Palingenesia 100

Aristotle's "de Caelo" III

Introduction, Translation and Commentary

Bearbeitet von
Theokritos Kouremenos

1. Auflage 2013. Buch. 121 S. Hardcover
ISBN 978 3 515 10336 7
Format (B x L): 17 x 24 cm

Weitere Fachgebiete > Philosophie, Wissenschaftstheorie, Informationswissenschaft > Philosophie: Allgemeines > Antike Philosophie

INTRODUCTION

In *Mete.* A 2, 339a11–27, Aristotle asserts that there are five principles of material things, five kinds of matter, or body, continuous in all three dimensions and unanalyzable into material constituents. Of these five simple bodies, one makes up the celestial objects, whereas the other four, which exist because of four, here unspecified, principles, make up the realm of the cosmos near the Earth. They are the "traditional" elements Empedocles of Acragas introduced into physics in the fifth century BC: fire, air, water and earth. The opening of *Cael.* Γ announces that these simple bodies are the topic of the book. In it, however, we do not find the theory of the bodies at issue, though it is certainly presupposed. The following account is based, often almost verbatim, on Kouremenos (2010) ch. 1.

1. ARISTOTLE'S COSMOS

The near-Earth realm of the cosmos as conceived by Aristotle is circumscribed in effect by the circular orbit of the Moon around the Earth: it is a sphere whose great circle is the lunar orbit (see *Mete.* A 3, 340b6–10). The interior of this sphere is stratified into an outermost spherical shell of fire, which is a highly flammable and extremely subtle gas (the fire of everyday experience is elemental fire undergoing combustion; see *Mete.* A 3, 340b19–23, and 4, 341b6–22). Next comes a spherical shell of air, and then a spherical shell of water blanketing almost all the surface of the Earth, a globular clump of the homonymous simple body which is homocentric with the spherical cosmos. Beyond the near-Earth, or sublunary, realm of the cosmos are the heavens: apart from the Moon, they contain the Sun, the five planets known in antiquity (Mercury, Venus, Mars, Jupiter and Saturn) and, finally, the fixed stars. Beyond them is the outermost boundary of the cosmos, a spherical surface analogous to the celestial sphere of astronomy (Aristotle demonstrates the stratification of the cosmos into concentric spherical layers in *Cael.* B 4). According to *GC* B 8, all objects in our close surroundings are ultimately made up of all four Empedoclean simple bodies, bound together in insignificant amounts by comparison to how much of each exists in the cosmos. As it is, though always neatly stratified on the cosmological scale, the four traditional simple bodies are not separated at any given time on much smaller scales. But the simple body which is the sole constituent of the celestial objects is completely separated from the other four simple bodies. It is called "the first element" in *Mete.* A 3, 339b16–19, where it is made clear that it not only makes up the celestial objects but also fills up the heavens. These lines are actually a note to an earlier discussion, in the *de Caelo*, of the nature of this simple body and its role as filler of the heavens.[1] The introduction of a fifth element by Aristotle is one of his most notable contributions to physics.

1 For the priority of the *de Caelo* see Kouremenos (2010) 77 n. 53.

2. THE FIRST SIMPLE BODY

The existence of a fifth element, which in *Cael*. B 7, 289a11–19, is said to be the filler of the heavens and the sole constituent of the celestial objects, is demonstrated in *Cael*. A 2. Its properties are derived in *Cael*. A 3, where it is called "the first simple body" (270b2–3) because its circular natural motion is prior to the rectilinear natural motion of any Empedoclean simple body.[2] A mass of e.g. earth outside its "natural place", where most of this element is agglomerated at any given time, tends to accrete to the clump–it will move there spontaneously if nothing prevents it. This "natural motion" of the four traditional simple bodies follows radii of the spherical cosmos. Two of these simple bodies, earth and water, move towards the center of the cosmos; insofar as they have the potentiality to do so, they are heavy. But the other two, air and fire, shoot up away from the center and towards the periphery of the cosmos; insofar as they have the potentiality to do so, they are light. Hence there must be another element, the first, any quantity of which has a natural motion which is not radial, towards the center of the cosmos or away from it, but circular, about the center of the cosmos or a point on an axis through it: the whole existing mass of the first simple body cannot rotate like a flat disk about a single point since only one shape, the spherical shell, is appropriate for it. This important detail is not even hinted at in *Cael*. A 2–3, where Aristotle focuses only on circularity, alluding in passing even to the connection of the first simple body with heavenly objects. But it is obvious from *Cael*. B 4, 286b10–287a5, the beginning of an argument for the articulation of the cosmos into concentric spherical strata.[3]

