere is the interior of the sphere. It is what lies between the limits.

This connects with the general meaning of 'interval or extension (διάστημα)'. It means generally an interval between two things, as for example the interval between two fingers.[159] More specifically, in Euclid this is the technical notion for the radius:[160]

> Let the circle BCD with centre A and radius AB have been drawn.[161] (Euc. I.1)

This use of *diastema* is, I believe, very close to the more general usage we find in Aristotle. Euclid's use in the sense of 'radius' can be seen as a derivation of Aristotle's broader use. I think that Aristotle's conception is broader because for Aristotle a line is not identical to a certain extension. Extension is what lies between the limits and is bounded by them. If this conclusion can be established, one can see nonetheless that roughly the same conception is at work in the case of a radius in Euclid. In the case of a radius the extension is the length of the radius. According to Aristotle, the radius is a line which has an extension. The interval is the extension of the line, but it is not identical to the line. According to Euclid, the interval *is* the radius. The distinction between the radius, which is a line, and the extension of the radius is ignored. How could that happen? Though I do not intend this to be a *historical* explanation, I think that *conceptually* the following explanation is possible: there is a sense in which *both* the radius and its extension are bounded by the limit points.[162] The line that is the radius is defined by its limits, with one limit being the centre point of the circle and the other point lying on the circumference. The extension of the radius is, however, bounded by these limit points, too. Yet, the relation the line bears to its limit points is

[158] *ᾗ δὲ δοκεῖ ὁ τόπος εἶναι τὸ διάστημα τοῦ μεγέθους, ἡ ὕλη· τοῦτο γὰρ ἕτερον τοῦ μεγέθους, τοῦτο δ' ἐστὶ τὸ περιεχόμενον ὑπὸ τοῦ εἴδους καὶ ὡρισμένον, οἷον ὑπὸ ἐπιπέδου καὶ πέρατος.*

[159] For the following remarks see Liddell et al. 1996 s.v. *diastema*. Cf. also Morison 2002, 108–9.

[160] Cf. Fitzpatrick 2007, 541. Also Liddell et al. 1996 s.v. *diastema*.

[161] *Κέντρῳ μὲν τῷ Α διαστήματι δὲ τῷ ΑΒ κύκλος γεγράφθω ὁ ΒΓΔ.*

[162] Aristotle is aware of this subtle distinction. Cf. *Ph.* IV.2 209b2–6.

distinct from the relation the extension has to these limit points. A line is a composite of limit *and* extension. A line, so to speak, is identical to a certain extension with limit points. On the other hand, the extension *qua such* is unbounded. The extension is bounded by the limit, too, but is distinct from the whole magnitude and the limit. Ben Morison uses the example of the skin to make that distinction clear:

> My skin is my boundary, but also the boundary of all that it encloses. (Morison 2002, 107)

What is enclosed by my skin is my interior. But I am not identical to that interior. Topologically speaking, I am the interior and the skin. This is a subtle, but crucial, distinction.

Be that as it may, it becomes clear, I believe, from Aristotle's other remarks that the extension of a magnitude is conceived as that which literally extends between the limits.

> I say that the length of it [*sc.* the cosmos] is the extension between the poles, one pole being above and the other below.[163] (*Cael.* II.2 285b8–10)

The length of the cosmos is the extension between its poles. The poles are points of a sphere. They lie on the surface of the cosmos and thus bound the cosmos.[164] Generally, an interval or extension is that which lies between the extremes.[165] And in the case of spatially extended objects the extension is what lies between the topological limits. Any magnitude can be conceived of as a form–matter compound: It has a limit, its topological form, and matter, its extension.[166]

Proposition 21. *The extension of a magnitude is that which is bounded by the limits of the magnitude.*

6.4.3. *Why is the interval indeterminate?*

The extension, then, is what lies between the limits of the magnitude. One feature that warrants calling the extension 'matter' is that extension is, as Aristotle says, indeterminate. What does that mean? I will argue that extension *qua* such is indeterminate because it is not tied to any particular shape. The same extension can acquire different shapes. Extension, thus understood, is defined solely by its amount of quantity.

