

Cohesive Causes in Ancient Greek Philosophy and Medicine

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Abstract

This paper is about the history of a question in ancient Greek philosophy and medicine: what holds the parts of a whole together? The idea that there is a single cause responsible for cohesion is usually associated with the Stoics. They refer to it as the *synectic cause* (ἀλτιον συνεκτικόν), a term variously translated as ‘cohesive cause,’ ‘containing cause’ or ‘sustaining cause.’ The Stoics, however, are neither the first nor the only thinkers to raise this question or to propose a single answer. Many earlier thinkers offer their own candidates for what actively binds parts together, with differing implications not only for why we are wholes rather than heaps, but also why our bodies inevitably become diseased and fall apart. This paper assembles, up to the time of the Stoics, one part of the history of such a cause: what is called ‘the *synechon*’ (τὸ συνέχον) – that which holds things together. Starting with our earliest evidence from Anaximenes (sixth century BCE), the paper looks at different candidates and especially the models and metaphors for thinking about causes of cohesion which were proposed by different philosophers and doctors including Empedocles, early Greek doctors, Diogenes of Apollonia, Plato and Aristotle. My goal is to explore why these candidates and models were proposed and how later philosophical objections to them led to changes in how causes of cohesion were understood.

1 Parts and Wholes

Aristotle is often credited with the phrase, ‘the whole is greater than the sum of its parts.’ He may never have said it (it does not appear in any of the writings we have), but that has not stopped it from being quoted, almost always without a reference, in order to suggest an ancient pedigree for certain twentieth-century topics like holism, synergy, systems theory and emergence – topics at whose core is some kind of anti-reductive stance.¹ This is not a coincidence. There

1 The attribution to Aristotle is remarkably common across disciplines. A sample: Vallero (2011) 80 on engineering and bioethics; Scalabrino (2018) 56–57 on psychology; Hanson

is something Aristotelian about the phrase. After all, Aristotle is the ancient Greek philosopher most associated with the idea that some kinds of things in the world require explanations that go beyond the enumeration of their parts. If Aristotle asked you what a house is, you would not get away with telling him that it is the bricks and beams that went into building it, even if you managed to mention every one of them; and you certainly would not get away with telling him that bread is simply flour, salt, water and yeast.² This is because, for Aristotle, if what we are talking about is not a heap of random things, but a whole, then citing only a list of ingredients misses something essential about the whole the ingredients are meant to explain. They fail to tell us how and why the parts are arranged the way they are and so why those parts form a unified thing. Not just any arrangement of materials, even of the appropriate materials, counts as a barn or a bagel, and Aristotle thinks the same goes for natural things as well.³ To understand what a horse is, it is not enough to give a list of every hair and hoof. Something more needs to be added, something about the overall form and arrangement of those parts for it to count as an explanation of a horse. People who study Aristotle today tend to refer to this as his *hylomorphism*: the idea that unified things, especially natural and living things, are composed of matter and form and that both need to be mentioned

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- (1995) 1 and Forrest (2018) 3 on systems theory; Hanson (2014) 84 on social theory; Elliott (2004) 454 on business; Marks et al. (2008) 599 on molecular biology. Schuster (2007) claims it is in Aristotle's *Metaphysics*, but does not cite a passage. It is also associated with Gestalt psychology, although no Gestalt theorist seems to have said it either, on which see Fuller (1990) 101–2. For a discussion of instances found on the internet (where it pops up quite often as well), see the blog, Sententiae Antiquae, 'No, Aristotle didn't write "a whole is greater than the sum of its parts."' Last accessed at sententiaeantiquae.com/2018/07/06/no-aristotle-didnt-write-a-whole-is-greater-than-the-sum-of-its-parts/ on 02-04-19.
- 2 The view is first stated in Plato's *Phaedo* (Pl. *Phd.*) 98b–e, but Plato develops it extensively in the *Theaetetus*, particularly the discussion of Hesiod's wheel at 206e4–208b9. It is worth noting that this is not always the case. If someone asked me to explain the things on my desk, it would be fine to say that they are two books, a computer, a lamp; and it is perfectly fine (in North America anyway) to say that a quarter is twenty-five cents. These, according to Aristotle, are not wholes (τὰ ὅλα), but totals (τὰ πάντα). The total / whole distinction first shows up, as far as I know, also in Plato's *Theaetetus* (Pl. *Tht.*) at 204a11–b1: 'Do you in fact call 'total' (τὸ πᾶν) and 'whole' (τὸ ὅλον) the same thing or something else?' Aristotle takes up Plato's distinction in *Metaphysics* (Arist. *Metaph.*) 8.6, 1045a8–12, quoted below. On *Theaetetus*, see Harte (2002), especially chapter 1.
 - 3 For the house example, see Aristotle, *De partibus animalium* (Arist. *Part. an.*) 1.1, 639b5–30. See also Aristotle, *Topics* 6.13, 150b22–26. The extension of the analogy to natural objects is found in many works, but the point is made most explicitly at Aristotle, *Meteorologica* (Arist. *Mete.*) 4.12, 390b2–14.

in any explanation of what those things are.⁴ If, like Aristotle, we think the parts of a thing count as its matter,⁵ then it is not too far off to say he thinks ‘the whole is more than the sum of its parts.’ Some things are not identical to their parts alone: they are also their arrangement. As Aristotle would say, they are also their forms.

Now, while Aristotle never said, ‘the whole is greater than the sum of the parts,’ he does come close to saying it over a few pages in books 7 and 8 of his *Metaphysics*. At *Metaphysics* 8.6 he comes especially close. There he says that *if* something with parts is also a whole, then there must be some cause – some reason – that explains why those parts form a whole in the first place. He writes:

What is the cause (αἴτιον) of something being one? For, for everything that has a plurality of parts (πλείω μέρη) and the totality (τὸ πᾶν) is not like a heap (οἶον σωρός), but the whole (τὸ ὅλον) is something besides the parts (παρὰ τὰ μέρη), there is some cause, since even in the case of bodies, the cause of their being one is sometimes contact, other times stickiness (γλισχροτήτης) or some other such property.

ARISTOTLE, *Metaphysics* 8.6, 1045a8–12⁶

One thing worth pointing out about this passage is that Aristotle does not say that the whole is *greater* (μεῖζον) than the sum of its parts; rather, he says that there are cases (presumably self-evident ones) where the whole is something *besides* (παρὰ) or *in addition to* the parts. The difference between ‘greater’ and ‘besides’ is not merely grammatical. Aristotle, like some early Gestalt theorists, thinks the difference is ontological.⁷ Wholes are different kinds of things from the parts that make them up, just as syllables are different from (but not in any straightforward sense *more than*) the letters that make them up. This is

4 ‘Hylō-’ from *hylē* (Aristotle’s neologism for matter) and ‘-morphism’ from *morphē* (or form). There is substantial literature on Aristotle’s hylomorphism (a word Aristotle himself never uses) and its more recent revivals. Good surveys of the idea and issues surrounding it can be found in Peramatzis (2018), and the Stanford Encyclopedia articles by Ainsworth (2016), Cohen (2016) and Shields (2016). For contemporary defences, see Scaltas (1994), Koslicki (1998, 2006, 2018), Marmodoro (2013).

5 Aristotle, *Physics* (Arist. *Phys.*) 2.3, 195a15–21; *Metaph.* 5.2, 1013b17–23.

6 τί αἴτιον τοῦ ἕν εἶναι; πάντων γάρ ὅσα πλείω μέρη ἔχει καὶ μὴ ἔστιν οἶον σωρός τὸ πᾶν ἀλλ’ ἔστι τι τὸ ὅλον παρὰ τὰ μέρη, ἔστι τι αἴτιον, ἐπεὶ καὶ ἐν τοῖς σώμασι τοῖς μὲν ἀφή αἰτία τοῦ ἕν εἶναι τοῖς δὲ γλισχροτήτης ἢ τι πάθος ἕτερον τοιοῦτον. (All translations are my own unless noted otherwise.)