The spherical shell is the only appropriate shape for the whole existing mass of the first simple body because, as this simple body is first in that it is prior to all other bodies, the shape at issue is prior to all three-dimensional shapes, for exactly the same reason that, according to *Cael*. A 2, 269a18–23, the circle is prior to the straight line, hence circular natural motion to rectilinear. Moreover, since it is circular, the natural motion of the first simple body cannot but be eternal. Assumed quite unambiguously in *Cael*. A 2, 269b6–9, and 3, 270b20–24, its eternity is explained in *Cael*. B 1, 284a3–6, on the ground that it is such, i.e. circular, that it lacks an end, unlike rectilinear motion. A quantity of the first simple body moves of its own accord in a circle, just as a stone falls spontaneously. The path of a falling stone is a straight line joining the center of the Earth, near which the stone will

2 The natural motion of the first simple body is shown in *Cael*. B 6 to be uniform, in contrast to the non-uniform zodiacal motions of the planets, the Sun and the Moon (see 288a13–18). For some reason this crucial fact about the first simple body is not even hinted at in *Cael*. A 2–3. It entails that this simple body makes up only the stars and a diurnally rotating shell whose fixed parts they are: not it but fire must make up the seven remaining celestial objects and fill up the lower part of the heavens in which these celestial objects undergo their zodiacal motions. I argue in Kouremenos (2010) ch. 2 that this must be Aristotle's view on the cosmological role of the first element in the *de Caelo*, with the exception of B 7 which agrees with his revised view on this issue in *Mete*. A 2–3; see also commentary on 298a25–26 and Introduction, 6.

3 On whether Aristotle thinks that the theory of homocentric spheres provides an even approximately true description of the structure of the heavens, be they wholly or partially made up of the first simple body (cf. previous n.), see Kouremenos (2010) ch. 3.

come to rest, and another point, at a finite distance, from which the stone started falling. Motion on such a path, though natural and thus effortless, cannot be eternal. But natural motion in a circle never reaches any boundary where it could come to a halt, for in a circle there is no endpoint, nor did it ever begin, for a circle does not begin at some point from which natural motion could have begun. This is explicitly stated in *Cael*. B 6, 288a22–27, an argument for the uniformity of the natural motion of the first simple body.

