The Physics of Stoic Cosmogony

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Abstract

According to the ancient Greek Stoics, the cosmos regularly transitions between periods of conflagration, during which only fire exists, and periods of cosmic order, during which the four elements exist. This paper examines the cosmogonic process by which conflagrations are extinguished and cosmic orders are restored, and it defends three main conclusions. First, I argue that not all the conflagration's fire is extinguished during the cosmogony, against recent arguments by Ricardo Salles. Second, at least with respect to the cosmogony, it is not necessary to posit the existence of proto-elements. Third, while scholars such as Salles and David Hahm have argued that Cleanthes held a distinct theory of cosmogony from Zeno and Chrysippus, I argue that each of these Stoics endorse the same cosmogonic theory.

1. Introduction

The early Stoics claim that the world experiences periodic "conflagrations" (ἐκπυρώσεις). During these periods, fire consumes all other bodies and exists by itself.[1] After a conflagration, a

[1] This is true for most bodies, at least—specifically, for bodies at the level of complexity of the elements or higher. The Stoics also posit two corporeal "principles" (ἀρχαί): God and matter. The relationship between the principles and elements is notoriously difficult to determine. See Hensley 2017; Lapidge 1973; White 2003. It is possible that the principles exist, in some form, during conflagrations. Thus, the statement that fire exists by itself means that fire is the only body at least as complex as the elements during conflagrations; and the statement that fire consumes all other bodies only means that fire consumes air, water, earth, and complex bodies composed of the elements. However, see Plutarch, *Stoic. repug.* 1052c/SVF 2.604/LS 46E, in which Chrysippus is quoted as saying that God consumes or uses up matter during conflagrations. This might entail that matter does not exist during this period, as

period of "cosmic order" (διακόσμησις) occurs. During cosmic orders, the four elements—fire, air, water, and earth—exist, they combine to form complex objects, and the world proceeds exactly as it did during previous cosmic orders. Ultimately, each cosmic order ends with another conflagration, and the cycle between periods continues forever.

This paper examines the process by which the world changes from a period of conflagration to a period of cosmic order—the cosmogony. During this series of changes, the conflagration is extinguished and the cosmic order is restored. Furthermore, the four elements are produced, and each begins to characterize an area of the cosmos. As a result, the cosmogony intersects with Stoic theories of elemental change and cosmic structure. Additionally, the cosmogony is a biological process. For the Stoics believe that the world itself is an animal composed of a body and a soul, and the cosmogony brings that compound into existence. Thus, we can use Stoic physics, chemistry, and biology to better understand Stoic cosmogony. This is my strategy in this paper.

I will argue for three main claims. First, not all of the conflagration's fire dies during the cosmogony; thus, there is a portion of fire that persists throughout the cosmic cycle. Traditionally, many scholars have endorsed this claim, but it has been attacked by others.[2] Thus, I take a fresh look at the evidence and argue that, on balance, it supports the traditional view. Second, while some have explained the strange sequence of elemental changes that constitutes the Stoic cosmogony by positing entities called "proto-elements", I will argue that this is unnecessary. Instead, we can explain the strangeness by comparing Stoic cosmogony to Stoic embryology. Third, I will argue that the first three leaders of the Stoic school—Zeno, Cleanthes, and

well. (In this paper, I will provide references to von Arnim 1903–5 ("SVF") and Long and Sedley 1987 ("LS") when available.)

[2] Those who endorse the traditional view include Hunt 1976, 49; Lapidge 1973, 266; 1978, 166; Long and Sedley 1987, 1.279; Mansfeld 1979, 161–162; and Sellars 2006, 97–98. Those who have argued against it include Gould 1970, 121 and n. 1; Salles 2015, 17; Todd 1978, 143–145; and perhaps Cooper 2009, 105–107. Hahm 1977, who discusses the Stoic cosmogony at length, does not make clear whether he believes all of the conflagration's fire dies. See especially 57–61 and n. 2.

Chrysippus—endorse the same cosmogonic theory. Against this, Ricardo Salles and David Hahm have argued that Cleanthes' account of the cosmogony is distinct from his predecessor and successor's.[3] Hence, I will respond to their arguments.

Here is how I will proceed. Section 2 establishes what I will call the "uncontroversial account" of Zeno and Chrysippus's cosmogony—a description of the sequence of elemental changes beginning from the conflagration's fire and ending with the object that is minimally sufficient to qualify as a cosmic order. I call this the "uncontroversial account" because it is general enough that most scholars would endorse it as an interpretation of Zeno and Chrysippus. Thus, this will serve as a foundation to discuss more controversial interpretive questions. In Section 3, I argue that, according to Zeno and Chrysippus, not all of the conflagration's fire dies during the cosmogony. Correlatively, the elemental changes that constitute the cosmogony are partial, and some of each change's precursor element persists. In the course of arguing for these claims, I will respond to arguments against this view put forward by David Hahm and Ricardo Salles. In Section 4, I will describe a curious fact about Stoic cosmogony: it seems to require fewer elemental changes than actually occur. To explain this, I compare Stoic cosmogony and Stoic embryology. I also reject another explanation in which the Stoics posit proto-elements. In Section 5, I will analyze the evidence for Cleanthes' cosmogony and argue that he agrees with Zeno and Chrysippus, while responding to Salles' arguments to the contrary.

[3] Salles 2015, 22–26; Hahm 1977, 79–81; 240–247.

2. The Cosmic Order and the Uncontroversial Account

The cosmogony is the process by which the cosmic order is produced from a conflagration. Once the cosmic order exists, the cosmogony has ended. Given this, defining the cosmic order will be useful, since doing so will describe the end point of the process we are attempting to understand.

As I stated above, during conflagrations, only fire exists.[4] On the other hand, a cosmic order is characterized by an "equality" of the four elements.[5] This equality manifests in the following way: the cosmos is composed of four concentric spheres or shells, and each of these cosmic layers is characterized by one of the elements. This is evident from the report of Diogenes Laertius, who describes the cosmic order:

> They think that the cosmic order is like this. The earth is the middle, playing the role of a center, after which there is a spherical body of water, which has the same center as earth. Thus the earth is in the water. An air sphere comes after the water. Then there are five circles in heaven (Diogenes Laertius, 7.155/SVF 2.558, 2.651).[6]

Diogenes goes on to name the five heavenly circles. For our purposes, we should note that the heavenly circles are composed of fire. This is clear from a passage earlier in his presentation of Stoic physics, in which he states:

> Fire is the uppermost, which is also called aether, in which the first sphere of the fixed stars is produced, and next the sphere of the planets. After fire, there is air, and then water, and earth is the foundation of all things, since it is the middle of everything (Diogenes Laertius, 7.137/SVF 2.580/LS 47B).[7]

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[4] See Cicero, *ND* 2.118/SVF 2.593; Eusebius, *Praep. ev.* 15.18.3/SVF 2.596; Philo, *Aet. mun.* 94/SVF 2.618; Plutarch, *Stoic. repug.* 1053b/SVF 2.605/LS 46F; Stobaeus, *Ecl.* 1.171,2-5/SVF 2.596.

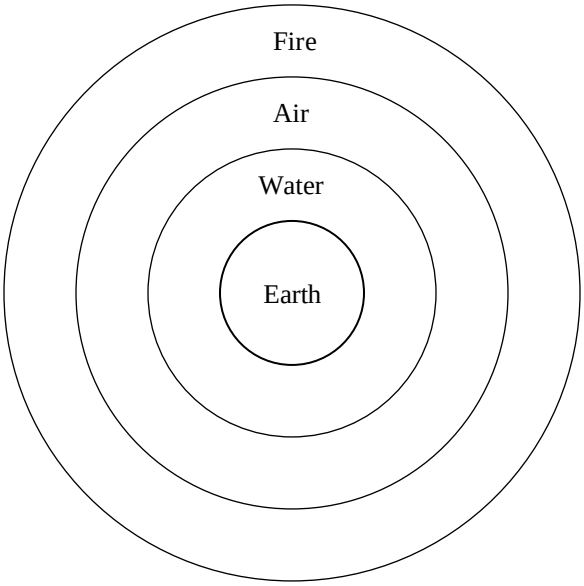
[5] This is Philo's term. See *De specialibus legibus* 1.208/SVF 2.616.