7 Heider (1977) 383.

something Aristotle argues for explicitly at *Metaphysics* 7.17, 1041b11–42a2.⁸ He believes that if we were to think that wholes are greater than their parts (or greater than their ‘elements’, as Aristotle refers to them here), then we run into a problem. If, for example, the syllable BA were *greater* than the sum of its parts, B and A, then something would need to have been added to make it greater. The whole, therefore, is presumably B + A + X. Now, however, we need something else to explain why B, A and X form a whole, and so we would need to posit another part to get B + A + X + Y, a process that would go on *ad infinitum*. Aristotle thinks such a regress is hopeless and so he argues that wholes are not created by adding something.⁹ Instead, there must be some other kind of thing (ἔτερόν τι) that makes a syllable a syllable, or a whole a whole. In the example of the syllable BA, this other kind of thing will be whatever it is that causes the elements B and A to be the syllable BA and Aristotle indicates two causes that fit the bill: one, the arrangement of the letter B (or the sound ‘B’) before the letter A (or the sound ‘A’) – what he calls the formal cause; the other, the person or agent who places the B before the A, what he calls the efficient cause. The form and the agent which causes the elements to take on that form are different kinds of thing altogether. The form is a cause to the parts of their *being* a whole rather than a heap; while the agent is a cause to the parts of their *becoming* a particular thing and so of the form and the matter becoming one.¹⁰

8 Arist. *Metaph.* 7.17, 1041b11–42a2: ‘Since what is compounded out of something in such a way that the totality is one, not like a heap, but like the syllable – the syllable is not the letters, nor are B and A identical to BA, nor is flesh fire and earth (...); the syllable therefore is something, not only the letters (the vowel and the consonant), but also something else; and flesh is not only fire and earth or hot and cold, but also something else.’ (ἐπεὶ δὲ τὸ ἕκ τινος σύνθετον οὕτως ὥστε ἐν εἶναι τὸ πᾶν, [ἀν] μὴ ὡς σωρὸς ἀλλ’ ὡς ἡ συλλαβὴ – ἡ δὲ συλλαβὴ οὐκ ἔστι τὰ στοιχεῖα, οὐδὲ τῷ « β α » ταῦτό τὸ « β » καὶ « α », οὐδ’ ἡ σὰρξ πῦρ καὶ γῆ (...): ἔστιν ἄρα τι ἡ συλλαβὴ, οὐ μόνον τὰ στοιχεῖα τὸ φωνῆεν καὶ ἄφωνον ἀλλὰ καὶ ἕτερόν τι, καὶ ἡ σὰρξ οὐ μόνον πῦρ καὶ γῆ ἢ τὸ θερμὸν καὶ ψυχρὸν ἀλλὰ καὶ ἕτερόν τι). The passage is incorrectly interpreted as stating the whole is more than the sum of its parts in the translation by Adolf Lasson (1907) 129: ‘Das was aus Bestandteilen so zusammengesetzt ist, dass es ein einheitliches Ganzes bildet, nicht nach Art eines Haufens, sondern wie eine Silbe, das ist offenbar mehr als bloß die Summe seiner Bestandteile.’ Again, Aristotle seems to be taking up themes from the *Theaetetus*. See n. 2 above.

9 On this, see Menn (2001) 125–34. I avoid for the purposes of this paper the question – equally perplexing to Scotus and Ockham as to contemporary metaphysicians – of how matter and form, conceived as parts of the form-matter composite (the ‘hylomorphic compound’ or σύνολον), comprise a unified whole. On this issue, see the seminal paper by Ackrill (1972/3); for contemporary philosophical approaches, see Fine (1999) and (2010), Johnston (2006), Koslicki (2008); on Medieval approaches, e.g. Cross (1999) and Ward (2014); on its relevance to holism and the notion of sympathy, see Holmes in this volume.

10 Cf. Arist. *Metaph.* 8.6, 1045b20–23; *Phys.* 2.3, 194b16–32 (where they are called causes of generation and corruption, not being and becoming – thanks to David Ebrey for pointing

The account I have just sketched – or something close to it – is what people normally have in mind when they think about Aristotle's relationship to holism. Wholes are not just their parts, they are also their forms, and while we might think things are composed of matter and form, forms are not, at least in any straightforward sense, another part of a thing. Rather, they are a special kind of cause, which confers to the parts their being and unity. Aristotle famously refers to this kind of cause as *ousia* or substance. The story I wish to tell in the paper is about a different name he gives it: the *synechon* (τὸ συνέχον) – that which holds things together.

The idea that there is a kind of cause responsible for holding things together and whose weakening or dissolution brings with it disease and decay appears often in ancient philosophy and medicine. The cause itself goes by many different names.¹¹ It is, however, perhaps most commonly associated with the Stoics. The Stoics refer to it as the *synectic cause* (αἴτιον συνεκτικόν), a term variously translated as 'cohesive cause,' 'containing cause' or 'sustaining cause,' although none of these intuitively express in English what the Stoics meant (I will use 'cohesive'). For the Stoics, the cohesive cause is a body, namely *pneuma* (πνεῦμα), a mixture of fire and air, which is active within all things as a kind of binding movement or force.¹² Now, Galen claims that 'the first philosophers of [his]

this out to me). Typically, this is expressed by saying that some agent causes what is potentially F (the matter) to be actually F. B and A are potentially BA, but they are also potentially AB or perhaps even ABBA. Aristotle thinks that the cause of the letters being actually BA, instead of just being able to be BA, is their substance or formal cause, while the cause of the letters taking on the form, of actually becoming BA, is the agent or efficient cause. While it is an understatement to say the distinction between being potentially and being actually is important for Aristotle's metaphysics, it does not have much of a place in the story I tell here.

- 11 Galen gives a good summary of synonyms for the term: 'the cause that holds together [συνέχον], or the cohesive cause [συνεκτικόν], or proximate cause [προσεχές] or however one might wish to call it ...' (Galen, *De symptomatum causis* 1.5, VII.109.7–10 K.). Philip van der Eijk points out to me that the author of the treatise *Fever*, attributed to Alexander of Aphrodisias (c. second century CE), uses the term 'coupling cause' (συνεξευγμένον αἴτιον) (ps.-Alexander, *De febribus* 27.1–12, 22,8–24,24 Tassinari). I discuss other terms in what follows.
- 12 For writers after Galen, 'cohesive' (συνεκτικός) comes to mean simply 'primary,' e.g. Simplicius: '(Aristotle) says 'highest cause' in the sense of 'what is most properly (a cause),' which others call 'cohesive' (« ἀχρότατον » μὲν λέγει « αἴτιον » τὸ κυριώτατον λεγόμενον, ὃ ἄλλοι συνεκτικόν ὀνομάζουσιν)' (Simplicius, *In Aristotelis physicorum libros commentaria* (Simpl. in Arist. Phys.) 9.326,13–21 Diels, ad Arist. Phys. 2.3, 195b21). It is important to note that by calling it a force, I do not imply that it is non-bodily or immaterial. For the Stoics, forces were bodies, insofar as anything that acts or is acted upon must, for them, be a body; this is not so foreign, as forces continue to be conceived of as bodies, e.g. gluons, photons and bosons more generally.

acquaintance to speak of a cohesive cause were the Stoics,' and something like Galen's view of the history of the concept continues to be held today.¹³ The consensus among scholars today is roughly that the Stoics introduce the cohesive cause as an active, corporeal analogue of the Aristotelian form: Aristotelian forms and Stoic cohesive causes explain what something is, why it acts the way it does and why it persists as that thing, while the Stoic innovation is to understand this cause as a kind of bodily (but perhaps non-material) force binding things together as a whole.¹⁴ I think, however, that Galen's claim that this is a Stoic innovation is potentially misleading. Once we see that Aristotle's *synechon* and the Stoic cohesive cause are both answers to the question, 'what actively holds the parts of a whole together?', then it becomes clear that they are more than analogues. In fact, the Aristotelian *synechon* and the Stoic cohesive cause refer to the same thing: the nature or soul (the Stoics also add 'cohesion' (ἔξις), which is more or less an Aristotelian inanimate nature) understood as an internal principle of motion and rest. Aristotle believes this nature or soul is an immaterial yet substantial unmoved mover – an agent that always acts in the same way to produce the same kind of activity in the parts that make what it is. The Stoics believe that this (cohesion or) nature or soul is *pneuma*, an active, self-moving corporeal cause which interpenetrates and binds the passive material into a whole through what the Stoics call its 'tensional movement.' The Stoics' answer to the question 'what holds things together' might, therefore, more closely resemble Plato's self-moving world-soul in the *Timaeus* than the unmoved souls of Aristotle's *De anima*. Nevertheless, Aristotle and the Stoics both believe that a thing's parts are bound together by a kind of internal, active cause that is not an additional part.

Plato, Aristotle and the Stoics offer refined notions of the *synechon* in response to what they see as inadequacies in earlier attempts to explain how parts might form a whole. Their responses, however, were not the only ones possible. Democritus seems simply to have rejected the idea of wholes altogether, suggesting they are figments of the imagination.¹⁵ Alcmaeon of Croton

13 Galen, *De causis contentivis* (Gal. CC) 1.1 (52,1–2 Lyons); *Adversus Iulianum* 6.13 (XVIII A.279–80 κ. = 57,15–58,6 Wenkebach); *Synopsis librorum suorum de pulsibus* (IX.458.8–14 κ.). Cf. Frede (1987) 145. Susan Bobzien (1999) 228 argues (more precisely) that the term is a later Stoic invention and not found in Chrysippus.

14 See e.g. Frede (1987) 145; Long and Sedley (1987) 340–41; Hankinson (1998) 240–41; Bobzien (1999) 229. These authors all seem to rely on the same testimony of Galen. I return to this below. On cohesive causes as things other than agents, but still causes of effects, see Hankinson (1987) 81–85.