The claim that the extension is indeterminate might—in view of the fact that Aristotle calls the extension 'matter'—seem natural. Matter is generally characterized

[163] *Λέγω δὲ μῆκος μὲν αὐτοῦ τὸ κατὰ τοὺς πόλους διάστημα, καὶ τῶν πόλων τὸν μὲν ἄνω τὸν δὲ κάτω·*

[164] Accordingly, a body is defined by being extended in all three directions. A body is what is extended length-wise, breadth-wise, and depth-wise. Cf. *Ph.* IV.1 209a4–6; *Ph.* III.5 204b20.

[165] *Ph.* IV.4 211b7–8; *Metaph.* X.5 1056a36.

[166] The closest Aristotle gets to a more formal account of extension is the following passage in *De Caelo*: 'I say that the extension of the lines is that outside which no magnitude can be taken which is in contact with the lines' (*Cael.* I.5 271b30–32). However, as the context of the passage suggests, Aristotle speaks of an extension that lies between two lines. Cf. Simp. *In Cael.* 204.8ff. In this sense, Aristotle is not defining the extension of a single magnitude, but rather the extension between two magnitudes.

as 'formless (*ἄμορφον*)' (*Ph.* I.7 191a10). If extension is akin to matter, it is reasonable to assume that it is, in a sense to be specified, formless, too. Aristotle picks up this characterization of matter in the already quoted passage in *Physics* IV.2:

It is what is surrounded and determined by the form, as by a surface and boundary. Matter and the indeterminate is of such a kind; for when the boundary and attributes of a sphere are taken away, nothing but the matter is left.[167] (*Ph.* IV.2 209b7–11)

Extension and matter are both formed by something. The extension is similar to matter in the sense that it is *qua such* unformed and indeterminate. But, as Aristotle explains in the *Physics*, matter is unformed relative to something. The bronze *qua* matter is unformed relative to the brazen statue and the wood is unformed relative to the wooden bed.[168] Thus, to say that the extension is unformed is as such not informative. Relative to what is extension unformed? The answer must be that extension is unformed with respect to its form, the topological limit. The relation of extension to the topological limit is comparable to the relation between the wood and the bed, or the bronze and the statue. Consider a brazen sphere. If the limit of the sphere is taken away, what are we left with? Just some bronze. The bronze is still three-dimensionally extended, but it has no definite shape or size. It has indeterminate extension.

To be sure, in the quote above Aristotle alludes to the idea of *pure* extension when he writes that the 'attributes' are taken away.[169] This, however, involves a distinct type of abstraction. I will argue that extension *qua* such is an abstraction from ordinary matter. For now, we can set this aside. We merely want to know how something could be indeterminately extended.

This is also how I am inclined to understand Morison's remark:

Consider the sentence 'the shape of that ball is a sphere' (as opposed to 'that ball is a sphere'). If you take the shape as the thing which is a sphere (and hence spherical), and the ball as being a sphere derivatively, in virtue of having that shape, then since the shape is a sphere, it must be something spherical, namely, spherical interval or extension. On this way of thinking, extension itself is considered as that which is extended as a sphere. But in that case, extension is being considered as something indeterminate, to which form or shape is added to yield something determinate. (Morison 2002, 109)

The important insight is that if we conceive a body as a matter–form composite and identify the form with the topological limit and the matter with extension, the extension *qua* such does not have a limit. But being without a limit does not mean that it is infinite.[170] If one takes away the boundary of a surface, one is left with an area or

[167] *τοῦτο δ' ἐστὶ τὸ περιεχόμενον ὑπὸ τοῦ εἴδους καὶ ὡρισμένον, οἷον ὑπὸ ἐπιπέδου καὶ πέρατος, ἔστι δὲ τοιοῦτον ἡ ὕλη καὶ τὸ ἀόριστον· ὅταν γὰρ ἀφαιρεθῇ τὸ πέρας καὶ τὰ πάθη τῆς σφαίρας, λείπεται οὐδὲν παρὰ τὴν ὕλην.*
[168] Cf. *Ph.* I.7 191a8–12.
[169] On this point see Hussey 1983, 104.
[170] A mistake made by Studtmann 2004. Cf. my discussion in Appendix A.