3. THE EMPEDOCLEAN SIMPLE BODIES AND THEIR COMPOUNDS

In *Cael*. B 6, 288a27–b7, a second argument for the uniformity of this natural motion invokes the results established in *Cael*. A 3: the first simple body is ungenerated, indestructible and, in general, unchangeable. By contrast, on scales much smaller than the cosmological scale, the four Empedoclean elements constantly turn into one another, which is why the cosmic layer of each of them is contaminated with bits of all others, as well as why the first simple body is pure from all traces of foreign elements (see *GC* B 10, 337a7–15); an exception, Aristotle suggests in *Mete*. A 3, 340b6–10, is the outermost part of the fire-shell, perhaps the depths of the Earth, too, according to *GC* B 3, 330b21–331a1. He thinks of the traditional elements as made up each of two qualities, one from each of two pairs of contraries, the four principles associated in *Mete*. A 2, 339a11–27, with the traditional elements. Earth is dry and cold, water is cold and wet, air is wet and hot, fire is hot and dry (see *GC* B 3, 331a3–6). Aristotle considers this to be an empirical fact, and since the qualities at issue are shown in *GC* B 2 to be the simple qualities of perceptible bodies, those that give rise to all other qualities of such bodies, the bodies earth, water, air and fire must be simple, too, the elements of all other perceptible bodies (see *GC* B 3, 330a30–b7). As operative here, the pairs of contraries cold and hot, wet and dry cannot give rise to a fifth body, hence the first simple body cannot be qualified by their members. But the cold is potentially the hot and vice versa, and the dry is potentially the wet and vice versa: if the elements they characterize come into contact, each quality acts on its contrary, the cold e.g. trying to assimilate to itself the hot while its action is resisted by an opposite reaction, and the overpowered contrary will assimilate itself to the other, which will suffer a reciprocal change from the interaction (*GC* B 7, 334b20–30). The assimilation of the cold to the hot results in the transformation of e.g. earth into fire since the unaffected dry is shared by both. This is the first of the three mechanisms Aristotle sets out in *GC* B 4 by which one or two traditional elements can become another, and it is clear why the first simple body is ungenerated and indestructible since the other simple bodies can neither generate it nor be produced from it; hence he thinks he can argue that the first simple body must be exempt from all change whatsoever. [4]

4 In assuming that the four traditional elements are subject to generation and decay Aristotle follows not Empedocles but Plato; see commentary on 298b33–299a1. His conception of each of these elements as the combination of two qualities was influenced by medicine; see Longrigg (1993) 220–226.

Equality of the contraries in power results in the two elements being left intact, but if it is only approximate, the contraries cancel each other out, and are substituted by the properties of a compound, in whose formation the interaction of the two simple bodies results (see again *GC* B 7, 334b20–30). The nature of compound bodies depends on the relations in which the amounts of the elements making up the compounds stand to one another (see *GC* A 10, 328a23–31). Thus exact equality of the contraries or sufficiently large inequality for the one to assimilate the other into itself also depends on the relation between the interacting amounts of simple bodies. As it is, since two Empedoclean simple bodies adjacent on the cosmological scale are in contact and thus act on each other in virtue of their contraries, their total amounts in the cosmos must always be in such a ratio that the absorption of one by the other or the formation of a compound out of both cannot happen. This is a crucial assumption in *Mete*. A 3, 340a1–13, an argument for the existence of a fifth simple body. On much smaller scales, the four Empedoclean simple bodies always turn into one another. Local mass-gains and mass-losses of each of them must thus be assumed to balance out exactly if the mass-ratio of a pair of adjacent elements on the cosmological scale is to be always the same. This presupposes that the ratio between an amount of a traditional simple body and an amount of the cosmically adjacent simple body into which it can turn must be equal to the ratio between the quantities of the two simple bodies existing on the cosmological scale, an assumption stated in *Mete*. A 3, 340a11–13.

4. CELESTIAL OBJECTS AND THE EMPEDOCLEAN SIMPLE BODIES

Precondition for the transformation of the four Empedoclean elements into one another on much smaller scales is evidently the seeding of the cosmic layer of each of them with amounts of all others. According to *GC* B 10, 337a7–15, this is caused by "the double motion" of the Sun, which thus powers the constant generation of the four traditional simple bodies from one another, or their decay into one another, as well as the incessant formation of compound bodies from all four of them and their decay (see 336a15–b26): the diurnal motion, responsible for a short cycle of variation in the amount of solar heating, and the annual motion in the ecliptic, which superimposes a longer undulation on the short cycle. Aristotle explains in *Mete*. A 4, 341b6–22, that the Earth generates water-vapor and fire as the Sun heats it. The source of the former is the simple body water upon and within the Earth, of the latter the simple body after which the Earth is named. By the last of the three processes that can turn one, or two, Empedoclean simple bodies into another, the hot in air, intensified by solar heating, assimilates to itself the cold in earth, and the dry in earth assimilates to itself the wet in air: the result is dry and hot fire. Naturally more buoyant than water-vapor and air, it shoots up towards its cosmic layer and, as it interacts with them, it might change into water or air somewhere but absorb these simple bodies to itself elsewhere; still elsewhere its interaction with water might yield earth (the cold in water will assimilate the hot in fire to itself and the dry in fire will assimilate the wet in air to itself: the result will be cold and dry earth). Through the heating of the adjacent strata of fire and air it induces, the motion of the Sun perpetually seeds the cosmic layer of air with the other three traditional simple bodies, allowing all four of them to interact with one another in all possible ways.