[6] Ἀρέσκει δ' αὐτοῖς καὶ τὴν διακόσμησιν ὧδε ἔχειν· μέσην τὴν γῆν κέντρου λόγον ἐπέχουσαν, μεθ' ἣν τὸ ὕδωρ σφαιροειδές, ἔχον τὸ αὐτὸ κέντρον τῇ γῇ, ὥστε τὴν γῆν ἐν ὕδατι εἶναι· μετὰ τὸ ὕδωρ δ' ἀέρα ἐσφαιρωμένον. κύκλους δ' εἶναι ἐν τῷ οὐρανῷ πέντε,

[7] ἀνωτάτω μὲν οὖν εἶναι τὸ πῦρ, ὃ δὴ αἰθέρα καλεῖσθαι, ἐν ᾧ πρώτην τὴν τῶν ἀπλανῶν σφαῖραν γεννᾶσθαι, εἶτα

Thus, according to Diogenes Laertius, a cosmic order has the following structure. An earthen sphere constitutes the center of the cosmos. It is surrounded by a watery shell, which is surrounded by an airy shell. Finally, a fiery periphery surrounds the air shell. No void exists within the cosmos, according to the Stoics.[8] It follows that these elemental layers constitute one continuous body. I have represented the structure of the cosmic order in Illustration 1:

Illustration 1: The Cosmic Order



We should note that the actual structure of the cosmos will probably not be as neat as Illustration 1 suggests. We can observe, for example, that earth and water are not sharply separated from one another, since there appears to be no watery layer above landmasses. This explains Diogenes' statements that the earth and water have the same center, and that the earth is in the water. This means that the Stoics think that the earth and water spheres are mixed together. Hence,

τὴν τῶν πλανωμένων· μεθ' ἣν τὸν ἀέρα, εἶτα τὸ ὕδωρ, ὑποστάθμην δὲ πάντων τὴν γῆν, μέσην ἁπάντων οὖσαν.
[8] Galen, *Diff. puls.* 8.674,13–14/SVF 2.424/LS 49D; *Qual. inc.* 19.464,10–14/SVF 2.502/LS 49E.

oceans and continents exist, roughly, it the same cosmic space. Still, they assign water to a higher place in the cosmos and distinguish the watery and earthen layers.

Of course, the Stoics also claim that these four elements combine to form complex objects like plants and animals existing in these elemental layers. These objects are parts of the cosmic order, as well.[9] So, when these objects are generated, changed, and destroyed, the cosmic order will change. But the object that is minimally sufficient to be a cosmic order is made up of these four elemental layers. Thus, the cosmogony is complete when this object is produced, and if we successfully describe the process that brings this object into existence, we will successfully describe the cosmogony.

Now let us turn to analyzing the sequence of changes that composes the cosmogony. First, we will examine Zeno and Chrysippus's theories. There are four pieces of evidence that describe their views on this subject, which all describe the same events. Thus, it is likely that Zeno and Chrysippus endorse the same theory of cosmogony.

First, consider the following report from Stobaeus. (I will insert my own section numbers in the next four passages, in which the same number is meant to refer to the same stage of the cosmogony.)

> Zeno declared the following. It will be necessary periodically that there is such a cosmic order of the whole out of substance, when a turning happens (1) from fire (3) into water (2) through air. (4a) One part will settle down and earth will condense, (4b) and from what's left, another part will remain water, (4c) and from the evaporated part, air will come about. (5) And when air thins, fire ignites. (6) And mixture and blending come about by means of

[9] Eusebius, *Praep ev.* 15.15.3/SVF 2.528

> a change of the elements into each other, when one body totally goes through another. (Stobaeus, *Ecl*. 1.152,19–153,6/SVF 1.102)[10]

We can divide the cosmogony into five stages. (I will discuss the curious Stage (6) later.) It begins with Stage (1): fire. This is the conflagration. The Stoics think that elemental identity supervenes on density.[11] Fire is the least dense element, followed by air, water, and earth in that order. Thus, to change into each other, the elements must change density. Therefore, a change from Stage (1)'s fire to Stage (3)'s water requires an intermediary: air. This is Stage (2). This is why fire first changes into air, which changes into water.[12]

Then several events occur. Part of Stage (3)'s water changes into earth at Stage (4a), part changes into air at Stage (4c), and part remains water at Stage (4b). It is likely that these three events happen roughly simultaneously, but the text does not strictly entail this. Finally, part of Stage (4c)'s air changes into fire at Stage (5). Stage (5) must occur after Stage (4c), given that the fire is produced from a thinning of the air.

This completes the cosmogony. For, at this stage, the stratified elemental layers that make up the cosmic order exist. To see this, note that the language used in the passage indicates that Stages (4a) and (4c) are not only elemental changes. They are also changes in position. As earth forms, it "settles down" (ὑφίστασθαι). Air "evaporates" (ἀτμιζομένου) from water at Stage (4c). This leaves a portion of water in the middle between earth and air. When fire ignites at Stage (5),

[10] Ζήνωνα δὲ οὕτως ἀποφαίνεσθαι διαρρήδην· τοιαύτην δὲ δείσει εἶναι ἐν περιόδῳ τὴν τοῦ ὅλου διακόσμησιν ἐκ τῆς οὐσίας, ὅταν ἐκ πυρὸς τροπὴ εἰς ὕδωρ δι' ἀέρος γένηται, τὸ μέν τι ὑφίστασθαι καὶ γῆν συνίστασθαι, [καὶ] ἐκ τοῦ λοιποῦ δὲ τὸ μὲν διαμένειν ὕδωρ, ἐκ δὲ τοῦ ἀτμιζομένου ἀέρα γίγνεσθαι, λεπτυνομένου δὲ τοῦ ἀέρος πῦρ ἐξάπτεσθαι, τὴν δὲ μῖξιν <καὶ> κρᾶσιν γίγνεσθαι τῇ εἰς ἄλληλα τῶν στοιχείων μεταβολῇ σώματος ὅλου δι' ὅλου τινὸς ἑτέρου διερχομένου.

[11] For a detailed defense of this view, see Hahm 1985, 42–47. See also Salles 2016. Evidence includes Galen, *Nat. Fac*. 1.3/SVF 2.406/LS 47E, discussed below; Stobaeus, *Ecl*. 1.129,17–23/SVF 2.413/LS 47A.

[12] Following Salles 2015, 17.

a shell of fire begins to encompass Stage (4c)'s airy shell, as flames protrude off of a burning object. Thus fire exists at the periphery.[13]

I have represented the order of these changes and the position of each sphere or shell in Table 1:

Table 1: The Uncontroversial Account of Zeno and Chrysippus's Cosmogony

Periphery					Fire
Intermediate Shell				Air	Air
Inner Shell				Water	Water
Inner Sphere	Fire	Air	Water	Earth	Earth
Positions	*Stage (1)*	*Stage (2)*	*Stage (3)*	*Stage (4)*	*Stage (5)*

Table 1 represents what I will call the "uncontroversial account" of Zeno and Chrysippus's cosmogony. Most scholars would agree that Stobaeus's report explicitly describes every change in Zeno's cosmogony. The following passages do not. However, we can use Stoabeus to fill in the details missing from the others. Consider the following report from Diogenes Laertius.

> The cosmos is generated whenever substance is turned (1) from fire (2) through air (3) into moisture. Next, (4a) when the thicker part of it condenses, earth is completed. (4c) The thinner part of it rarefies, (5) and when this becomes even thinner, fire is produced. (7) Next, plants, animals, and the other genera are composed from these by mixture. Zeno talks about the generation and destruction of the cosmos in his *On the Whole*, and Chrysippus in

[13] See Cooper 2009, 105–106.

> the first book of his *Physics*, and Posidonius in the first book of his *On the Cosmos*, and Cleanthes, and Antipater in the tenth book of his *On the Cosmos*. (Diogenes Laertius, 7.142/SVF 2.581/LS 46C)[14]

Diogenes agrees with Stobaeus.[15] However, he leaves out a few details. His report does not mention Stage (4b), where some water remains after parts of Stage (3)'s cosmogonic water turn into air and earth. It also fails to explicitly call the product of Stage (4c) "air", though it does mention the process by which air is produced. These omissions do not seem to imply a difference in theory. Using Stobaeus, we can supply the missing details.

Diogenes says that fire turns into "moisture" (ὑγρότης) at Stage (3). Some have claimed that "moisture" refers to something different than water.[16] However, this is unlikely. For in an earlier passage, Diogenes uses "water" (ὕδωρ) in reference to this same stage.[17] So he seems to use "water" and "moisture" interchangeably, at least in the cosmogonic context.

Diogenes attributes the theory to Zeno and Chrysippus among others. Since we seem entitled to fill in the details of this passage with details from Stobaeus's report, Chrysippus likely endorsed the theory of cosmogony represented by Table 1.