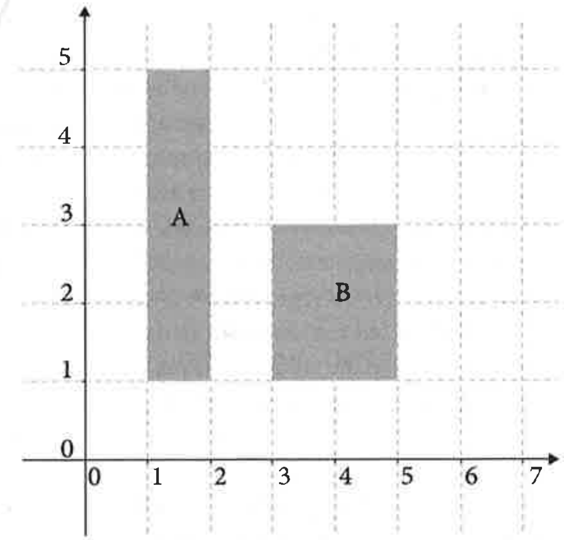

Fig. 6.3.

two-dimensional extension which has the same size as the surface.[171] The difference between an area, that is, the extension of a surface, and the surface is, first, that the area corresponds to an open object and, second, that it is not tied to any specific shape. It is a 'bare' quantity which could be any shape. This explains why it is apt to call the extension indeterminate.[172]

Proposition 22. *The extension is indeterminate because it has no definite shape. It is a quantity in the sense of an amount. Extension is a length or area or volume.*

The extension is indeterminate relative to a specific shape. A body, a surface, or a line are defined by their limits. A surface is defined by its limits, the lines that bound it. The extension of the surface, its area, is *as such* indeterminate relative to various topological configurations it might have. A square with sides of two feet in length and a rectangle with a side of one and a side of four feet in length are distinct surfaces. But they have the same extension. They are areas of the same size. Both are areas of four square feet.[173]

Let us suppose that the rectangle A is transformed into the square B (Fig. 6.3). Its shape has changed. It has acquired a new shape. But the extension has remained the same. Both surfaces have the same area or extension.

[171] This is a consequence of the claim that boundaries are not a part because they do not measure the whole. See Section 6.3.4.3.
[172] Admittedly, Aristotle never explicitly says this. I offer additional support of my interpretation in my discussion of *Metaphysics* V.13 in Appendix A.
[173] Notice that I speak of the extension as a particular. There are literally *two* areas of four square feet. The boundaries make the extension determinate, but not particular. I will address this issue in Section 6.4.4.

Thus, I believe that the following comparison is apt: the bronze as such is indeterminate and without a form relative to the statue. *Qua* bronze it is essentially neither a herm nor a bust of Socrates. Both the herm and the bust of Socrates are defined by their forms. If the form is taken away, nothing but some bronze remains. The bronze, however, is indeterminate not with respect to being bronze. It is perfectly identifiable as some bronze, though it is not identifiable *qua* a bust of Socrates. The case of a quantitative body is similar. The extension as such is indeterminate and without a form relative to a specific body. *Qua* extension it is not essentially a cuboid of a certain type. A cuboid is a body that is defined by its form, by the surfaces that are its limits. If the boundary is taken away, nothing but the extension remains. The extension, however, is not indeterminate with respect to the volume. It is perfectly identifiable as a certain volume, though it is not identifiable *qua* being a certain cuboid.

6.4.4. *The ontology of extension*

The characterization of extension that I have given above does not commit us to a specific view on the ontology of extension. The extension of an object is what lies between the limits of the object. It is the length, breadth, and depth of an object. But what is the ontological status of these? The question is not trivial, as one might have supposed. Consider a golden sphere. What lies between the limit, the surface of the sphere, is—at first sight—gold. But gold is not the extension of the sphere. The extension is rather, one might say, the volume that the golden sphere occupies. The sphere is made of gold, and this gold occupies a certain volume. To put it sightly differently, the extension of the sphere is the space the sphere occupies. This, I believe, is a way of thinking about extension that would be accepted by many modern-day philosophers. This way of conceptualizing the extension allows for a sharp distinction between the matter, that which an object is made of, and the extension, the space the object occupies. The fact that Aristotle calls the extension 'matter' would, according to this view, be either a case of mere homonymy or a case of serious confusion on Aristotle's part. The space the object occupies is not a constituent part of the object, and hence it should not be called 'matter'. To call it 'matter' nonetheless would be a highly misleading way of putting it.