15 Simplicius, *In Aristotelis De caelo commentaria* (Simpl. in *Airst. De cael.*) 295,1–14 Heiberg = Democritus 68 A 37 DK.

believed cohesion resulted from an equipollence of opposing powers among the parts, and a similar view is found in Galen's criticism of the Stoic notion of a cohesive cause. The first thinker, however, who is reported to have talked about something like a cohesive cause is not a Hellenistic Stoic, but the sixth-century BCE Ionian physicist Anaximenes. After him, different candidates for the *synechon* are proposed by different philosophers and doctors, including Empedocles, some early Greek (i.e. Hippocratic) medical writers, and Diogenes of Apollonia. In what follows, I proceed by looking at these various thinkers' proposals – the early Greek philosophers and doctors, and also Plato, Aristotle and the Stoics –, how they think they bind the parts of a thing into a whole and the problems these proposals raised. I think there is something important gained by examining this history, even though it means I have to leave aside many details and that, given the nature of some of our evidence, the account I give will at times be speculative. The views of the Stoics in particular need more careful treatment than what I can provide here (the school was hardly united on this issue).¹⁶ Still, I think this approach offers a productive way of thinking about the history of wholes, active causes and cohesion, of which Aristotle is a part.

2 Early Greek Philosophers and Physicians

I begin this story with the earliest accounts of bodily cohesion in Greek philosophy. Many philosophers and doctors before Aristotle explain how the parts of something are bound together into a whole, and one of their common strategies is to posit some special kind of part, a *synechon* (or related term), which holds the other parts together. The idea is intuitive. Glue, nails, fasteners, thread, etc., are all what we might call 'binding parts': bodies that hold something together, while at the same time being a part of it. Early Greek philosophers posited such binding parts to explain the unity of things, from simple solid bodies to the cosmos itself.

A familiar example of this kind of thinking is Empedocles' Love (Φιλότης). Love in Empedocles' cosmology is a hypostatized notion of a unifier – that which 'brings everything together into one' (συνερχόμεν' εἰς ἓν ἅπαντα).¹⁷ Love

16 Frede (1987) remains the best entry point to these issues in Stoic philosophy. In this paper, I avoid discussions of determinism and responsibility as motivations for the Stoic theory of causes. I also will not be discussing Cicero's report of Chrysippus' causal distinctions at *De fato* 41–43, which I think raises more questions than it answers.

17 *Simpl. in Arist. Phys.* 9.158,7 Diels = Empedocles 31 B 17 DK. An anonymous reviewer points out to me that unity is not the same as holism: both Love and Strife result in wholes, either

works in opposition to the great cosmic 'Strife' (Νεῖκος), which Empedocles thinks is responsible for separating the cosmic elements out into different kinds, fire, air, water and earth. This cosmogonic requirement of difference and sameness, narrated as separation and unification, is already anticipated in early Greek mythology. In the *Theogony*, for example, Hesiod describes the birth of the cosmos as an act of divine separation: Kronos, son of Gaia (earth) and Ouranos (sky), separated the primordial gods by castrating Ouranos, who had forced himself on Gaia in perpetual sexual union, with an adamantine sickle. When Kronos later tossed Ouranos' genitals into the sea, Aphrodite, the personification of union (Φιλότης) was born from them (Hesiod, *Theogony* 190–206; on Empedocles' identification of Love with Aphrodite, see Simpl. in *Arist. Phys.* 158,24 Diels = Emped. 31 B 17 DK). The difference for Empedocles is that, like other physicists of the sixth and fifth centuries, he begins to think of the unifier as an element: something equiprimordial, bodily and able to extend throughout the cosmos (Arist. *Metaph.* 1.4, 1091b28), and which is able to determine what things are by becoming a part of them.¹⁸ Empedocles' Love does this by spreading out from the centre of the cosmos to its limits, becoming integrated into the mixtures of things it unifies (Simpl. in *Arist. De cael.* 529,1–15 = Emped. 31 B 35 DK, cf. Arist. *Metaph.* 1.4, 985a27–28). Other thinkers posit different cosmogonic elements and narratives. The pattern, however, at least in its general details, is the same.

When the *synechon*, like Empedocles' Love, is conceived of as a binding part, we find that it shows up at different levels of the cosmic hierarchy (in inanimate objects, in living things, in the cosmos as a whole); at all levels, however, binding parts share three general characteristics. First, they are conceived of as parts of the whole they compose; second, the whole depends on them in a different way than it depends on the other parts; and third, perhaps most important, they bring about wholeness by preventing the other parts from acting according to their own impulse. In other words, to form a whole or unity, a

by Love's uniting all the elements into one whole, or by Strife's uniting the elements into separate wholes; *holism*, however, arises somewhere in the middle, when the little wholes differentiated by Strife can work together to function as parts of a larger whole. The issue here is not whether Love is a *synechon* but whether it is the only one, since one could consider Strife to be what unifies the elements into separate wholes, a point already made by Aristotle in his criticism of Empedocles (Arist. *Metaph.* 1.4, 985a23–29), and who thinks Empedocles is confused. And it is interesting to note that, for Empedocles, cosmogony occurs *between* the complete rules of Love or Strife, and therefore holism results from *both* causes. Love, however, is still the cause of *different* things being unified, and so a more plausible candidate for the history of the *synechon* I am sketching here, even if Strife is the cause of the parts maintaining their distinctness *as parts*.

18 Menn (1995) treats many related issues here. My story is guided by his study.

binding part needs to somehow overpower the other parts in order to compel them to maintain their arrangement.

The first characteristic of early theories of *synechon* is that what holds a whole together is a part of that thing. In the passage from *Metaphysics* 8.6 quoted earlier, Aristotle mentions stickiness (γλίσχροτης) as a cause of bodily parts being a whole. This is not an idle example, but something Aristotle actually believes. As far as I can tell, the abstract noun ‘stickiness’ is first found in the writings of Aristotle and his student Theophrastus. Aristotle often, however, slips back into an earlier paradigm and simply calls it ‘the sticky’ (τὸ γλίσχρον). The difference is that ‘the sticky’ need not be an abstract entity, and Aristotle sometimes speaks of it as itself a part of the body (rather than as a quality of some part). At *Generation of Animals* 2.1, 737a36–b1, for instance, he emphasizes that ‘the sticky’ (τὸ γλίσχρον) is that which ‘holds all bodies together (πάντα δὲ τὰ σώματα συνέχει).’¹⁹ And in the Aristotelian *Problemata* 21.6, 927b6–14, the sticky moisture within loaves of bread (τὸ ἐν αὐτοῖς γλίσχρον ὑγρόν) is thought to be the reason why hot loaves of bread placed next to one another cohere (συνέχονται) or become glued together (κολλῶνται).²⁰ The *Problemata* comes either from the time of Aristotle or not too long after, and it too continues to conceive of some *synechonta* as kinds of parts. The characteristic of parthood can also be inferred in thinkers earlier than Aristotle. Aristotle suggests that bodies that bring about cohesion were part of Empedocles’ physics, and he emphasizes the similarities between Empedocles’ views and his own. In the *Meteorology*, he writes, ‘the moist (τὸ ὑγρόν) is a cause to the dry of it being determined (ὀρίζεσθαι), and one is like a glue (κόλλα) for the other – as Empedocles wrote in his poem on Nature: ‘gluing meal together with water’ (ἄλφιτον ὕδατι κολλήσας)’ (Arist. *Mete.* 4.4, 381b29–82a8 = Emped. fr. 31 B 34 DK). Empedocles is using glue as a metaphor here, but (at least according to Aristotle) the metaphor implies that he thinks the cohesion of a whole results from the composition of earth and water, where water is given the role of binding part. Aristotle agrees with Empedocles and he himself adopts this view in *Generation and Corruption*: ‘the moist is what holds it (sc. the dry) together (τὸ συνέχον).’²¹ The point of all this, however, is not to make a porridge. Empedocles and Aristotle are both saying that water or wetness is responsible

19 πάντα δὲ τὰ σώματα συνέχει τὸ γλίσχρον. Cf. Arist. *Phys.* 5.3, 227a16–17, ‘and however the *synechon* happens to be one (τὸ συνέχον ἓν), in this way, too, the whole will be one, e.g. either by a bolt, glue, contact or adhesion’ (καὶ ὡς ποτε γίνεται τὸ συνέχον ἓν, οὕτω καὶ τὸ ὅλον ἔσται ἓν, οἷον ἢ γόμφῳ ἢ κόλλῃ ἢ ἀφῆ ἢ προσφύσει).