A possible role of the planets and the Moon as causes of the constant transmutation of the Empedoclean simple bodies into one another, as well as of the formation of various compound bodies and of complex medium-sized objects from the latter, is hinted at in *Cael.* Β 3, 286b6–9, and in *GA* Δ 10, 777b16–778a9, the synodic month is assumed to also regulate the heating of the Earth. Aristotle's attempt at explaining how the celestial objects produce light and, at least the Sun, heat is problematic. He gives an account in *Cael.* Β 7, 289a19–35, where he assumes that light and heat are produced by friction between the Sun and the air. But since in the earlier section of *Cael.* Β 7, 289a11–19, he also posits that the first simple body, far above air, is the filler of the heavens and the sole constituent of the celestial objects, friction between air and the Sun is impossible.[5]

5. THE CONTENTS OF *CAEL.* Γ

Setting out the topic of *Cael.* Γ in ch. 1, Aristotle says that the four traditional simple bodies, two of which are heavy and two light, as well as the things made up of them, i.e. all other stuffs and all medium-sized objects in the core of the cosmos, must be those things to which generation, if it really occurs, is restricted. Thus the introduction to *Cael.* Γ gives the impression that the treatise will deal with the four Empedoclean simple bodies and, if only at an introductory level, with the generation of their various compounds that the formation of complex medium-sized objects in the near-Earth part of the cosmos requires. As it is, readers are led to expect that *Cael.* Γ will cover most of the above, that it will be a brief but quite systematic treatment of the four traditional simple bodies following the introduction of the first simple body in *Cael.* Α, which also includes extensive arguments for the finitude and eternity of the cosmos, and the discussion in *Cael.* Β of the eternal heavens. In *Cael.* Γ, however, Aristotle answers only some very general questions about the traditional simple bodies, and his discussion is polemically framed as a critique of rival theories. Though presupposed in *Cael.* Γ, his crucial concept of the traditional simple bodies as combinations of qualities is treated in *GC* Β, along with the germane topics of the production of these elements from one another and their mixing together into compounds; though the importance of the celestial objects in the constant transformation of the Empedoclean simple bodies into one another is clear from *Cael.* Β 3, which seems to look forward to *GC* Β 10, it is not even hinted at in *Cael.* Γ; weight and lightness are discussed in *Cael.* Δ.

In *Cael.* Γ 1 Aristotle notes that some of his predecessors reject generation wholesale; others believe that all things did come into being once, though some are imperishable and some not; others hold that all things are subject to generation and

5 The production of heat and light by the Sun is explained frictionally without problems if the Sun is fiery and moves zodiacally in fire (cf. above, n. 2); see Kouremenos (2010) 84–85 n. 65.

change, with the exception of one thing which transforms into all others but itself persists through change; others, finally, think that everything material is subject to generation, not out of bodies, though, but planes, which are also the ultimate products of material decay. A critique of this view, the basis of the physics in the Platonic *Timaeus*, takes up the rest of the chapter.