However, as attractive as this view might be for us today, it is not Aristotle's. The extension of an object cannot be the space the object occupies, because for Aristotle there is no space independent from the object. Space, as it is often conceived of today, is independent and separable from the object. If the object moves somewhere else, it is possible for another object to occupy the same three-dimensional region. It seems to be part of the logic of occupiable regions that they are separate from the objects that occupy them.

One might claim instead that the extension of an object is literally the matter of that object. Thus, the ultimate matter of an object would be akin to space, although 'space' in this sense would not be separate from the objects. But as I have said above, this is part of a Platonic theory (or Aristotle's interpretation of it), and not Aristotle's.[174]

In what follows I shall argue that the extension of an object is, according to Aristotle, a feature of the object. The extension of an object cannot be identified with the space the object occupies (if the space is seen as independent). But this does not commit Aristotle to the view that extension literally *is* the matter of the object. The extension or interval of an object can be seen as the ordinary matter of the object considered in an abstract way. In this sense, the extension or the matter of a body is a logical abstraction from the ordinary matter of a physical substance.

6.4.4.1. INDEPENDENT AND DEPENDENT EXTENSION

Aristotle emphasizes in several places that there is no extension or *diastema* over and above the bodies. The assumption is most prominently rejected in *Physics* IV.4 211b14–29. Aristotle's argument there is difficult to understand.[175] Though the details of Aristotle's arguments are obscure, the trend of Aristotle's argument is that the assumption of an independent *diastema* would commit us to an infinite proliferation of places (which seems the point of *Physics* IV.4) or to the theory that there is a void (which is the point of *Physics* IV.6). The conceptual connection between these two points is the thought that independent extension can either be the place of a thing, if it is occupied, or be void, if it is currently not occupied. Thus, Aristotle remarks:

> For, those who hold that the void exists regard it as a sort of place or vessel which is thought to be a plenum when it holds the bulk which it is capable of rceieving, and void when it is deprived of that—as if void and plenum and place were the same thing, though their being is different.[176]
>
> (*Ph.* IV.6 213a15–19)

And a little later he expands on that:

> But people really mean by void an interval in which there is no perceptible body.[177]
>
> (*Ph.* IV.6 213a27–29)

If we take these two passages together, we see that Aristotle was familiar with a theory akin to the theory of occupiable regions that I mentioned above. Aristotle is familiar with philosophers who believe that there is an extension that is independent

[174] I follow Morison 2002, 103–19 here. For a discussion of such theories in later antiquity see Sorabji 1988. Note that I deliberately say 'part of a Platonic theory' because Plato and Aristotle differ both on the question whether extension is the matter of an object and on the question whether it is independent of the object. As I said, the latter question is very difficult to assess. But is seems clear that, at least from Aristotle's perspective at least, if something is the matter of an object it cannot be separate.

[175] Cf. Morison 2002, 121–32 for a detailed analysis of the argument.

[176] *οἷον γὰρ τόπον τινὰ καὶ ἀγγεῖον τὸ κενὸν τιθέασιν οἱ λέγοντες, δοκεῖ δὲ πλῆρες μὲν εἶναι, ὅταν ἔχῃ τὸν ὄγκον οὗ δεκτικόν ἐστιν, ὅταν δὲ στερηθῇ, κενόν, ὡς τὸ αὐτὸ μὲν ὂν κενὸν καὶ πλῆρες καὶ τόπον, τὸ δ' εἶναι αὐτοῖς οὐ ταὐτὸ ὄν.*

[177] *οἱ δὲ ἄνθρωποι βούλονται κενὸν εἶναι διάστημα ἐν ᾧ μηδέν ἐστι σῶμα αἰσθητόν.*

of the body that occupies it. This extension can either be occupied or not. Suppose it is occupied by a golden sphere. It is obvious that this extension satisfies Aristotle's definition of the extension of that body. The independent extension lies between the limits of the golden sphere.