20 The sticky moisture is also referred to as ‘the gluey’ (τὸ κολλῶδες) in the same passage.

21 Cf. Aristotle, *Generation and Corruption* (Arist. *Gen. corr.*) 2.8, 334b30–35a3: ‘earth has no ability to remain together (συμμένειν) without the moist (ἄνευ τοῦ ὑγροῦ). On the contrary,

for the fact that solid bodies cohere, while the different proportions of water and earth, or wet and dry, will determine the different levels of cohesion. Too much fluid and a body will no longer be solid; too little fluid and the parts will not form a whole. There still remains the question of what determines these proportions. For Empedocles, it seems they are determined by a different kind of glue, the 'glue of Harmonia' ('Ἀρμονίης κόλλησιν ἀρηρότα,' *Simpl. in Arist. Phys.* 300,24 Diels = Emped. fr. 31 B 96 DK), where Harmonia is, at least according to Simplicius, another of Empedocles' names for Love conceived, as before, as something actively binding things together.²² I will come back in the next section to what Aristotle thinks determines these proportions. For now, it is enough to say that water causes the cohesion of solid bodies by becoming, along with earth or the dry, a part of them.

The second characteristic of the *synechon* conceived of as a binding part is that, so long as it remains present in a thing and maintains its own cohesion, then the whole which it causes to cohere will remain coherent. If, however, the *synechon* leaves or loses cohesion, the parts will cease to form a whole. This is the case with Empedocles' cosmos, which, when Love retreats from that which it had been mixed with previously, results in the parts dissociating. Similarly, when wood is completely burned and the water expelled from it, what is left behind is uncohesive ash. Or when there is a loss of cohesion in the sinews that hold a joint together, then the joint loses cohesion as well and can no longer function – an obvious point perhaps, but worth making nonetheless. It appears often among early Greek medical writers. For instance, the author of *Instruments of Reduction* writes that, among other bones, 'the vertebrae are held together by sinew (σπόνδυλοι ... νεύρω συνεχόμενοι)' (Hippocrates, *Leverage (Mochl.)* 1, IV.342 L. = 246,9–11 Kühlewein); and the author of the second *Prorrhethics* writes about lameness caused by injuries that sever the 'sinews that hold the internal joints together (τὰ νεύρα τὰ συνέχοντα)' (Hippocrates, *Prorrhethicus II* 15, IX.40 L. = 254,26–28 Potter). The idea that there are bodily tissues like cords that hold us together is obvious enough, and like the earlier example of 'the sticky,' the *synechon* as a bodily tissue is also adopted by Aristotle: 'the nature of sinew (ἡ τοῦ νεύρου φύσις) holds together the parts of animals (συνέχει τὰ μόρια τῶν ζώων)' (Aristotle, *Generation of Animals* 2.1, 737a34–b7).²³ Reflection on this aspect of the *synechon* may have led later

the moist is what holds it together (τὸ συνέχον); for it (sc. earth) would fall to pieces if the moist were eliminated from it completely.'

22 Many thanks to Gábor Betegh for pointing me to this passage.

23 Some scholars excise this passage. The passage shares affinities with the Hippocratic work *Fleshes*: 'that, on the other hand, which happened to be more gluey [κολλωδέστερα] and to contain cold, could not be burnt up on being heated or become dry, [...] for this reason

thinkers to define cohesive causes as causes such that when they are present the effect is present and when they are absent the effect is absent.²⁴ This aspect will become central to debates about cohesive causes in ancient medicine from Erasistratus (third century BCE) onwards, where the notion of cohesive causes is extended to all causes that are contemporaneous with their effects, but most importantly, from a medical point of view, to causes of disease, e.g. that thing which is, right now, causing disease, like a kidney stone, as opposed to that thing which, at some earlier point in time, did something which later led to disease, like a bite from a dog.²⁵ In our case, while the parts remain what they are even when the *synechon* and the whole do not exist, the existence of the whole requires the simultaneous existence and presence of the *synechon*.

The last characteristic of the *synechon* I want to look at is its role as a ‘pre-venter’ (τὸ κωλύον): something which checks or hinders the tendencies of the other parts that comprise the whole. Early Greek physicists believed that there are basic, unchanging elements that have (or just are) tendencies or powers, and they needed some story to tell about what it is that prevents the different parts from either separating out or collapsing. Clay may be a mixture of fire and earth, but fire tends to go up, earth to go down, and clay does not routinely fly apart. The sky and the earth may both be made of things that have weight and so tend to fall, but, at least for now, the sky has not fallen. With the products of human craft, one can say, e.g., that the pillars hold up the roof, or the glue holds the joints. Different options were offered for what serves the analogous preventing or hindering function in nature.

It will take a little work to present the evidence, but at least according to Plato and Aristotle, one of the earliest figures to think of the *synechon* along these lines was Diogenes of Apollonia. There is some evidence that before Diogenes, the Ionian physicist Anaximenes did so as well. Some sources report that Anaximenes argued that, as our soul is a kind of air that holds us together (συγκρατεῖ), so there also exists some kind of *pneuma* or air that

it took a form rather different [...] and became cords and vessels [νεῦρα καὶ φλέβες]’ (Hippocrates, *De carnibus* (Hipp. *Carn.*) 3, VIII.586 L. = 134.6–18 Potter, tr. Potter, modified). Aristotle, too, thinks the vessels hold the body together. See Arist. *Part. an.* 3.6, 668b20–27. The shell is the analogue of cords and vessels in non-blooded animals. See Arist. *Part. an.* 2.8, 654a3–8.

24 On this, see Frede (1987) 146–47, Bobzien (1999), and the excellent discussions in Hankinson (1998) 376–79 and Havrda (2016) 262–73, 306.

25 For the debate, see Gal. *CC* 2.1 (55,6–11 Lyons); *Adversus Iulianum* 6.13 (XVIII.A.279–80 κ. = 57,15–58,6 Wenkebach). For examples, see Ps.-Galen, *Introductio sive Medicus* ([Gal.] *Int.*) 8 (XIV.691–92 κ. = 16,9–24 Petit); ps.-Galen, *Definitiones medicae* ([Gal.] *Def.*) 157; XIX.392–93 κ.; Sextus, *Pyrrhoniae hypotyposes* (S. E. *PH*) 3.15; Clement, *Stromata* 8.33.1–7 (101,16–102,16 Havrda).

encompasses (περιέχει) the cosmos as a whole (ὅλον τὸν κόσμον) (Ps.-Plutarch, *Placita*, 876a10–12 = Anaximenes 13 B 2 DK).²⁶ If this fragment is authentic, then it is the earliest explicit reference to the soul being that which holds the body together, as opposed to some other part like sinews or bones. It is also one of the first places where we find parallel cohesive entities mentioned at micro- and macrocosmic levels. Yet the authenticity of the fragment is at best dubious; instead, the earliest point at which we can reliably say the *synechon* becomes an object of philosophical reflection is in response to the works of Diogenes of Apollonia.

Diogenes is an eclectic thinker, who combines ideas from Anaximenes, Heraclitus, Anaxagoras and Leucippus. He attempts to update the theories of an earlier generation, which posited a single material principle from which everything arose, and he is especially fond of Anaximenes, agreeing with him that everything in the cosmos derives from air and is moved by air and that our soul, which animates us and moves us, is also a portion of cosmic air contained within our body. He combines this old-fashioned view with the new physics of Anaxagoras, who posited a special kind of stuff called reason (νοῦς), which he thinks permeates all things and is responsible for moving the other bodies in a rational way to form a cosmos. Anaxagoras believed that νοῦς, which is ‘the absolute ruler (αὐτοκρατές)’, must be ‘unmixed with any of the other stuff (μέμικται οὐδενὶ χρήματι)’ of the cosmos, for if it were mixed, ‘it would be hindered ... so that it could not rule any of the stuff (μηδενὸς χρήματος κρατεῖν) as it now does being alone by itself’ (Simpl. in *Arist. Phys.* 156,13–15 = Anaxagoras 48 B 12 DK). Diogenes agrees with Anaxagoras that the fact that the cosmos is intelligible and well-ordered needs to be explained by proposing a rational cause of order – and what better cause of rational order than hypostatized reason itself? He thinks, however, that reason is not independent of all the other stuff, but is instead to be identified with air, which he thinks possesses thinking (νοήσις). The air, therefore, is the source of movement in the cosmos, while its thought is the source of the order of that movement.²⁷ We can speculate that

26 There is a great deal of uncertainty both about the reliability and the interpretation of this fragment. Kirk et al. (1999) 159–61 claim the form *συγκρατεῖ* is impossible in the sixth century. They are likely correct. A search of the TLG shows no use before the late Hellenistic period. Their suggestion that it is a combination of *συνέχειν* and *κρατεῖν* is plausible. It is possibly Stoic: see its uses at [Plut.] *Plac.* 14, 907a8 and [Gal.] *Def.* 96, XIX.372 κ., the latter in which *συνέχειν* and *συγκρατεῖν* are treated synonymously. *πνεῦμα* and *κόσμον* are also unlikely in Anaximenes’ time. On this, see also Vlastos (1955) 363–64 and n. 56.