We should also note that Diogenes attributes the theory to Cleanthes. This is *prima facie* evidence that Cleanthes also endorsed this theory. However, in the final section of this paper, I will discuss a report that focuses solely on Cleanthes' cosmogony. According to Ricardo Salles,

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[14] Γίνεσθαι δὲ τὸν κόσμον ὅταν ἐκ πυρὸς ἡ οὐσία τραπῇ δι' ἀέρος εἰς ὑγρότητα, εἶτα τὸ παχυμερὲς αὐτοῦ συστὰν ἀποτελεσθῇ γῆ, τὸ δὲ λεπτομερὲς ἐξαραιωθῇ, καὶ τοῦτ' ἐπὶ πλέον λεπτυνθὲν πῦρ ἀπογεννήσῃ. εἶτα κατὰ μίξιν ἐκ τούτων φυτά τε καὶ ζῷα καὶ τὰ ἄλλα γένη. περὶ δὴ οὖν τῆς γενέσεως καὶ φθορᾶς τοῦ κόσμου φησὶ Ζήνων μὲν ἐν τῷ Περὶ ὅλου, Χρύσιππος δ' ἐν τῷ πρώτῳ τῶν Φυσικῶν καὶ Ποσειδώνιος ἐν πρώτῳ Περὶ κόσμου καὶ Κλεάνθης καὶ Ἀντίπατρος ἐν τῷ δεκάτῳ Περὶ κόσμου.

[15] Note that Diogenes also uses language of condensation and rarefaction to represent elemental changes. The thicker part of Stage (3)'s water "condenses" even further. In doing so, it changes into earth. The thinner part of Stage (3)'s water "rarefies" and "becomes even thinner". In doing so, it changes into air and fire respectively. Thus Diogenes confirms that a change in elemental identity supervenes on a change in density. See n. 11.

[16] Frede 2005, 228.

[17] See below. See also discussion by Cooper 2009, 106 and n. 28.

this report differs from Diogenes Laertius's account; thus, he infers that Diogenes mistakenly attributes Zeno and Chrysippus's view to Cleanthes in the passage above.[18] I disagree with this. Thus, I will not yet infer that Cleanthes endorsed the theory represented in Table 1, so that I do not beg the question in my favor.

Finally, we should note that Diogenes includes a seventh stage in his description. After the cosmic layers are produced, the four elements combine to form complex objects like animals and plants. This confirms that these objects, while being a part of the cosmic order, come into existence after the generation of the object that is minimally sufficient to qualify as a cosmic order.

Let us move on to our third piece of evidence. In an earlier passage, Diogenes presents an abbreviated version of the cosmogony:

> In the beginning, when [God] was by himself, he turned all substance (2) through air (3) into water. And just as the seed is surrounded in the generative material[19], so too he, the seminal reason of the cosmos, stays behind as such in the moisture, making matter malleable to himself with respect to the generation of the subsequent things. (4a–4c, 5) Next, he first produces the four elements: fire, water, air, and earth. Zeno talks about them in his *On the Whole*, Chrysippus in the first book of his *Physics*, and Archedemus in a book of his *On Elements*. (Diogenes Laertius, 7.136/SVF 2.580/LS 46B)[20]

In this earlier passage, Diogenes does not mention Stage (1)'s fire and instead mentions God. His reasons for this are not clear. Perhaps he assumes that God and the conflagration's fire

[18] Salles 2015, 15.

[19] I have adopted this non-committal translation of γονή from Cooper 2009, 101, whose explanation in his n. 19 seems correct to me. Given that the γονή serves two distinct biological roles in this process, which I describe in Section 4, a non-committal translation is best.

[20] κατ' ἀρχὰς μὲν οὖν καθ' αὑτὸν ὄντα τρέπειν τὴν πᾶσαν οὐσίαν δι' ἀέρος εἰς ὕδωρ· καὶ ὥσπερ ἐν τῇ γονῇ τὸ σπέρμα περιέχεται, οὕτω καὶ τοῦτον σπερματικὸν λόγον ὄντα τοῦ κόσμου, τοιόνδε ὑπολείπεσθαι ἐν τῷ ὑγρῷ, εὐεργὸν αὐτῷ ποιοῦντα τὴν ὕλην πρὸς τὴν τῶν ἑξῆς γένεσιν· εἶτ' ἀπογεννᾶν πρῶτον τὰ τέσσαρα στοιχεῖα, πῦρ, ὕδωρ, ἀέρα, γῆν. λέγει δὲ περὶ αὐτῶν Ζήνων τ' ἐν τῷ Περὶ τοῦ ὅλου καὶ Χρύσιππος ἐν τῇ πρώτῃ τῶν Φυσικῶν καὶ Ἀρχέδημος ἔν τινι Περὶ στοιχείων.

are the same. Perhaps, in this passage, he focuses on the roles of the Stoic principles in this process and so does not discuss the elements in as much detail. In any case, the phrase "through air into water" clearly marks this passage as being cosmogonic, since this language shows up in our other three sources for Zeno and Chrysippus's cosmogonic theories. Since it was orthodox Stoic doctrine that fire is present during the conflagration, and since the cosmogony is the process by which the cosmos shifts from conflagration to cosmic order, Diogenes' failure to mention fire does not imply a difference in theory.

Diogenes also abbreviates his description of how the stratified spheres and shells that make up the cosmic order are produced by saying that God produces "the four elements". Given the details of the other passages we have examined, it seems that the best way to interpret this claim is that God produces the stratified arrangement of the cosmos out of Stage (3)'s water. At this point, the cosmic order exists, and we can treat fire, air, water, and earth as beginning to realize their roles as primary immanent components of the world. It is in this sense that the elements are produced.[21] In all, while this earlier passage from Diogenes is not clear, it too seems to report the theory of cosmogony represented in Table 1, and it attributes that theory to Zeno and Chrysippus.

Finally, in the following passage, Plutarch quotes Chrysippus on the cosmogony:

> For [Chrysippus] says in the first book of his *On Nature*: "The change (1) of fire is like this: it is turned (2) through air (3) into water. And from this, (4a) while earth settles down, (4c) air evaporates. (5) When the air becomes thinner, the aether is poured around in a

[21] I argue for this claim in Hensley 2017. Alternatively, one could argue that God produces the standard elements from proto-elemental substances, and it is in this sense that the elements are produced. See Cooper 2009; Frede 2005. Even if this is correct, it is still clear that Diogenes describes the production of the stratified cosmos at this point in the passage.

circle. And the stars are ignited from the sea along with the sun." (Plutarch, *Stoic repug.* 1053a/SVF 2.579)[22]

Chrysippus describes a theory that agrees with the earlier evidence. We should note that he uses the term "aether" to refer to the fiery shell that ignites from the airy shell during Stage (5). Yet the Stoics use this term to refer to the fire at the periphery of the cosmos, as I noted in my discussion of the nature of the cosmic order.[23] When fire is generated from air at Stage (5), it comes to inhabit the periphery of the cosmos. So this passage agrees with our earlier evidence concerning the cosmogony. Thus, all of our evidence for Zeno and Chrysippus's cosmogonies agree with the uncontroversial account, which is represented by Table 1.

3. Fire Persists Throughout the Cosmogony

This section focuses on Stages (1), (2), and (3) of the cosmogony, as it is represented in the uncontroversial account. Does some portion of the fire present during the conflagration, i.e. Stage (1), persist throughout these changes? I will argue that it does.[24] This is clear from the following considerations. First, one source explicitly confirms this. Second, Chrysippus commits himself to this claim, when he claims that a soul is present in the water at Stage (3). Finally, prior commitments within Stoic physics concerning the relationship of fire and air to water entail that fire must be present in the cosmogonic water. Thus, even given some conflicting considerations cited by Ricardo Salles and David Hahm, on balance, the evidence supports the view that not all of the conflagration's fire is extinguished during the cosmogony.

[22] λέγει γὰρ ἐν τῷ πρώτῳ περὶ Φύσεως· 'ἡ δὲ πυρὸς μεταβολή ἐστι τοιαύτη· δι' ἀέρος εἰς ὕδωρ τρέπεται· κἀκ τούτου γῆς ὑφισταμένης ἀὴρ ἀναθυμιᾶται· λεπτυνομένου δὲ τοῦ ἀέρος ὁ αἰθὴρ περιχεῖται κύκλῳ· οἱ δ' ἀστέρες ἐκ θαλάσσης μετὰ τοῦ ἡλίου ἀνάπτονται.'

[23] See Lapidge 1973, 254–259.

[24] I put forward a preliminary, brief version of this argument in Hensley 2017, 381 n. 48.

Let us begin with a report from Philo. He says:

> For since fire is the cause of motion, and motion is the source of generation, and nothing comes about without motion, [the Stoics] said that after the conflagration, when the new cosmos is about to be constructed, the whole of fire is not quenched, but a certain amount of it remains (Philo, *Aet. mun*. 89, trans. Long 2008 modified).[25]

According to Philo, the Stoics maintain that fire is the cause of motion.[26] Since motion and change occur throughout the cosmogony, fire must be present during these events. Hence, Philo explicitly states that all of the conflagration's fire is not quenched. Thus, at least the initial change from Stage (1)'s fire to Stage (2)'s air is partial, and part of the conflagration's fire persists throughout the cosmogony.