This is not the place to discuss Aristotle's argument against the assumption of independent extension.[178] Instead, let us ask what alternative conception Aristotle has to offer. It is one thing to deny that there is an extension that is independent from the body, and it is quite a different thing to come up with a viable alternative.

Aristotle does not deny that there is extension. He denies that there is *independent* extension. But it seems, at least nowadays, easier to conceptualize independent extension than dependent extension. Thus, the challenge we might pose to Aristotle is the following: how can he make sense of extension as a feature of bodies? This may seem especially so, if we consider that Aristotle does not have the Platonic theory that objects literally have extension as their matter.

6.4.4.2. THE MATTER OF MAGNITUDE

Having posed this challenge I imagine Aristotle responding as follows. It is not he, Aristotle, who has to make sense of extension that belongs to magnitudes. On the contrary, the assumption of independent extension not only leads to various problems, but is also theoretically superfluous. Everything that can be explained by the assumption of independent extension can be explained better without that assumption and solely by relying on facts about physical bodies. This then is his detailed reply:

> The cube, too, [1] has a magnitude equal in amount to the void it occupies; [2] and even if this—I mean the *onkos* of the wooden cube—is hot or cold, or heavy or light, yet none the less it is different in being from all the qualities even if not separable [from them]. [3] Hence (even if it were separated from all the other things and were neither heavy nor light), it will occupy an equal amount of void, and will be in the same spot as the part of place or part of the void equal to itself. [4] How then will the body of the cube differ from an equal amount of void and place? And if there are two such things, why should not there be any number of things in the same spot? [5] This then is one absurd and impossible consequence. [6] Again, it is manifest that the cube when it changes position will still have this [volume], which all other bodies have. [7] So if it is in no way different from place, what need is there to construct a place for bodies over and above the *onkos* of each, if the *onkos* is without properties? [8] No contribution is made by any *other* equal extension of this kind there may be apart from this.[179] (*Ph.* IV.8 216b2–16)

[178] I refer to the discussion by Morison 2002; Hussey 1983.

[179] *ἀλλὰ μὴν καὶ ὁ κύβος γε ἔχει τοσοῦτον μέγεθος, ὅσον κατέχει κενόν· ὃ εἰ καὶ θερμὸν ἢ ψυχρόν ἐστιν ἢ βαρὺ ἢ κοῦφον, οὐδὲν ἧττον ἕτερον τῷ εἶναι πάντων τῶν παθημάτων ἐστί, καὶ εἰ μὴ χωριστόν· λέγω δὲ τὸν ὄγκον τοῦ ξυλίνου κύβου. ὥστ᾽ εἰ καὶ χωρισθείη τῶν ἄλλων πάντων καὶ μήτε βαρὺ μήτε κοῦφον εἴη, καθέξει τὸ ἴσον κενὸν καὶ ἐν τῷ αὐτῷ ἔσται τῷ τοῦ τόπου καὶ τῷ τοῦ κενοῦ μέρει ἴσῳ ἑαυτῷ. τί οὖν διοίσει τὸ τοῦ κύβου σῶμα τοῦ ἴσου κενοῦ καὶ τόπου; καὶ εἰ δύο τοιαῦτα, διὰ τί οὐ καὶ ὁποσαοῦν ἐν τῷ αὐτῷ ἔσται; ἓν μὲν δὴ τοῦτο ἄτοπον καὶ ἀδύνατον. ἔτι δὲ φανερὸν ὅτι τοῦτο ὁ κύβος ἕξει καὶ μεθιστάμενος, ὃ καὶ τὰ ἄλλα σώματα πάντ᾽ ἔχει. ὥστ᾽ εἰ τοῦ τόπου μηδὲν διαφέρει, τί δεῖ ποιεῖν τόπον τοῖς σώμασιν παρὰ τὸν ἑκάστου ὄγκον, εἰ ἀπαθὲς ὁ ὄγκος; οὐδὲν γὰρ συμβάλλεται, εἰ ἕτερον περὶ αὐτὸν ἴσον διάστημα τοιοῦτον εἴη.*
Translation by Hussey 1983 with slight modifications.