27 This account broadly follows Menn (1995). Cf. Simpl. in *Arist. Phys.* 152,13–22 = Diogenes 64 B 3–4 DK. Intelligence is attributed to air by the author of *The Sacred Disease*, but whether the author identifies them is unclear to me. See e.g. Hippocrates, *De morbo sacro* 19

Diogenes believes the advantage of this kind of account is that rationality in us and the cosmos, as well as life and movement, are explained by the same entity.

In a fragment from his *On Nature* preserved by Simplicius, Diogenes writes that air:

is great, strong (ἰσχυρόν), eternal (ἄϛδιον) and immortal (ἄθάνατον) and knows many things (πολλὰ εἰδός).

Simpl. in Arist. Phys. 153,21–2 = Diogenes of Apollonia 64 B 8 DK

What Diogenes means by claiming air is strong (ἰσχυρόν) is not immediately clear from the fragment, but parallels of this fragment in Plato and Aristotle can at least tell us how they understood him. For Plato and Aristotle, the strength of air refers to its role as a *synechon*, and they took Diogenes to be saying that it exercised its role as a *synechon* by hindering the impulses of other bodies. The first passage is in Plato's *Phaedo*, and although Diogenes is not named, the similarity to the fragment above is suggestive of the fact that Plato has Diogenes' *On Nature* in mind. He writes that the physicists

believe they will one day discover an Atlas that is stronger (ἰσχυρότερον), more immortal (ἄθανατώτερον) and better able to hold everything together (συνέχοντα) than this (sc. the Good); and they think that that which is truly good and binding (τὸ ἀγαθὸν καὶ δέον) doesn't bind (συνδεῖν) and hold together (συνέχειν) anything.

PLATO, *Phaedo* 99c2–6²⁸

If this is a representation of Diogenes' views, then Plato thinks that Diogenes is talking about the *synechon* in *On Nature*. Plato goes so far as to call the *synechon* Atlas: a Titan strong enough to hold the cosmos together.²⁹

(VI.390 L.). The author of the Hippocratic *Fleshes*, however, attributes almost an identical set of properties to 'heat' (τὸ θερμόν) at Hipp. *Carn.* 2 (VIII.584 L.).

28 τὴν δὲ τοῦ ὡς οἶόν τε βέλτιστα αὐτὰ τεθῆναι δύνάμιν οὕτω νῦν κείσθαι, ταύτην οὔτε ζητοῦσιν οὔτε τινὰ οἶονται δαιμονίαν ἰσχὺν ἔχειν, ἀλλὰ ἡγοῦνται τούτου Ἄτλαντα ἂν ποτε ἰσχυρότερον καὶ ἀθανατώτερον καὶ μᾶλλον ἅπαντα συνέχοντα ἐξευρεῖν, καὶ ὡς ἀληθῶς τὸ ἀγαθὸν καὶ δέον συνδεῖν καὶ συνέχειν οὐδὲν οἶονται.

29 Why the Titan Atlas? David Ebrey suggests to me that Plato may be contrasting the earth-born Titan with notions of Olympian divinity. It is possible, moreover, that some physicist used Atlas illustratively, but we do not know which one. See next passage. Also similar is the Hippocratic *Breaths*: Hippocrates, *De flatibus* 4 (VI.96 L. = 93,18–19 Heiberg) and 15 (VI.114 L. = 101,16–23 Heiberg). On Diogenes as a common source for both Plato and the author of *Breaths*, see Menn (1995) 39–41.

The second parallel is from Aristotle's *Metaphysics* 5.23, and this passage makes the connection between the *synechon* and the 'preventer' explicit. Aristotle writes:

That which prevents (τὸ κωλύον) something from moving or acting in accordance with its own impulse is said 'to hold it' (ἔχειν), as e.g. pillars 'hold' (ἔχειν) the weights lying upon them and as the poets make Atlas 'hold' (ἔχειν) the sky, since it would fall upon the earth, just as some of the physicists also say. In this way what holds together (τὸ συνέχον) is said to hold (ἔχειν) what it holds together (συνέχει), since each would separate in accordance with their own impulse.

ARIST. *Metaph.* 5.23, 1023a17–23³⁰

According to Aristotle, one way of understanding the *synechon* is as that which prevents (τὸ κωλύον) the parts from acting according to their own impulses. The sky, for instance, left to its own impulses, would fall to the earth;³¹ but, as long as it is held up by Atlas and as long as Atlas can overpower the tendency of the sky to fall, the cosmos will be sustained.³² In the same way, the *synechon* prevents the parts of a thing from separating out. The assumption, then, is that the parts of things have impulses, which on their own would lead them to separate out; since wholes exist, those impulses must somehow be restrained. The *synechon* is the name given to whatever it is that does this.

3 Plato

The model of the *synechon* of the early Greek physicists is, we might say, *tyrannical*, at least as it is understood by Plato and Aristotle. The *synechon* is a distinct kind of part which holds things together, what I have called a binding

30 ἔτι τὸ κωλύον κατὰ τὴν αὐτοῦ ὀρμὴν τι κινεῖσθαι ἢ πράττειν ἔχειν λέγεται τοῦτο αὐτό, οἷον καὶ οἱ χίονες τὰ ἐπικείμενα βάρη, καὶ ὡς οἱ ποιηταὶ τὸν Ἄτλαντα ποιοῦσι τὸν οὐρανὸν ἔχειν ὡς συμπεσόντ' ἂν ἐπὶ τὴν γῆν, ὡσπερ καὶ τῶν φυσιολόγων τινὲς φασιν· τοῦτον δὲ τὸν τρόπον καὶ τὸ συνέχον λέγεται ἂν συνέχει ἔχειν, ὡς διαχωρισθέντα ἂν κατὰ τὴν αὐτοῦ ὀρμὴν ἔκαστον.

31 Diogenes is reported to think it sometimes does fall as meteorites. See Aetius *Placita* 2.13.15 and 9 = no. 608 Kirk et al. (1999) 445.

32 One might object that Atlas is clearly keeping things apart, rather than holding them together, and the variation between Plato's and Aristotle's terminology, where Plato says that Atlas 'holds together' (συνέχειν) all things, while Aristotle says that it 'holds' (ἔχειν), suggests the terminology was not settled. The general agreement, however, is that the *synechon* holds things together by being stronger than the things it holds together and restraining the parts that make up the whole.

part, and it does this by overpowering the tendencies or impulses of the other parts.³³ A whole is made up of competing forces, subdued by the strength of a dominant force, compelling and forcing them to unite as one.

The tyrannical model of the *synechon* we find in Diogenes is adopted and refined by both Plato and Aristotle (I will turn to Aristotle in the next section). In the passage from the *Phaedo* above, Plato complains that they ‘think that that which is truly good and binding (τὸ ἀγαθὸν καὶ δέον) does not bind (συνδεῖν) and hold together (συνέχειν) anything.’ Plato agrees with Diogenes (and Anaxagoras, Empedocles and the others), that intelligence or the good should be that which holds the cosmos together, but he thinks this needs a different kind of model of cohesion, one that does not unite parts into a whole merely through force and compulsion, but under a common virtue or good. Plato has Socrates make a similar point in the *Gorgias*: ‘the wise say that fellowship and friendship, orderliness, self-control and justice hold together (συνέχειν) the heaven and earth, gods and men, and because of these things, my friend, they call this whole (τὸ ὅλον) a cosmos (κόσμος) and not unarranged (ἀκοσμία) or uncontrolled (ἀκολασία)’ (Plato, *Gorgias*, 507e6–8a4).³⁴ At this level of abstraction, the point is not idle. If the parts of a whole share a unity of purpose, such that they are directed towards achieving one good, then Plato thinks such an entity has a better claim to being a whole than if it were merely assembled by force.

Why Plato thinks this is not entirely clear, but there have been some suggestions. In an article on Socrates’ objections to the earlier physicists in the *Phaedo*, Stephen Menn points out that one thing Plato might be criticizing is the failure of materialist accounts like Diogenes’ to explain why things are

33 So, in Euripides, *Supplikes* 311–14:

... and all those who confuse the customs of Hellas,
stop. For what holds together (τὸ συνέχον) the cities of men
is this: when someone rightly preserves (σώζει) the laws.

Alexander of Aphrodisias thinks Aristotle was trying to avoid this implication, claiming the difference between the way a tyrant ‘holds’ a city and the *synechon* ‘holds’ a whole, is that a tyrant imposes his impulse on things, while the *synechon* prevents other things from acting according to their impulse (Alexander, *In Aristotelis Metaphysica commentaria* 421,17–21 Hayduck).