What kind of motions occur during the cosmogony that would require fire to be present? Here, some basic tenets of Stoic physics can be used to fill in the details. Consider the following passage from Cicero:

> Indeed, air itself, which is the coldest element, is by no means devoid of warmth. In fact, it is mixed with a great amount of warmth. For it itself originates from a vaporization of water. For air must be considered like a certain water vapor, and it exists in virtue of the motion of the warmth that is contained in the waters. (Cicero, *ND* 2.26–27)[27]

According to Balbus, the Stoic speaker in this passage, the process by which water transforms into air requires "warmth" (calor). Heat contained in water causes part of the water to vaporize, and this vaporized water becomes air. During Stage (4c) of the cosmogony, part of the cosmogonic

[25] ἐπειδὴ γὰρ αἴτιον κινήσεώς ἐστι τὸ πῦρ, κίνησις δὲ γενέσεως ἀρχή, γενέσθαι δ' ἄνευ κινήσεως ὁτιοῦν ἀδύνατον, ἔφασαν ὅτι μετὰ τὴν ἐκπύρωσιν, ἐπειδὰν ὁ νέος κόσμος μέλλῃ δημιουργεῖσθαι, σύμπαν μὲν τὸ πῦρ οὐ σβέννυται, ποσὴ δέ τις αὐτοῦ μοῖρα ὑπολείπεται·

[26] This report is confirmed by Cicero, *ND* 2.31–2.

[27] Ipse vero aer, qui natura est maxime frigidus, minime est expers caloris; ille vero et multo quidem calore admixtus est: ipse enim oritur ex respiratione aquarum; earum enim quasi vapor quidam aer habendus est, is autem existit motu eius caloris qui aquis continetur …

water turns into air. If Balbus is representing standard Stoic doctrine in this passage, then there must be heat present in the cosmogonic water in order for the change at Stage (4c) to occur. According to the Stoics, fire is the only hot element.[28] Thus, if there is heat present in the cosmogonic water at Stage (3), then there is fire present in that water. How did fire come to be present in this water? The simplest explanation is that only part of the conflagration's fire is extinguished during the initial series of cosmogonic changes.

Against this, one might argue that while Balbus is accurately representing Cleanthes' cosmogonic theory in this passage, his account should not be applied to Zeno or Chrysippus. Thus, given this passage, we are not entitled to infer that part of the conflagration's fire persists throughout the cosmogony, according to these two Stoics.[29]

I disagree with this criticism for two reasons. First, the fact that Cleanthes believes a claim is a defeasible reason to think that Zeno and Chrysippus also hold that belief. While there are several issues on which the first three leaders of the Stoics disagreed, they more often agreed. Thus, unless there is evidence to the contrary, if we assume that Balbus accurately represents Cleanthes' views in the above passage, then we can use this passage to understand Zeno and Chrysippus's views, as well.

Second, the theory of elemental change that underlies Balbus's explanation of vaporization is explicitly confirmed and attributed to all of the Stoics by Galen. He writes:

[28] See Diogenes Laertius 7.137/SVF 2.580/LS 47B. Salles 2016, 141–142 has challenged this, partly on the basis of the passage from Cicero that I have just quoted. He argues that air itself can be hot, given this passage. However, this is not what the passage entails. Rather, Balbus claims that air is *mixed* with heat or warmth, and he does not claim that air *itself* is hot or warm. Thus, Cicero's Balbus does not provide evidence that the other elements can themselves be hot or warm without the presence of fire.

[29] Thank you to Ricardo Salles for raising this criticism. See the reference to Cleanthes in *ND* 2.24.

> Although, since they ascribe even the change of the elements into each other to certain diffusions and compressions, it was reasonable for the Stoics to make the hot and the cold efficient principles. (Galen, *Nat. Fac.* 2.8/SVF 2.406/LS 47E)[30]

The Stoics claim that elemental identity supervenes on density. As elements become denser, they turn from fire into air, into water, and finally into earth. As elements become rarer, they turn from earth into water, into air, and finally into fire.[31] Thus, Galen reports that they called the hot and the cold efficient causes. For, presumably, heat causes a decrease in density, and coldness causes an increase in density. A change from water into air is a decrease in density. Therefore, the hot causes the change. The Stoics think that fire is the only hot element, as I noted above. It follows that heat is present because fire is present, and fire causes changes from water into air. Thus, Balbus's causal explanation of vaporization agrees with the orthodox Stoic theory of elemental change. Because fire must be present to facilitate the change from Stage (3) to Stage (4c), only part of the conflagration's fire is extinguished, and at least one of the initial cosmogonic changes is partial.

Thus far, I have argued that part of the conflagration's fire persists throughout the cosmogony, and so the initial change from Stage (1) to Stage (2) is partial. However, there are also reasons to think that, at least according to Chrysippus, the change from Stage (2) to Stage (3), in which air changes into water, is a partial change. In the following passage, Plutarch quotes Chrysippus:

> "For when the cosmos is totally fiery, it is directly also its own soul and ruling part. But when, changing into the moisture and the soul that has been left behind in it, it changed in

[30] καίτοι τούτοις μέν, ὡς ἂν καὶ αὐτῶν τῶν στοιχείων τὴν εἰς ἄλληλα μεταβολὴν χύσεσί τέ τισι καὶ πιλήσεσιν ἀναφέρουσιν, εὔλογον ἦν ἀρχὰς δραστικὰς ποιήσασθαι τὸ θερμὸν καὶ τὸ ψυχρόν.

[31] This theory is attributed in nearly these exact terms to Chrysippus in Stobaeus, *Ecl*. 1.129,17–23/SVF 2.413/LS 47A. .

some way into body and soul so that it is composed out of these, it had another reason." (Plutarch, *Stoic. repug.* 1053b/SVF 2.605/LS 46F)[32]

Chrysippus describes the cosmogony. This is clear, since he describes the process by which the cosmos goes from being totally fiery during the conflagration to containing other elements. He also describes it in biological terms: the cosmos goes from having only a ruling part of the soul, to being composed of a body and, we can assume, a complete soul—that is, a soul with parts other than a ruling part.

On the elemental level, the cosmos changes from fire to moisture with a "soul left behind in it" (τὴν ἐναπολειφθεῖσαν ψυχήν). We saw in the previous section that "moisture" is a term that refers to the cosmogonic water of Stage (3). So Chrysippus claims that a soul is left behind in the cosmogonic water.

According to Chrysippus, souls are made of pneuma, which is a substance that is blended out of fire and air.[33] Thus a compound of fire and air is left behind in the Stage (3) cosmogonic water. "Left behind" implies that the soul, in some sense, existed beforehand. Clearly, the passage indicates that the pure, ruling part of the soul existed during the conflagration. So a portion of the fire that existed during the conflagration persists, it mixes with a portion of the air at Stage (2) to form a complete soul, and then a portion of that air transforms into water at Stage (3).

The evidence concerning Zeno's theory of the composition of the soul is not as clear. However, it is probable that he posits fire as a component of souls.[34] So, he would certainly agree

[32] "διόλου μὲν γὰρ ὤν ὁ κόσμος πυρώδης εὐθὺς καὶ ψυχή ἐστιν ἑαυτοῦ καὶ ἡγεμονικόν· ὅτε δέ, μεταβαλὼν εἴς τε τὸ ὑγρὸν καὶ τὴν ἐναπολειφθεῖσαν ψυχήν, τρόπον τινὰ εἰς σῶμα καὶ ψυχὴν μετέβαλεν ὥστε συνεστάναι ἐκ τούτων, ἄλλον τινὰ ἔσχε λόγον."

[33] For defenses of this interpretation of the makeup of pneuma, which is widely-accepted in the literature, see Hahm 1977, 158; Hensley Forthcoming; Long and Sedley 1987, 1.277–78; Salles 2017, 228–32**.** Evidence includes Alexander of Aphrodisias, *Mixt.* 224,14–22/SVF 2.442/LS 47I; *Mixt.* 225,6–8; Galen, *PHP* 5.3.8/SVF 2.841/LS 47H.

[34] See, for example, Stobaeus, *Ecl*. 1.213,15–21/SVF 1.120/LS 46D in which Zeno is reported to have claimed that souls are made of a type of fire.

that, if a soul is a present in the cosmogonic water, then fire must be present within the cosmogonic water. This is accomplished through the initial cosmogonic change being partial.

Finally, one additional tenet of Stoic physics supports the interpretation according to which the initial cosmogonic changes are partial. Namely, it is a standard Stoic view, at least from Chrysippus onward, that fire and air hold together earth and water. The denser elements lack their own tension, which they acquire through being blended with the rarer elements.[35] Imagine that the cosmos at Stage (3) is made only of water, and it contains no fire or air. It would follow that the cosmos would lack tension and disperse. This does not occur. In fact, it seems to hold together for an amount of time sufficient for God to act on it, according to Diogenes. Therefore, there must have been fire and air present within the water, holding it together. Again, the best explanation for how this occurs is that the initial two cosmogonic changes are partial.[36]

Against this interpretation, scholars have cited two passages. First, as we saw in the previous section, Diogenes states that God turns "all substance" through air into water. On the basis of this, Ricardo Salles has argued that all of the fire and air present during Stages (1) and (2) of the cosmogony are transformed into water at Stage (3). For he interprets "all substance" to refer to everything that exists.