Aristotle presents two lines of argument against the assumption that we must assume an independent extension to explain certain facts about bodies. For ease of reference I numbered the sentences that correspond to the main steps in the argument. The first line of argument runs from [1] to [5]. The second line of argument runs from [6] to [8]. Aristotle draws in both [5] and [8] the conclusion that the assumption of an extension over and above extended bodies is theoretically meaningless or even leads to an impossibility. What is peculiar in Aristotle's argument is that in the course of it he presents his own version of the ontology of extension. Extension is and should be regarded as a feature of bodies. Extension is the *onkos* of a physical body. The *onkos* of a body is, I will argue, the extension that depends on the body in question. But if there is an extension that belongs to a body, the assumption of another extension which is distinct and independent from the body leads to a theoretical impasse.

The first line of argument. Extension as the bulk of a magnitude. Let me start with Aristotle's first line of objection. Aristotle begins his argument with the case of a wooden cube that occupies an independent interval. The wooden cube, he says, occupies a certain void, that is to say, the wooden cube occupies a region that can be occupied, but is not necessarily occupied. Aristotle starts his argument with the observation that [1] the cube has a magnitude that is equal to the void. In the next sentence [2] Aristotle says more on what he means by 'magnitude'.[180] He means the *onkos* of the wooden cube. What is an *onkos*? The word is used by Aristotle mainly in contrast to void.[181] It is something that belongs to the body, whereas the void is independent of the body. Thus, it seems that *onkos* is the extension or *diastema* that depends on the body in question.

Moreover, Aristotle says that the *onkos* is hot or cold, heavy or light. Thus characterized, the *onkos* seems to be the matter of the wooden cube, namely its wood. However, as Aristotle makes clear the *onkos* of the wooden cube is not simply the wood. The *onkos* is only an aspect of the wood. It is the wood considered *qua* being extended. This is, I believe, the moral we should draw from his remarks about separability. The extension of the wooden cube is different in being from all the other attributes. This does not mean that the extension is ontologically independent and exists on its own, which is precisely what Aristotle denies here. Rather, the extension is logically separable. It can be conceived without any of the other attributes the wooden cube may have. This connects with my claim in Part I of this study. Quantitative features of objects can be conceived without other attributes. The wooden cube can be considered merely *qua* extended object. And similarly, the matter of the wooden cube, the wood, can be conceived simply insofar as it is a certain extension.

[180] Hussey rightly observes that this passage contains 'a confusing selection of terms' (Hussey 1983, 134), which may indicate that Aristotle did not yet have a fixed terminology when writing this passage. '*Onkos*', 'body', and 'magnitude', however, seem to be used in the same sense here. They all refer to the three-dimensional extension that belongs to the wooden cube. Cf. *Ph.* III.5 204b20.

[181] Besides the passage quoted above see especially *GC* I.8 326b20. For a general overview see also Bonitz 1870.

In the next sentence [3] Aristotle's argument against the assumption of an independent extension takes on a more concrete form. The extension or *onkos* of the wooden cube will occupy a region that is equal to the void. If we consider the *onkos* of the wooden cube separately, the *onkos* itself will occupy a region. The idea is, I suggest, that we must not only say that the wooden cube occupies some now-filled void, but also that the extension of the wooden cube occupies the same amount of void. This is an important step in Aristotle's critique, I believe. For, the whole argument started with the idea that the *wooden cube* occupies an independent extension. But then Aristotle made clear that the *wooden cube* not only occupies a certain extension, but also *has* an extension which belongs to it and is logically different from all other attributes. The extension of the wooden cube, then, occupies the independent extension, too.