34 φασι δ’ οἱ σοφοί, ὃ Καλλίκλεις, καὶ οὐρανὸν καὶ γῆν καὶ θεοὺς καὶ ἀνθρώπους τὴν κοινωσίαν συνέχειν καὶ φιλίαν καὶ κοσμιότητα καὶ σωφροσύνην καὶ δικαιοσύνην, καὶ τὸ ὅλον τοῦτο διὰ ταῦτα κόσμον καλοῦσιν, ὃ ἔταίρε, οὐκ ἀκοσμίαν οὐδὲ ἀκολασίαν. Xenophon’s Socrates also discusses ‘the one who coordinates and holds together the whole cosmos (ὁ τὸν ὅλον κόσμον συντάττων τε καὶ συνέχων)’ as a cause of everything beautiful and good (πάντα καλά καὶ ἀγαθὰ) (Xenophon, *Memorabilia*, 4.3.13).

wholes at all.³⁵ A mass of things held together by compulsion may have spatial contiguity, but this would not be enough to get us substantial or conceptual unity, since it leaves unexplained the most important fact about it: that it is a whole, a single subject, with parts that have the arrangement, or *cosmos*, they have. To explain that there is a single thing, we need a different kind of *synechon*, something unlike air or the other kinds of material things which the tyrannical model assumes.

In addition to this conceptual problem, Plato may also believe that it is implausible to consider the kinds of things Diogenes or Anaxagoras posit to be sources of orderly, rational movement in other things. Plato believes, and thinks his interlocutors believe as well, that all perceptible things share one feature: water, earth, even Diogenes' air, Anaxagoras' Reason, or Empedocles' Love, move by contact: by moving and being moved by other things.³⁶ This may be why Plato says the physicists are looking for an Atlas stronger than the bodies it compels and also why he thinks these projects are bound to fail. If bodies move by being moved, then when Atlas pushes up against the sky to hold it, the sky will push back against him. For Plato, however, such an arrangement is implausible: no matter how rational Atlas is, as long as he is a body, he will be moved by the things he is moving contrary to his reason. Given a long enough time, perhaps the *cosmos* might descend into disorder,³⁷ or perhaps this is too impious a position to attribute to a divine cause of order. But whatever Plato's precise reason, the *cosmos* is not disorderly, and so he thinks what holds the *cosmos* together must be an even more absolute ruler than Diogenes' tyrant, one which can hold the *cosmos* together without its authority being threatened. To do this, it needs to be a different kind of thing altogether, some entity that can bring about an effect in the parts and preserve the whole they compose, without itself being subject to change from the things it is acting upon.

To conclude this section, I think it is useful to compare Plato's revision of Diogenes' tyrannical model (we can call it the monarchic model) with a still earlier one, which appeals to another political metaphor – that of equality or *isonomia*. Its most famous proponent is Alcmaeon of Croton, who (at least according to the report) claimed, 'what is cohesive of health is the equality of powers' (τῆς μὲν ὑγιείας εἶναι συνεκτικὴν <τὴν> ἰσονομίαν τῶν δυνάμεων), while, of diseases and corruption more generally, 'the agent is a monarchy among

35 Menn (2010) 53–61.

36 Plato develops these themes further in *Timaeus* 52a–e and *Laws* X 893b–99d.

37 Menn (1995) 41. This study continues to serve as a foundational introduction to Plato's critique and refinement of early Greek physics.

them, since monarchy is each thing's agent of destruction' (τὴν δ' ἐν αὐτοῖς μοναρχίαν νόσου ποιητικὴν· φθοροποιὸν γὰρ ἑκατέρου μοναρχίαν) ([Plutarch], *Placita philosophorum* 30, 911a2–9 = Alcmaeon 14 B 4 DK). As Gregory Vlastos points out in 'Equality and Justice in Early Greek Cosmologies,' for many early Greek physicists and physicians, including Alcmaeon, 'the order of nature is maintained because it is an order of equals.'³⁸ Rather than assuming there is one body or force which compels unity on parts to form a whole, this model assumes that cohesion is something that emerges from an equality or equipollence among opposing bodily forces. The same model of equality is found in some Hippocratic writers, who see the equal mixture (κρᾶσις) of the powers in the body (e.g. hot cold moist dry) to be equivalent to health. It is also found in Plato's *Phaedo* as the view proposed by Simmias, who claims 'our body is as it were made taut (ἐντεταμένον) and held together (συνεχόμενον) by hot, cold, dry, wet, and things like them, and our soul is a mixture (κρᾶσις) and *harmonia* or attunement (ἄρμονία) of those same things' (Pl. *Phd.* 86b7–c1).³⁹ The fact that the *isonomia*/mixture model is put forward by Simmias, with his apparent ties to Pythagoreanism, suggests the model may also be at work in theories in which the soul is conceived of as a *harmonia*, where the *harmonia* literally is the mixture or attunement of the constituent elements.⁴⁰ The author of the text attributed to Alcmaeon in the *Placita*, of course, is himself stretching when he writes that Alcmaeon calls *isonomia* 'cohesive' of health and monarchy its agent of destruction. Alcmaeon almost certainly did not use the term 'συνεκτικήν' for 'cohesive', which in this quotation has its later, Hellenistic sense of a cause such that when it is present the effect is present. The author's interpretation nevertheless highlights what Alcmaeon and Simmias are suggesting, namely that coherence and unity emerge from an equipollence of opposing parts.

The idea that cohesion arises from an equality of opposing forces is about as far as one can get from Diogenes' tyrannical model of the *synechon* of living bodies and of the cosmos as a whole. Nevertheless, mixture (κρᾶσις), or an equality of forces, remained a productive way of understanding material composition and cohesion. The physician Galen will go so far as to write a treatise in this tradition, *That the Qualities of the Soul follow the Mixtures of the Body (QAM)*, which sets out to prove that the qualities of the soul depend on, and so emerge from, the mixture of elements in the body, thus suggesting that

38 Vlastos (1996) 58–61.

39 I am grateful to Gábor Betegh and David Ebrey for suggesting a connection with Simmias' claims in the *Phaedo*.

40 On Simmias' Pythagoreanism, see Sedley (1995).

the body is what holds the soul together, rather than the other way around.⁴¹ Aristotle, however, took a different approach to the notion of mixture. He supposed, like Plato, that bodies cannot be causes of their own cohesion. This role must be filled by something else, some cause that is not another part, which Aristotle called nature or soul.

4 Aristotle

So far, I have claimed that the *synechon* of Plato's and Aristotle's predecessors share three characteristics, which I call the 'tyrannical' model of cohesion. The first is that the *synechon* is a part of what it holds together, what I call a binding part. The second, that the whole it holds together only exists so long as the *synechon* exists. And the third is that the *synechon* holds parts together by hindering the impulses of those parts. I have also argued that Plato criticized and refined two of these characteristics. Against the first characteristic, Plato argues that, at least at the level of living things and the cosmos as a whole, the *synechon* cannot be another part of the whole the same as other bodily parts. If it were, it would end up being jostled around too much by the things it is trying to hold together to plausibly maintain the order and integrity of the cosmos we observe.⁴² Against the third characteristic, Plato argues that the *synechon*, if it is to produce a whole, cannot merely be what hinders the impulses of the parts, but also needs to be what directs those impulses towards a common purpose. This may involve tempering or hindering the individual impulses, but what unifies them into a whole is not merely their being forced into some kind of contiguity, but the purpose to which they are being aimed.

I have also shown that at the bodily level, Aristotle continues to use the tyrannical model of cohesion presented by his predecessors. He thinks the

41 Galen, *QAM* (IV.767–822 κ. = 32,1–79,24 Müller). I cannot here do justice to the complexities around theories of mixture and their rise in Hellenistic and later thought. For an overview, see Singer et al. (2018) 1–46; and Mirrione (2017).

42 Plato does often talk about the soul in ways that make it seem similar to perceptible bodies, e.g. especially in the *Timaeus*, where he says it is something spatially extended and jostled around by the bodies it inhabits. As David Ebrey points out to me, this might imply souls as *synechonta* are subject to the same criticism – and this may be true, and perhaps even desired, since living things, unlike the cosmos, are not immortal, which they would be if what held them together could never be weakened. Plato needs to give other arguments in the *Timaeus* to explain why the cosmos is immortal, namely because there are no bodies outside of it which might impede its activity by acting on it from without. See *Pl. Ti.* 32c–34b.

cohesion of things like chairs or animal bodies can be explained by the presence of binding parts like glue, rivets or sinews. At the same time, he agrees with Plato that if a whole is to be a true unity, then there needs to be some cause that unifies the parts more than spatially or by contact. There needs to be a unity of purpose, what Plato calls the good and Aristotle 'that for the sake of which' something exists. In this section, I want to focus on another model of bodily coherence which Aristotle uses to illustrate this kind of cause, namely the arts.

There are three passages in Aristotle's *De anima* where he addresses the question, what is it that actively holds the parts of the body together? In these passages, Aristotle uses the characteristics of the *synechon* accepted by his predecessors, including Plato, to argue for a different model of the *synechon* that is not based on the relation of a tyrant to what it rules or on an equipollence among opposing powers, but on the relation of an art to its instruments or organs.