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[35] Alexander of Aphrodisias, *Mixt.* 218,2–6/SVF 2.473/LS 48C; Galen, *De causis contentivis* 1/LS 55F; *De plenitudine* 3/SVF 2.439/LS 47F; Plutarch, *De comm. not.* 1085c–d/SVF 2.444/LS 47G.

[36] Ricardo Salles has suggested to me that dispersal is not the only possible outcome for a body that lacks tension. Perhaps a portion of water or earth that contains no fire or air will *expand* and lose its identity, as it is converted into the rarer elements. In fact, one could argue that this is what happens, in the case of the cosmogonic water. Lacking tension, a portion of it expands and turns into air at Stage (4c). I disagree with this interpretation for three reasons. First, it would entail that earth and water have a natural tendency, absent any causal influence from fire or air, to evaporate or burn. Fire, then, would be an overdetermining cause of any case of expansion and combustion. But, presumably, the Stoics did not think that fire was an overdetermining cause, since they identify it as the cause of expansion and combustion. In fact, fire plays a crucial role in the events leading up to the conflagration. See Cicero, *ND* 2.118 and discussion by Salles 2005. Second, the idea that the denser elements naturally tend to expand and burn seems to be contradicted by direct observation. That is, we do not observe water or earth naturally tending to turn into fire on their own. Third, two of the three portions of the cosmogonic water do not expand during Stage (4): part remains water, and part condenses into earth. This is unexplained if we adopt this theory. Thus, dispersal seems like a more likely candidate than expansion for what occurs in a body that lacks tension.

Additionally, David Hahm has cited the following passage from Seneca in support of the claim that the initial two cosmogonic changes are total:[37]

> Water is, as Thales said, the most powerful element. He thinks that this was the first, and out of it everything arose. But we [Stoics] too have the same opinion, or something close. For we say that fire fills the world and it transforms everything into itself. And we suppose that fire vanishes and grows faint and that when fire has been extinguished, nothing remains in nature except moisture. In this the hope of the world to be lies. Thus fire is the end of the world, and water the beginning. (Seneca, *Naturales quaestiones* 3.13)[38]

Here, Seneca seems to refer to the conflagration, when he says that fire turns everything else into itself. According to Seneca, fire is then extinguished, and only moisture remains. When read in light of the passages describing the cosmogony, this suggests that only water exists during Stage (3).

Let us consider these two passages in turn. First, what does it mean when Diogenes claims that "all substance" is changed into water? Is there a way to understand this passage such that it does not mean that God turns everything that exists into water? "Substance" is a term that often refers to the Stoic passive principle, which is also called "matter".[39] Diogenes might be using the term de dicto to refer to the object that is playing this role, or at least an analogous passive role. That is, he could be claiming that the patient—the whole and only patient—of the cosmogony becomes the cosmogonic water. This water is acted on by God, through fire and air in the ways that I have specified. In this case, "all substance" would not refer to everything that exists. Instead,

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[37] Hahm 1977, 83 n. 2.

[38] Adiciam, ut Thales ait, 'valentissimum elementum est'. Hoc fuisse primum putat, ex hoc surrexisse omnia. Sed nos quoque aut in eadem sententia, aut in <vicina> eius sumus. Dicimus enim ignem esse qui occupet mundum et in se cuncta convertat; hunc euanidum languentemque considere et nihil relinqui aliud in rerum natura igne restincto quam umorem; in hoc futuri mundi spem latere. Ita ignis exitus mundi est, umor primordium.

[39] See, for example, an earlier passage in Diogenes Laertius, 7.134/SVF 2.300/LS 44B, in which he calls matter "unqualified substance".

it would refer to everything that is acted on. Thus, this passage is consistent with the earlier interpretation of Zeno and Chrysippus's cosmogony.

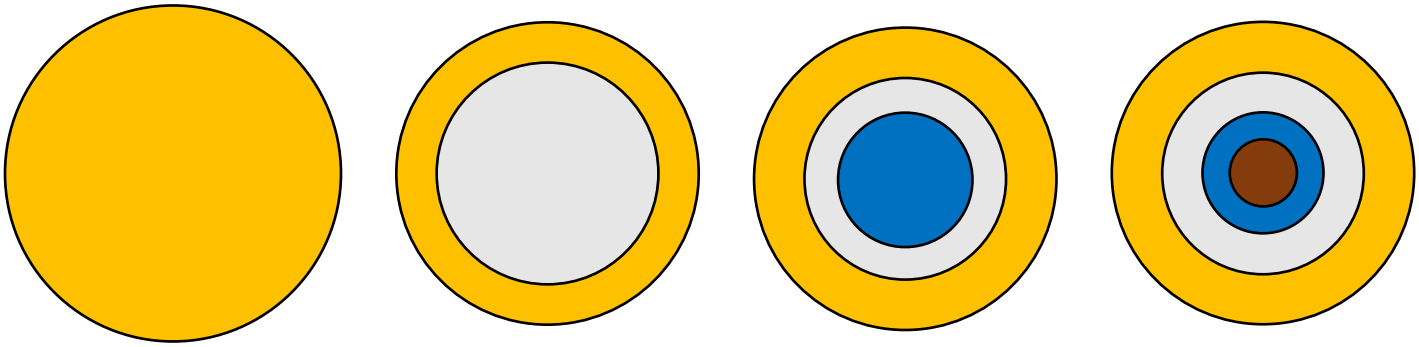
The passage from Seneca does not admit of an alternative interpretation. He explicitly says that fire is extinguished, and nothing remains but water. So, according to Seneca, the initial cosmogonic changes are total. But, at this point, it seems appropriate to weigh the competing evidence. Philo states denies that all of the conflagration's fire dies, Chrysippus states that an object that is made of fire and air is present in the water of Stage (3), and, according to basic Stoic physics, fire and air must be present in the cosmogonic water to cause the remaining changes and to sustain the water long enough for these changes to take place. On the other hand, we have Seneca. And, while being a bona fide Stoic, it is unclear whether he is reporting orthodox early Stoic doctrine here, a later Stoic's views, or his own view. Thus, on balance, it seems that the evidence supports the interpretation according to which the initial two cosmogonic changes are partial, and some of the conflagration's fire persists throughout the cosmogony. Additionally, as I will show in the Section 5, this interpretation would entail that Zeno and Chrysippus have a similar theory of cosmogony to Cleanthes. For I will argue that Cleanthes believes that part of the conflagration's fire persists during the cosmogony. If that argument is sound, and if one would prefer that the first three leaders hold consistent views, then this might be an additional reason to adopt the interpretation according to which part of the conflagration's fire persists.

4. Proto-Elements and Stoic Embryology

An additional aspect of the uncontroversial account needs to be explained. Fire exists during Stage (1) of the cosmogony, and air exists at Stage (2). Then, air reemerges at Stage (4c), and fire reemerges at Stage (5) at the periphery of the cosmos. Why do fire and air occur twice in

the cosmogonic process? The cosmogony could proceed by means of linear sequence of three changes in which part of the conflagration's fire transforms into air, part of the resulting air transforms into water, and part of the resulting water transforms into earth. Each of these changes could place the elements in the appropriate cosmic position relative to each other. Thus, the final change in this sequence would produce the object that is minimally sufficient to qualify as a cosmic order, and the cosmogony would be complete. I have represented this hypothetical process, which I will call the "Linear Sequence" in Illustration 2.

Illustration 2: The Linear Sequence



Instead of the Linear Sequence, fire and air do not take their final positions until the end of the cosmogony. A full account of Stoic cosmogony must explain this.

Some have explained this feature of the cosmogony by invoking the concept of a proto-element.[40] A proto-element is a substance that goes by the name "fire", "air", or "water", but which differs from the standard elemental bodies that are normally referred to by those names. According to these commentators, proto-elements exist at Stages (1), (2), and (3) of the Stoic cosmogony.

[40] See Cooper 2009; Frede 2005. I should note that neither Cooper nor Frede explicitly state that the proto-elemental hypothesis explains this aspect of the cosmogony. However, both first introduce the concept of a proto-element in discussing the Stoic cosmogony. This suggests that they believe proto-elements are necessary to explain some part of Stoic cosmogony.

The fire of Stage (1) is proto-fire, the air of Stage (2) is proto-air, and the water of Stage (3) is proto-water. This proto-water then transforms into the standard elemental bodies at Stage (4a), (4b), and (4c). Table 2 represents this theory:

Table 2: The Proto-Elemental Account

Periphery					Fire
Intermediate Shell				Air	Air
Inner Shell				Water	Water
Inner Sphere	Proto-Fire	Proto-Air	Proto-Water	Earth	Earth
Positions	*Stage (1)*	*Stage (2)*	*Stage (3)*	*Stage (4)*	*Stage (5)*

According to this account, the reason why the Linear Sequence does not occur is that the standard elemental bodies fire and air do not exist at Stages (1) and (2) of the cosmogony. Instead, these bodies are first generated at Stages (4c) and (5). Because of this, it is not necessary to explain the cosmogonic reemergence of fire and air, since these substances do not reemerge at all.