However, as Aristotle states in [4], if this is right, it becomes difficult to say how the extension of the wooden cube should differ from the amount of void it occupies. After all, when asked for the extension of the cube, we may reply 'It is an extension of five cubic feet'. And when asked what the supposedly independent extension is we may also reply 'It is an extension of five cubic feet'. So we have an extension of five cubic feet occupying another distinct extension of five cubic feet. How, then, do they differ? Notice that it does not help to say that the extension of the wooden cube has more characteristics to it. For although the extension of the wooden cube has certain characteristics such as being hot or cold, it does not have these characteristics essentially. It is different in being from all these characteristics. Thus, if we say what the extension most precisely is, we do not mention these characteristics. It seems that at this point one is forced to say that the extension that belongs to the wooden cube and the extension that is independent differ, if they differ at all, only in the assumption that one extension is dependent and the other extension is independent. But *this* difference does not justify the assumption that the independent extension does in fact exist. On the contrary, it opens the door for an introduction of even more distinct extensions. If there is a void extension distinct from the extension of the cube, why should there not also be another place extension? If we allow for two, why not for more?[182] This leads to a rather bizarre ontology of possible infinitely many distinct coinciding extensions.

Hussey wonders why Aristotle did not consider the possibility that the two extensions differ in being.[183] But, as I reconstruct the argument, Aristotle implicitly shows that the *only* possible difference in being between the two extensions is their respective dependence or independence. For the trend of the first line of argument is to show that the wooden cube has itself a certain extension that depends on it. The extension of the wooden cube can be considered without all of the characteristics that modify the wooden cube *qua* wooden cube. Considered in this way, the extension of the wooden cube does not differ from a supposedly independent extension, except for the brute fact that one extension is dependent and the other independent. But, as said, relying on

[182] Cf. *Ph.* IV.6 213b7–8. [183] Hussey 1983, 137.

such a brute fact opens the door for further coinciding extensions. This, then, shows that one should restrict oneself to only one extension, namely the extension of the wooden cube.

The second line of argument. The second line of argument further elaborates on the fact that the explanatory function the extension of the wooden cube can play makes the assumption of further extensions besides the extension of the wooden cube superfluous. Aristotle begins his second line of argument with [6] the observation that, if the wooden cube changes its position, it still has the same extension. If the wooden cube has an extension of five cubic feet and it moves somewhere else, it still has an extension of five cubic feet. However, this seemingly trivial assertion has an important theoretical implication. For, if we conceive of the extension of the wooden cube as belonging to the wooden cube, we need not posit another independent extension that is distinct from the cube's own extension and that it occupies after it has moved.[184] That is to say, the fact that the wooden cube has the same extension before and after it has moved is not explained by the fact that it first occupied a place of five cubic feet and then occupies another place of five cubic feet. Rather, the sameness of extension is simply explained by the fact that the wooden cube has a certain extension, which has remained the same. The wooden cube has neither grown nor shrunk. Thus, it still has the same extension.

This is, I propose, why Aristotle says in his conclusion that it is not necessary to postulate a place or indeed any other equal extension. According to Aristotle, we need not postulate place or void to account for the extension of objects. Being extended is a property of objects that they have in virtue of being enmattered. There is no explanatory gain in postulating an extension over and above the objects. Extension is a feature of the matter of the objects.[185] It is separable in definition, though not ontologically separable.

6.4.5. *The divisibility of matter and extension*

Before I turn to Aristotle's distinction between continuity and contact in the next chapter, I will make some remarks on Aristotle's belief that continuous objects cannot be made up of indivisibles. I argued in Chapter 5 that the continuous is defined by Aristotle as a certain connection between the parts. Aristotle believes that a continuum is divisible into infinitely divisible parts. If we take, for example, a line, all the adjacent parts of the line are connected by a point. If we were to divide the line at the middle, the resulting two halves would, in turn, have middle points at which their parts are connected. If we were to divide the halves there, we would end up with

[184] This I propose is also partly the reason why Aristotle says that the extension of an object is not its place. For, since it is a feature of the matter of the object, in changing place it does not change its extension. Cf. *Ph.* IV.4 211b29–212a2.

[185] Cf. *GC* I.5 320b14–25.