In the first passage, Aristotle uses the argument from the *Phaedo* to show that the soul cannot be made up of several different elements, in other words, that the soul cannot arise, like health does for Alcmaeon, from several different elements combining.

Someone might also raise the problem: (if the soul is composed of different elements), what is it that makes them one (τὸ ἐνοποιούν)? For the elements, at any rate, look like matter, while the *synechon* – whatever it is – is most powerful. But it is impossible for anything to be stronger than and rule over (κρείττον καὶ ἄρχον) the soul, even more impossible (for something to rule over) reason.

ARIST. *De an.* 1.5, 410b10–14⁴³

This argument is similar to the ones from Diogenes and Plato we met earlier, but Aristotle is extending those arguments from macro- to microcosm. Whatever the *synechon* is, whether it is a body or an immaterial substance or something else, it must be 'the most powerful,' i.e., more powerful than any of the things it is meant to hold together. Otherwise, it would not be able to hinder the impulses of the things it binds. And Aristotle, following the *Phaedo*, will argue that this means the *synechon* cannot be material: matter can always be moved, because it is always just as strong as any other matter. The *synechon*

43 ἀπορήσειε δ' ἂν τις καὶ τί ποτ' ἐστὶ τὸ ἐνοποιούν αὐτά· ὕλη γὰρ ἔοικε τά γε στοιχεῖα, κυριώτατον δ' ἐκεῖνο τὸ συνέχον, ὃ τί ποτ' ἐστίν· τῆς δὲ ψυχῆς εἶναι τι κρείττον καὶ ἄρχον ἀδύνατον ἀδυνατώτερον δ' ἔτι τοῦ νοῦ.

must instead be something that cannot be moved, at least by the things it binds, and so must be something immaterial, i.e. soul or reason.

Aristotle then turns to a slightly different question, namely what holds the parts of the soul together. This argument appeals to the second characteristic of the *synechon*, that the whole exists only so long as the *synechon* exists and is present in it. Aristotle uses it against an opponent who thinks the soul is naturally divided (μεριστή πέφυκεν), asking what it is that holds the divided soul together (συνέχει τὴν ψυχὴν). Aristotle argues that it is 'surely not the body,' since the opposite is obvious, namely that the soul 'holds (συνέχειν) the body together, since the body evaporates and putrefies when it departs' (Arist. *De an.* 1.5, 411b6–9).⁴⁴ Aristotle's target here is almost certainly Plato. In the discussion of different kinds of soul at *Timaeus* 69c–73d, Plato has the lesser gods construct and localize the mortal kinds of soul in different regions of the body. When he goes on to explain how the different kinds of soul are bound together, including the immortal soul, he explains it by their common bond to the body: the god 'bound the kinds of souls together by implanting them in the marrow (φυτεύων ἐν αὐτῷ [sc. τῷ μυελῷ] κατέδει τὰ τῶν ψυχῶν γένη)' (Pl. *Ti.* 73c3–4).⁴⁵ Aristotle thinks this explanation cannot succeed. Even if only the immortal, i.e. intellectual, soul departs at death, the body nevertheless rots, and this implies that the other souls (or parts of soul) have departed as well. These souls must, therefore, form a whole and not merely because they are present in the same body.

The third passage contains Aristotle's own solution to the problem of the *synechon* of the body. Aristotle has been discussing Empedocles' explanation of why the roots of plants grow down and their tops grow up (answer: earth naturally tends to go down, fire tends to go up, and the growth of the plant spreads along this axis). After some initial criticisms, Aristotle asks:

What is the thing that holds together (τὸ συνέχον) fire and earth, which tend to move in opposite directions? For they will be pulled apart if there is nothing preventing it (τὸ κωλύον). But if there is, then this is the soul and the cause of nutrition and growth. Some people think the nature of fire is the cause of nutrition and growth, especially since it is the only body that seems to be fed and to grow, and for this reason someone might assume, in the case of animals and plants too, this is the agent (τὸ ἐργαζόμενον). Although it is somehow the contributing cause (τὸ συναίτιον), surely the

44 τί οὖν δὴ ποτε συνέχει τὴν ψυχὴν, εἰ μεριστὴ πέφυκεν; οὐ γὰρ δὴ τό γε σῶμα δοκεῖ γὰρ τούναντιον μᾶλλον ἢ ψυχὴ τὸ σῶμα συνέχειν· ἐξελθούσης γοῦν διαπνέεται καὶ σήπεται.

45 Thanks to Gábor Betegh for pointing me to this passage.

cause (τὸ αἴτιον) strictly speaking is not (fire), but rather the soul: for fire's growth is unlimited as long as there is something to burn, while of things composed by nature, there is a limit and proportion of both size and growth. These belong to soul rather than fire and to reason (λόγος) rather than matter.

ARIST. *De an.* 2.4, 416a6–18⁴⁶

Aristotle begins this passage by appealing to the *synechon's* role as that which prevents the parts from separating according to their own impulses. The target is Empedocles and his attempt to explain the growth of plants according to the elements (the parts) that make them up. Aristotle's point is that Empedocles' strategy of trying to explain the activities of a whole in terms of the activities of the parts is hopeless, especially since those parts have opposing impulses, which, rather than leading to a complex activity and arrangement, as we in fact find, should simply lead to the plant being torn apart. Aristotle does not want to deny that the powers of the elements have a role in the growth and maintenance of a living thing; but he wants to reconsider what that role is in light of the fact that the elements cannot explain the arrangement and limit of a thing's growth. So, Aristotle calls fire in this case a co-cause (τὸ συναίτιον), while he reserves the term cause (τὸ αἴτιον) for the soul, since the soul is properly speaking the agent (τὸ ἐργαζόμενον) acting in accordance with a rational principle (λόγος), rather than a chaotic one. But what is the relationship between the two?

Aristotle appeals to a different model of the *synechon* from that of a tyrant or monarch, opting instead for a model based on the arts. In broad strokes, Aristotle thinks that, among living things, what makes them wholes is not a specific material part, but the soul, which actively holds the parts of the body together. The soul does this not by constraint or force, but by producing and maintaining the various parts of the body through nutrition and growth, an activity which uses the body and its components as instruments or *organs* (in Greek, τὰ ὄργανα). What guarantees the cohesion of the body in this instance is the fact that the body is a prerequisite for the soul to do whatever else it does

46 πρὸς δὲ τούτοις τί τὸ συνέχον εἰς τάναντία φερόμενα τὸ πῦρ καὶ τὴν γῆν; διασπασθήσεται γάρ, εἰ μὴ τι ἔσται τὸ κωλύον· εἰ δ' ἔσται, τοῦτ' ἔστιν ἡ ψυχὴ, καὶ τὸ αἴτιον τοῦ αὐξάνεσθαι καὶ τρέφεσθαι. δοκεῖ δὲ τισιν ἡ τοῦ πυρὸς φύσις ἀπλῶς αἰτία τῆς τροφῆς καὶ τῆς αὐξήσεως εἶναι· καὶ γὰρ αὐτὸ φαίνεται μόνον τῶν σωμάτων [ἢ τῶν στοιχείων] τρεφόμενον καὶ αὐξόμενον, διὸ καὶ ἐν τοῖς φυτοῖς καὶ ἐν τοῖς ζώοις ὑπολάβοι τις ἂν τοῦτο εἶναι τὸ ἐργαζόμενον. τὸ δὲ συναίτιον μὲν πῶς ἔστιν, οὐ μὴν ἀπλῶς γε αἴτιον, ἀλλὰ μᾶλλον ἡ ψυχὴ· ἡ μὲν γὰρ τοῦ πυρὸς αὐξήσεως εἰς ἄπειρον, ἔως ἂν ᾗ τὸ καυστόν, τῶν δὲ φύσει συνισταμένων πάντων ἔστι πέρασ καὶ λόγος μεγέθους τε καὶ αὐξήσεως· ταῦτα δὲ ψυχῆς, ἀλλ' οὐ πυρὸς, καὶ λόγου μᾶλλον ἢ ὕλης.

(reproduce, perceive, think). So long as the soul is present in the body, it will actively maintain the arrangement of the body in order that the body continues to serve as its instrument.

Aristotle does not use this model to suggest that the soul is like an artist using instruments; rather, he seems to be thinking of the soul like an *art* using its instruments.⁴⁷ The muses may always need a poet, but nature needs no such medium – it can act immediately through bodies. This leads Aristotle to make some bizarre-sounding claims. He says things like, ‘if the art of ship-building were in the wood, it would produce the same results by nature’ (Arist. *Phys.* 2.8, 199b28–29), i.e. the wood would turn itself into a ship. There is also a thought experiment about an axe as a natural body (φυσικὸν σῶμα), something like a cybernetic hatchet, whose soul is the capacity to cut things (ἡ δύναμις τοῦ ὀργάνου) and whose activity is to get up and cut things on its own, no carpenter required (Arist. *De an.* 2.1, 412b10–13a10). In the world of human craft, an artist is a necessary intermediary between the art and the instruments or organs through which it acts; nature, however, needs no intermediary. It operates like a doctor who cures herself (ὅταν τις ἰατρῆυῃ αὐτὸς ἑαυτὸν) (Arist. *Phys.* 2.8, 199b31).