The difficulty for this interpretation is that we lack evidence that explicitly states that the Stoics posited proto-elements. This hypothesis is plausible to the extent that the proto-elements are necessary to explain Stoic physics. Now, one could argue that without the proto-elemental interpretation, the fact that the Linear Sequence does not occur cannot be explained. Given this, one could conclude that we should accept the proto-elemental account. However, I think that we can explain this part of the cosmogony without positing proto-elements, and thus, at least with respect to this aspect of Stoic physics, the proto-elemental hypothesis is unnecessary.

To explain why the Linear Sequence does not occur, we should look toward Stoic embryology. First, we should note that it is standard Stoic doctrine that the cosmos is an animal.[41] Animals are compounds of bodies and souls. As we have seen, Chrysippus claims that during the conflagration, the cosmos is only a ruling part of the soul. After the cosmogonic water is produced, the cosmos is a compound of a body and a soul. Furthermore, Diogenes Laertius also compares the cosmogony to biological conception by stating that the conflagration's fire remains behind in the cosmogonic water just as "seed" (σπέρμα) is enveloped in the "generative material" (γονή). The active part of this compound—the fire or pneuma—then acts on the passive part of this compound—the water—to produce the rest of the cosmos. Thus, in addition to producing the four elements and placing them in the positions that will yield a cosmic order, the cosmogony is also an instance of biological conception.

Let us then examine non-cosmogonic biological conception. According to Zeno and Chrysippus, seminal fluid is a compound of pneuma and moisture.[42] Within this compound, the fiery pneuma is a portion of the father's soul, and it is the active component. As such, it would probably be identified with spermatozoa.[43] With respect to the cosmogony, it appears that the conflagration's fire becomes analogous to spermatozoa when it blends with the cosmogonic water. In non-cosmogonic biological conception, moisture appears to serve as a mere vehicle for the active pneuma in the compound. So the cosmogonic water has the role of a vehicle for the conflagration's fire. Returning to non-cosmogonic conception, according to the Stoics, once the seminal fluid falls into the womb, it gathers surrounding uterine material to form and shape an

[41] Calcidius, *in Tim.* 292/SVF 1.88; Cicero, *ND* 2.21–22/LS 54G; Diogenes Laertius 7.138/SVF 2.634; 7.142/SVF 2.633; Eusebius, *Praep. ev.* 15.15.1/SVF 2.528; Hermias, *Irrisio gentilium philosophorum* 14/SVF 1.495; Sextus Empiricus, *M.* 9.88–91; 9.104.
[42] Eusebius, *Praep. ev.* 15.20.1; Theodoret, *Gr. aff. cur.* 5.25, Diogenes Laertius, 7.158 (all collected in SVF 1.128); Galen, *Defin. Medicae* 94/SVF 2.742.
[43] See discussion by Cooper 2009, 101–102 n. 19.

embryonic body.[44] Of course, in the cosmogony, there is no such surrounding material; only an infinite void exists outside the cosmos. Thus, once the pneuma has mixed with the cosmogonic water, the active part of the compound only has the water to act on. So, in addition to being the vehicle of the pneumatic spermatozoa, the cosmogonic water also becomes analogous to the uterine material on which that fire-air compound acts. Thus, the cosmogonic water plays two of the necessary roles in conception.

According to Stoic embryology, pneuma becomes totally blended with passive uterine material during conception. For, after the seed gathers surrounding material to fashion an embryo, it changes into "nature" (φύσις). Nature is one of the main types of innate pneuma, which are totally blended with the bodies in which they come to be.[45] Specifically, nature is the type of pneuma that blends with plants. During fetal development, the fetus's pneuma continues to be natural pneuma, since the fetus is more like a plant than an animal. Once born, the pneuma changes into soul, and the fetus becomes an animal.[46] Thus, once the surrounding uterine material is gathered and formed into an embryo, it appears to remain totally blended with pneuma during its entire development until birth.

We have noted that the cosmogonic water has the role of the uterine material during non-cosmogonic biological conception. Since the cosmogony is also the generation of an animal, the Stoics likely thought that the cosmogony resembled the process of conception and fetal development. Thus, the cosmogonic water should remain totally blended with pneuma, including the fiery soul of conflagration. However, if the cosmogony proceeded by means a linear sequence of three partial the elemental changes, this would not occur. Instead, the fiery periphery of the

[44] Hierocles, 1,5–10/LS 53B.
[45] Alexander of Aphrodisias, *De mixtione* 217.32–218.1/SVF 2.473/LS 48C
[46] Hierocles, 1,15–30/LS 53B.

cosmos would surround the passive cosmogonic water. This would be analogous to spermatozoa somehow surrounding the gathered uterine material in the womb. Thus, if the Linear Sequence occurred, then the Stoic cosmogony would not resemble how the Stoics conceived of the formation of an embryo.

Thus, Stoic embryology can be used to explain why fire and air first blend with the cosmogonic water and then reemerge at the conclusion of the cosmogony at the periphery of the cosmos. Because the first step in fetal development is the total envelopment of an active seed in passive material, and because the cosmogony is also the process by which an animal is generated, it is necessary that the first step in the cosmogony is the total blending of fire and air with the cosmogonic water. Given this, we do not need to posit proto-elements to explain why the Linear Sequence does not occur. Hence, the uncontroversial account from the previous section should be understood as including only the standard four elements, fire, air, water, and earth.

5. Cleanthes' Cosmogony

In this section, I will examine an important piece of evidence that describes Cleanthes' cosmogony. I will argue that it suggests that Cleanthes agrees with Zeno and Chrysippus regarding Stages (1) to (3) of the cosmogony. Cleanthes claims that only part of the conflagration's fire changes into air and then water. Thus, a portion of the conflagration's fire persists throughout the cosmogony. Furthermore, Cleanthes' cosmogony provides helpful details about the physics of these changes that should inform our view of Zeno and Chrysippus's theories.

First, let us look at the passage in question. (I have inserted my own reference numbers into this passage to assist with my explanation.)

(i) After the universe has been scorched, first, its middle collapses. (ii) Next, the adjacent portions are totally extinguished. (iii) And once the universe has been liquefied, (iv) the last of the fire, after the middle has resisted it, (v) is turned in the opposite direction. (vi) Next, [Cleanthes] says that, being turned upward, (vii) the fire increases and begins to order the whole. (Stobaeus, 1.153,8–13/SVF 1.497)[47]

Imagine the cosmos during a period of conflagration. At some point, the fire will begin to go out. For it cannot burn continually; fire needs fuel.[48] As it goes out, it changes into the other elements. For the Stoics claim that matter cannot be destroyed completely; it can only change. And fire can only change into the other elements. When this occurs, its density increases. Thus, the same amount of matter will occupy a smaller volume as air and water than it would as fire. It follows that when fire changes into the other elements, the total volume occupied by the world decreases as it increases in density.

In (i), Stobaeus describes this process. The middle part of the cosmos "collapses" (συνίζειν). This means that when the middle of the cosmos changes from fire into other elements, its volume decreases as its density increases. This rapid decrease in volume causes a collapse or implosion. So the middle part of the cosmos falls inward and decreases in volume as the conflagration's fire begins to change into the other elements.

Cleanthes claims that this process of elemental change begins in the middle and proceeds toward the periphery of the cosmos. Hence, in (ii), Stobaeus says that the parts adjacent to the

[47] ἐκφλογισθέντος τοῦ παντὸς συνίζειν τὸ μέσον αὐτοῦ πρῶτον, εἶτα τὰ ἐχόμενα ἀποσβέννυσθαι δι' ὅλου. Τοῦ δὲ παντὸς ἐξυγρανθέντος τὸ ἔσχατον τοῦ πυρός, ἀντιτυπήσαντος αὐτῷ τοῦ μέσου, τρέπεσθαι πάλιν εἰς τοὐναντίον, εἶθ' οὕτω τρεπόμενον ἄνω φησὶν αὔξεσθαι καὶ ἄρχεσθαι διακοσμεῖν τὸ ὅλον· {καὶ τοιαύτην περίοδον αἰεὶ καὶ διακόσμησιν ποιουμένου τὸν ἐν τῇ τῶν ὅλων οὐσίᾳ τόνον μὴ παύεσθαι.} I have not translated the bracketed portion of the text, since I do not believe it helps us to understand the physics of Cleanthes' theory. I have included it here for readers to check for themselves.

[48] This claim is endorsed by Cleanthes according to Cicero, *ND* 2.40.

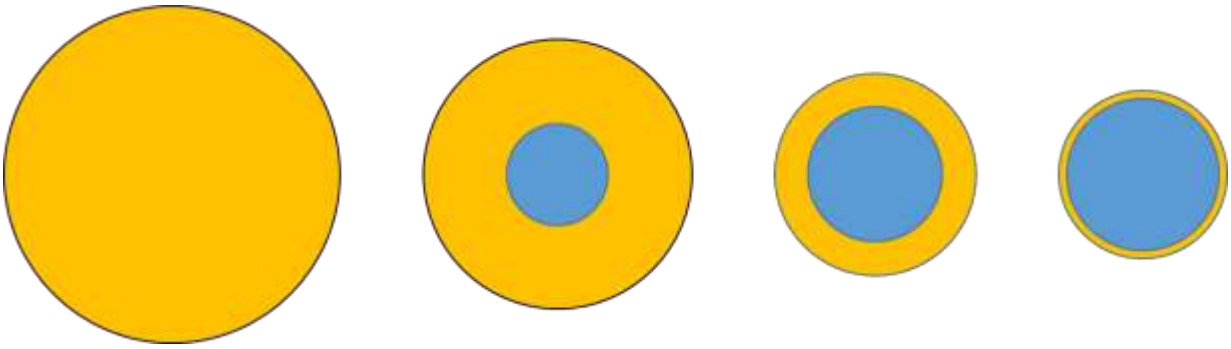
middle are totally extinguished. That is, the intermediate portions of the cosmos change from fire into a denser element.

When this process reaches the periphery of the cosmos, Stobaeus describes the events that follow in an abbreviated way. (iii) states that the universe has been liquefied. So we initially assume that the process of elemental change has proceeded from the middle to the extremes of the cosmos, and now the cosmos is composed entirely of water. (Note, the elemental change would have had to proceed through air, in accordance with our analysis from Section 2.) Yet (iv) mentions "the last of the fire" (τὸ ἔσχατον τοῦ πυρός). Thus the liquification of the cosmos referred to in (iii) does not entail that the entire cosmos is made of water. Instead, Cleanthes thinks the process of elemental change that begins in the middle of the cosmos and proceeds outward leaves some portion of conflagration's fire.

Then, abruptly, Stobaeus announces that the middle resists this peripheral fire. "The middle" here refers to the middle of the cosmos. An obvious question arises: when did the peripheral fire reach the middle of the cosmos? When did the peripheral fire begin to move at all? David Hahm puts forth such questions, and he announces that "[a]t this point Stobaeus becomes unintelligible if we take his words in their literal sense" (1977, 241).

However, thinking about the mechanics of the cosmogony can clarify Stobaeus's meaning and Cleanthes' theory. During the elemental change of fire into water, the cosmos increases density and loses volume. The peripheral fire stays attached to the rest of the cosmos during this process. For, as I explained above, the Stoics claim that the world is a continuous body that contains no void. Therefore, as the cosmos loses volume, the peripheral fire moves centripetally simply in virtue of staying attached to the rest of the cosmos. As the cosmos shrinks, the peripheral fire is brought along for the ride. I have illustrated this phenomenon in Illustration 3.

Illustration 3: The Cosmic Collapse



Eventually, the peripheral fire continues its centripetal motion, it moves through the cosmos in a blending process, and it makes contact with the cosmic center, according to (iv). As a result of this contact and resistance, the fire turns back toward the periphery of the cosmos, according to (v) and (vi). For Stobaeus equates being turned "in the opposite direction" with "being turned upward". Finally, in (vii), Stobaeus reports that the peripheral fire begins to increase. For it begins to convert small amounts of water into itself.[49] Then it begins to order the cosmos by producing the stratified elemental layers that make up the cosmic order.

Thus Stobaeus reports Cleanthes' theory of Stages (1) through (3) of the cosmogony. The conflagration's fire begins to go out—beginning at the middle of the cosmos, and proceeding toward the periphery. This extinguishing process is also a process of elemental change, and therefore a change in density. As such, the middle of the cosmos changes through air into water, increases in density, and decreases in volume. This change proceeds gradually toward the

[49] Note the parallel in the second passage from Diogenes, which I discussed in Section 3. Diogenes claims that God makes matter malleable to himself with respect to the generation of the subsequent things. Stobaeus describes the same process in elemental terms.

periphery. Thus the cosmos decreases in volume, and the fire at the periphery of the cosmos moves centripetally. Eventually, it moves through the watery cosmos and blends with it. After this, presumably, the concentric elemental spheres and shells are produced.

Cleanthes agrees with Zeno and Chrysippus, at least regarding the initial series of cosmogonic changes. Furthermore, Stobaeus's report supplies further details. For it describes the process by which the residual fire blends with the water of Stage (3). This agrees with Chrysippus's claim in that the soul of the cosmos stays behind in the water. This means that fire and air blend with the water. And this blending process can be explained by fire's motion, which is caused by the cosmos's rapid decrease in volume at the beginning of the cosmogony. Thus Cleanthes' cosmogony is useful for understanding further details about the early Stoic theory of cosmogony in general.

Cleanthes' theory can also help us make sense out of the puzzling Stage (6) mentioned in the passage from Stobaeus reporting Zeno's cosmogony. In that passage, Stobaeus seems to put forward a general principle that blending occurs by means of the elements changing into each other. But this likely incorrect. For the Stoics posit several blends which do not seem to require elemental change. For example, they claim that water and wine blend.[50] But they wouldn't say that this happens by means of elemental change. Since this claim is contained in a cosmogonic context, I think we should read Stobaeus as saying that fire or pneuma blend with the rest of the cosmos during the initial series of cosmogonic changes. For the motion imparted to fire by the initial collapse of the center of the cosmos, which is an elemental change, allows the elements to blend

[50] Alexander, *De Mixtione* 217,31–2/SVF 2.473/LS 48C9; Stobaeus, *Ecl*. 1.155,8–11/SVF 2.471/LS 48D; Diogenes Laertius, 7.151/SVF 2.479/LS 48A; Philo, *De confusione linguarum* 186/SVF 2.472; Plutarch *De comm. not.* 1078e/SVF 2.480/LS 48B.

with each other. Thus, the initial blending of pneuma with the cosmos occurs by means of elemental change.

Finally, we should again note that Diogenes Laertius ascribes the theory of cosmogony represented in Table 1 to Zeno, Chrysippus, *and* Cleanthes in 7.142. In Section 2, I withheld my approval of this attribution. Now, having analyzed this passage from Stobaeus, we can see that Diogenes' attribution is accurate. Thus, we do not need to posit conflicts among our sources for Cleanthes' cosmogony, which is an additional benefit of this interpretation.

Ricardo Salles has recently defended a different interpretation of Cleanthes' cosmogony (2015, 22–26). He claims that the middle collapsing in (i) refers to a gradual buildup of incombustible earth left over from the conflagration. Thus the earthen center is the first elemental layer that is produced. In fact, it is not "produced" at all—at least not in the way that Zeno and Chrysippus claim. Rather, the ashes of the conflagration simply settle down and clump together. The earthen center is formed from this process.

Salles claims that (ii) refers to the gradual extinguishing of the conflagration's fire and the gradual buildup of this incombustible earth. Then (iii) refers to the production of water. Like my interpretation, Salles claims that some portion of residual fire is left over from the conflagration, at least according to Cleanthes. This fire travels through to the center of the cosmos, turns upward, and then forms the fiery outer layer. Although Stobaeus does not mention it in this text, Salles maintains that Cleanthes thinks that the airy shell arises out of the water at some point during this process. Thus, according to Salles, this passage describes every stage in the production of the cosmic order. By its completion, we are meant to understand that the stratified cosmic order exists.

I disagree with this interpretation for several reasons. First, if Salles is correct, then Cleanthes' account of the *conflagration* would be different than Zeno and Chrysippus's. For it is

an orthodox early Stoic position that, during the conflagration, nothing exists in the cosmos except for fire.[51] According to Salles, Cleanthes' conflagration gradually produces an incombustible earthen residue. Thus everything in the world would not be fire during Cleanthes' conflagration. Such a difference between the Stoics would seem to be ripe for discussion in our sources. However, to my knowledge, no source states that Cleanthes put forth the view that, during conflagrations, there is both fire and earth. Thus, unless we are compelled to accept this interpretation for other theoretical reasons, we ought to be skeptical of this claim.

Other theoretical reasons do not compel us to accept this interpretation. Salles claims that the key to understanding (i), and his primary evidence for the interpretation according to which residual earth settles down during the conflagration, is the meaning of the verb συνίζειν, which I have translated with "collapse". It can also mean "sink" or "settle down".[52] Although this is the only source that uses the term with respect to Cleanthes' theory, two other sources use forms of it with respect to Zeno and Chrysippus's theories.[53] In both cases, it refers to Stage (4a) of the cosmogony: the earthen center being formed from the cosmogonic water. Hence, Salles infers that, in (i), συνίζειν refers to the process by which the earthen residue collects at the center of the cosmos.[54] For, he claims, this would understand the verb according to the same sense in which it used by all sources for Stoicism.