That is not to say that outside influences cannot act on the body and threaten its cohesion. The soul may be unaffected or unmoved by the body when it acts, since ‘like, the art of medicine ... when it produces health, it is in no way affected by the patient who is being healed’ (Arist. *Gen. Corr.* 1.7, 324a35–b1).⁴⁸ Nevertheless, the matter, i.e. the body, like food or a drug acting as instruments of the agent, is always affected when it carries out the soul’s activities: ‘the food, when it produces (health), is also affected in some way: for it is heated or cooled or otherwise affected at the same time as it acts’ (Arist. *Gen. Corr.* 1.7, 324b1–3). Over time, the body, like a blunted instrument, will become incapable of carrying out the activities of the soul, including the activity of maintaining its own cohesion.⁴⁹

47 Menn (2002) 95.

48 Cf. Arist. *De an.* 3.5, 430a17–19 ‘for reason (ὁ νοῦς) is separate, unaffected and unmixed, being substance in actuality. For the agent is always more honourable than the patient, and the principle than the matter.’ On the *Gen. Corr.* passage and its relevance, see Menn (2002) 95–99; Falcon (2005) 25.

49 Menn (2002) 113.

5 The Stoics, Pneumatists and Galen

The history of the *synechon* or cohesive cause which I have been tracing leads in the end to the more familiar Stoic notion. The Stoic position on cohesive causes resembles something like an eclectic mix of Diogenes of Apollonia and Aristotle. A comparatively large amount of literature exists on the Stoic theory of cohesive causes, at least much more than on earlier theories.⁵⁰ Rather than rehearse this literature, I want to conclude by noting a few aspects of the Stoic notion of cohesive causes that seem to me most closely related to this earlier tradition.

The first is perhaps trivial, but worth mentioning. It is often said that the Stoic cohesive cause is an analogue to the Aristotelian form,⁵¹ but speaking this way tends to obscure how similar the causal role of the Stoic cohesive cause and its Aristotelian equivalents are, whether that equivalent is soul, nature or the notion of actuality more generally – whatever that metaphysical item is which is the immaterial cause to the matter of its having the kind of activity it has: the force, so to speak, existing in the matter, as soul is the cause to a body of its being actually a living body. We may not think of ‘being a living body’ as a kind of activity, but for Aristotle, being alive or being anything else is to exist in actuality (*ἐνεργεῖα*), which is for him a kind of activity without movement. The Stoic view is remarkably close to this except, because they believe only bodies can be causes, they deny there are activities without movement. They do, however, maintain a distinction between the cause and the matter and, as does Aristotle, they believe the cause acts to confer cohesion to the matter. Galen gives the most complete summary of their view in his work on *Cohesive Causes*:

The first philosophers of my acquaintance to speak of a cohesive cause were the Stoics. Their view is that from the four elements are produced those bodies that Aristotle calls homoiomerous and that are described by Plato as ‘the first to be generated,’ while all other bodies are simply compounds of these. Of the elements themselves, some they call material and some active and dynamic. They maintain that the material elements are held together by those that are dynamic, fire and air being dynamic and active in their view, while earth and water are material. They say that, when the elements are intermingled, the dynamic wholly penetrate the material, that is to say, air and fire penetrate water and earth. Air is cold

50 See especially Frede (1987), Hankinson (1998), Bobzien (1999), and papers in Coughlin, Leith and Lewis (2020).

51 See n. 14 above.

and fire is hot. The natural effect of air is to consolidate and thicken a substance, whereas fire naturally causes expansion, loosening and widening. The two active elements have fine parts and the other two thick parts. Every substance with fine parts the Stoics call spirit (sc. *pneuma*), and they think that the function of this spirit is to produce cohesion in natural and in animal bodies. By natural bodies I mean those that are produced by nature and not by human skill, like stones, gold, wood and those parts of the animal body that are called the primary and homoiomerous parts, that is, nerves, arteries, veins, cartilages, bones and everything else of the same sort. Men join bits of wood together with glue, nails, pegs, clay, gypsum and lime. Similarly nature is found connecting all the parts of the body so as to form a united whole by means of cartilage, ligaments and tendons. If you like, you can call the parts of the body that produce this union in the simple members cohesive causes of the compounds, and the same term can be applied to clay, gypsum, lime and the other things that serve the same purpose in externals which are connected by the skill of man and not by nature. It is not these, however, but rather material substance with fine parts that the Stoics call a cohesive cause.

GAL. CC 1.1–5, 53.2–55.3 Lyons, trans. LYONS⁵²

Galen's summary, that *pneuma* (a mixture of fire and air) is the active element and brings about cohesion in the material elements, earth and water, by producing a two-fold movement outward and inward, is echoed in numerous other ancient sources.⁵³ Sextus Empiricus tells us that the Stoics also called 'what holds together (τὸ συνέχον) the whole compound' the soul.⁵⁴ Galen's other claim that things, like glue and nails, ligaments and tendons, can be called *synechon*, echoes the earlier use of the term, where it meant a binding part, as opposed to an active cause.⁵⁵ Galen himself rejects the Stoic cohesive

52 cf. Galen, *De plenitudine liber* 3 (VII.525 κ.) '... most of those who propose the cohesive capacity (τὴν συνεκτικὴν δύναμιν), like the Stoics, make what holds together (τὸ συνέχον) one thing and what is held together (τὸ συνεχόμενον) another. For the pneumatic substance (τὴν πνευματικὴν οὐσίαν) is what holds together, while the material (substance) (τὴν ὑλικὴν οὐσίαν) is what is held together, which is why they say air and fire hold together, but earth and water are held together.'

53 [Gal.] *Def.* 96, XIX.372.1–2 κ.; Plutarch, *De Stoicorum repugnantiis* 43, 1053f3–7.

54 Sextus Empiricus, *Adversus Mathematicos* 7.234.2–4 '[Some Stoics] assert soul is said in two ways: what holds the whole compound together [τὸ τε συνέχον τὴν ὅλην σύγκρισιν], and the leading part [τὸ ἡγεμονικόν] on its own.'

55 It is used in a similar way in Plutarch, *Quaestiones Convivales* 8.10, 735e5–f2, where the loss of leaves in autumn is explained in terms of the mixture (χρᾶσις) no longer being able to preserve them because what is glutinous and cohesive (τὸ ἐχέκολλον καὶ συνεκτικόν) no longer remains in it.

cause altogether in his work *On Cohesive Causes*, arguing that either (a) every whole needs a cohesive cause, in which case *pneuma* will also need a cohesive cause and we get a regress; or (b) some things need cohesive causes, while others are self-cohesive, in which case Galen thinks a much better case could be made for something like adamantite to be self-cohesive than hot air, since things like adamantite are solid and less prone to disperse (Gal. CC 6.2–5, 61,26–63,16 Lyons).

One of the most remarkable differences between the Aristotelian and Stoic notion of the cohesive cause, however, is what it says about us, or at any rate about how we fall apart. Atlas may be strong and eternal, but our cohesion is limited. Aristotle blames the instrument. The Stoics also blame the soul – at least, the Stoic-influenced Pneumatist physician,⁵⁶ Athenaeus of Attalia sees the source of incoherence in the powers of the soul itself:

Old age requires a more exact regimen and additional aids. For the psychic and physical capacities (ψυχικαί τε καί φυσικαί δυνάμεις) which hold us together and preserve us (συνέχουσαι καί διασφύζουσαι ἡμᾶς) lose their strength, their functions are brought to an end and the body wrinkles and becomes malnourished, loose and dry. And so when the capacity which keeps the body upright (ἡ μὲν διευθύνουσα τὸ σῶμα δύναμις), offers resistance against external things that cause us injury, and resists in accordance with certain spermatoc principles (σπερματικὸς λόγους) and natural necessities (φυσικὰς ἀνάγκας), falls to the floor (ὑπὸ πόδας χωρῆ), i.e. declines in strength), the body is easily affected and easily injured, requiring but a small cause and chance influence for harm. At the start, then, from an early age, one should also take precautions for the time of old age. For as those who wear out their cloak in the summer spend the winter in tatters, so those who in their youth neglect their bodily strength suffer the clothes of old age with great difficulty.

ATHENAEUS OF ATTALIA, quoted in Oribasius, *Collectiones Medicae* (libri incerti 39) 140,13–36 Raeder

I think we must enjoy our summers.

56 On the role of *pneuma* in the Pneumatist school of medicine, see Coughlin and Lewis (2020). On Athenaeus' relationship to thinkers other than the Stoics, see Coughlin (2018) 109–13.

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