However, I disagree with this claim. The other sources Salles discusses use συνίζειν to refer to the formation of earth out of water—a process of elemental change and an increase in density. However, Salles would understand συνίζειν in (i) as if it referred to a gradual collection

[51] See n. 4.
[52] *LSJ* s.v.
[53] Scholiast *in Apollonii Rhodii Argonautica* 44.4-6/SVF 1.104; Scholiast *in Hesiodum Theogoniam* 115/SVF 2.565.
[54] Similarly, Hahm 1977, 241 infers from these sources that Stobaeus refers to a change of fire into earth at (ii), as I discuss below.

of residual earth that accumulates in the center of the cosmos during conflagrations. Thus, in (i), συνίζειν would not have the same meaning as it does in other sources for Stoicism. If we were to understand (i) such that it did have the same meaning, it would refer to a process of elemental change in which a less dense element changes into a denser one. Thus, the center of the cosmos collapsing, as described in (i), would be a change of fire into one of the other denser elements. Given the gradual liquification process described in (ii) and (iii), and given the standard Stoic account of the cosmogony discussed above, the most likely candidate for that denser element is water. Thus, *pace* Salles, if we understand συνίζειν consistently, it would not refer to the gradual accumulation of earth during conflagrations. Instead, it would refer to a condensing elemental change, which Salles denies occurs at this stage in Cleanthes' cosmogony.

Against this, one could adopt a different interpretation—one that splits the difference between Salles' account and my own. Following Hahm, one could argue that event referred to in (ii) is not a collection of incombustible earth, as Salles maintains, but instead a change of fire into earth (1977, 80; 241). This interpretation has two advantages. First, Cleanthes could still maintain the orthodox Stoic doctrine that conflagrations contain only fire. Second, the meaning of the verb συνίζειν would still agree with its other uses in our sources for Stoicism. For, according to this interpretation, the center of the cosmos changes from fire into earth, which is a condensing change.[55] Thus, Hahm claims that (ii), (iii), and (iv) express the following theory: the center of the cosmos changes into earth, the adjacent portions change into water, and what remains is a portion of peripheral fire.

[55] We should note that the cosmos must change from fire through air and water to change into earth. This is why Salles 2015, 24, rejects this interpretation. Because Stobaeus does not mention the other changes that must proceed the change into earth, Salles assumes that this is not what occurs.

However, (iii) refers to an event in which the universe has "liquified" or "become wet" (ἐξυγραίνεσθαι). This puzzles Hahm. He calls this description "a summary more appropriate to a state in which the cosmos is totally water (as in the orthodox cosmogony) than to the cosmic state implied by Stobaeus with earth at the center, water in between, and fire surviving at the periphery" (1977, 242–43). Hahm's intuition is accurate here; this description *is* more appropriate to a watery cosmos. This is why his analysis of (ii) is likely inaccurate. (ii) and (iii) refer to a single process of elemental change from fire into water. The universe is liquified or becomes wet because almost all of the material is converted into water, with some residual fire mixed in imperceptibly. Earth is not formed in this process. Again, this understanding is consistent with how the verb συνίζειν is used in our sources for Stoicism. For the transformation of fire into water is a condensing elemental change. Thus, it seems to be the best option for understanding Stobaeus's meaning here.

Salles cites an additional piece of evidence that we should examine. Consider the following report from Hermias:

> But Epicurus thence demands that I in no way insult his beautiful doctrine of atoms and void. For everything is generated and destroyed by means of varied and multiform combination. I am not contradicting you, Epicurus, best of men. But Cleanthes, having raised his head from the well, ridicules your doctrine and he draws up the true principles—God and matter. *And earth changes into water, and water into air, and air moves upward, and fire goes to the edges of the earth* [τὰ περίγεια], and the soul totally pervades the cosmos—[the soul] of which, by partaking in a part, we are ensouled. (Hermias, *Irrisio gentilium philosophorum* 14/SVF 1.495)[56]

[56] Ἀλλά με παρακαλεῖ κἀκεῖθεν Ἐπίκουρος μηδαμῶς ὑβρίσαι τὸ καλὸν αὐτοῦ δόγμα τῶν ἀτόμων καὶ τοῦ κενοῦ. τῇ γὰρ τούτων συμπλοκῇ πολυτρόπῳ καὶ πολυσχηματίστῳ τὰ πάντα γίνεται καὶ φθείρεται. οὐκ ἀντιλέγω σοι βέλτιστε ἀνδρῶν Ἐπίκουρε· ἀλλ' ὁ Κλεάνθης ἀπὸ τοῦ φρέατος ἐπάρας τὴν κεφαλὴν καταγελᾷ σου τοῦ δόγματος καὶ αὐτὸς ἀνιμᾷ τὰς ἀληθεῖς ἀρχὰς θεὸν καὶ ὕλην. καὶ τὴν μὲν γῆν μεταβάλλειν εἰς ὕδωρ, τὸ δὲ ὕδωρ εἰς ἀέρα, τὸν δὲ ἀέρα

Salles maintains that the italicized portion of this passage describes Cleanthes' cosmogony. Part of the earth, having collected at the center of the cosmos during a conflagration, changes into water. Part of that water changes into air. Part of that air changes into fire at the periphery of the cosmos. This completes the cosmic order.

Yet the passage is not obviously cosmogonic. It is contained in a treatise that presents a grab-bag of metaphysical and physical doctrines from many different philosophers. I have been able to locate no additional cosmogonic passages in the immediate context. Instead, it seems that Hermias looks for an opponent of Epicurus and finds Cleanthes. He then presents orthodox Stoic physical and metaphysical views that conflict with Epicureanism: that God and matter are the principles, that the cosmos is a stratified body made up of four elemental layers, that the elements change into each other along a continuum of density, and that a soul pervades the entire cosmos. The italicized portion of this passage presents the Stoic theory of elemental change according to density, and it is not obviously cosmogonic.[57] Thus, we should not use it to understand the cosmogonic passage from Stobaeus.

Thus, there are strong reasons to doubt that Cleanthes' cosmogony differed from Zeno and Chrysippus's. It seems that Stobaeus describes the initial series of cosmogonic changes, which I have labeled Stage (1), Stage (2), and Stage (3). It does not describe the entire cosmogony, but only the process by which most of the conflagration's fire changes into water. All of the first three Stoics endorse this view. It follows that Cleanthes agrees with Zeno and Cleanthes, at least with respect to Stages (1), (2), and (3) of the cosmogony, and probably with respect to Stages (4) and

<ἄνω> φέρεσθαι, τὸ δὲ πῦρ εἰς τὰ περίγεια χωρεῖν, τὴν δὲ ψυχὴν δι' ὅλου τοῦ κόσμου διήκειν, ἧς μέρος μετέχοντας ἡμᾶς ἐμψυχοῦσθαι.

[57] Note the resemblance between the italicized portion of text and Stobaeus, *Ecl.* 1.129,21–23/SVF 2.413/LS 47A. This passage from Stobaeus describes elemental change in general and not a specifically cosmogonic sequence of changes. For discussion of the Stobaeus passage see Hensley 2017, 368–369 and n. 24 *contra* Hahm 1977, 81.

(5), given Diogenes' attribution of the theory represented by Table 1 to Cleanthes. Given this, Cleanthes provides crucial details about the mechanical process by which the fiery soul of the cosmos blends with the watery body, which we can use to understand Zeno and Chrysippus's cosmogonic theories.

While the first three leaders of the Stoics did not agree on several points within Stoicism, they agreed on many basic claims within their natural philosophy. For example, they each posited four elements that exist on a continuum of density, and which are arranged in the cosmos in a particular order. Furthermore, they seem to have agreed on the nature of conception and fetal development. Thus, it should not be surprising that they agreed on the cosmogony—the process that brings each of the four elements into existence in the correct position from an initial mass of fire, and which brings a (quite large) animal into existence. After all, if the laws of physics, chemistry, and biology are universal, and the Stoics agreed on them, then one would expect them to agree on many of their applications. When the sources reporting on the Stoic cosmogony are supplemented by a wider understanding of Stoic elemental theory and biology, the cosmogonic theory shared by Zeno, Cleanthes, and Chrysippus comes into focus.[58]

[58] I would like to thank Tad Brennan, Charles Brittain, and Gail Fine for comments on previous versions of this paper. I have benefited greatly from reading the work of Ricardo Salles on Stoic physics, and I would also like to thank him for comments and discussion he provided on a previous version of this paper. I presented previous versions of ideas in this paper at Cornell University, University College London, and the University of Missouri, and I would like to thank those audiences for their suggestions and criticisms.

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