The critique assumes that generated bodies consist of elements that are heavy and light, which means that they move naturally in a certain way. That all simple bodies must move naturally, and that some of them must be heavy and light, is established by Aristotle in ch. 2. At the end of this chapter Aristotle returns to the classification of views on generation in ch. 1, and argues that undoubtedly all bodies cannot be either subject to generation or ungenerated: only some bodies are subject to generation. Ch. 3 opens with the statement that it remains to be determined which bodies are subject to generation and why. The final answer to the first question is to be recalled from ch. 1: subject to generation are the four Empedoclean simple bodies, two of which are heavy and two light, and the things composed of them–all objects such as plants, animals and their various parts. Aristotle implies next that to answer both questions one must first see which of the bodies at issue are elements of the rest and why, how many they are and of what kind. This makes clear that the first of the two questions with which ch. 3 opens requires an implicit preliminary answer, from which the final answer given to it in ch. 1 will emerge, along with an answer to the second of these two questions: subject to generation are all things around us whose coming into being we observe–we cannot think of their coming into being as merely apparent, just an illusion. Why they come into being will be understood only after we have showed which of them are the elements of the rest and why these are the elements, the topic of ch. 3, how many these elements are, which is the topic of the next two chapters, and, especially, of what kind they are–that is, subject to generation, the topic of ch. 6. The answer to the second of the two questions with which ch. 3 opens is thus implicitly supplied by ch. 6: those objects around us whose coming into being we observe are truly subject to generation exactly because their elements are themselves subject to generation.

Since ch. 3 determines the elements of the bodies that are subject to generation, not which type of these bodies contains their elements, it also fixes the number of these elements–they are four. Ch. 4 then explains why these elements cannot be infinite, and ch. 5 why they must be more than one. Both of these chapters criticize earlier views. Ch. 6 argues that bodies subject to generation have as elements bodies which themselves come into being and must do so from one another, a conclusion strengthened in ch. 7 with a critique of earlier views on the mode of the generation of these four elements. This chapter resumes the critique of Plato's *Timaeus*, which continues in the eighth and final chapter of the book, where it is argued that the four Empedoclean simple bodies cannot be differentiated by the shape of their particles.

6. THE PRESENT TRANSLATION AND COMMENTARY

It is clear from the above that the third book of the *de Caelo* can be studied independently of the other three books of the treatise as it has come down to us. Its study can serve as a general introduction to Aristotle's theory of the four traditional elements and at the same time to the strongly dialectical character of his physics. The present work was motivated by the realization that, in its capacity to function as such an introduction, the third book of the *de Caelo* is not served well by the short section devoted to it in Jori (2009), the sole commentary on the entire *de Caelo* that has been published after Elders (1966), the sole modern commentary on the entire *de Caelo* and the only one available in English (Leggatt [1995] is restricted to the first two books). Though Elders discusses the third book at greater length, his comments are often unsatisfactory.

The following translation and commentary are based on Allan's OCT edition of the *de Caelo*, unless otherwise indicated. Though understandable, it is unfortunate that modern readers cannot enjoy a wide variety of easily available translations of Aristotle's treatises, unlike the case with many other Greek texts, especially literary; Guthrie (1939) and Stocks (1922) are the only two translations of the entire *de Caelo* in English, both of which are deservedly considered classic works, and Leggatt (1995) is the most recent translation of the first two books of the treatise. There is no reason to repeat here what is well known about the difficulties that translating Aristotle presents. A few words, however, about a major departure in the commentary from accepted doctrine in Aristotelian scholarship are not out of place. This departure has already been mentioned above, in nn. 2–3.

The commentary on 298a25–26 presupposes the theses I advanced in Kouremenos (2010): in the *de Caelo*, unlike in the first two chapters of *Mete.* A, which can be plausibly considered a later work, the first simple body is assumed to make up only the stars and a diurnally rotating shell whose fixed parts they are, whereas the simple body fire makes up the Moon, the Sun and the planets and fills up the lower part of the heavens, where these celestial objects move zodiacally; Aristotle never believed that the Eudoxean theory of homocentric spheres provided an even approximately true description of the structure of the heavens. In a happy coincidence my monograph came out shortly after Bowen & Wildberg (2009), a collection of essays on the *de Caelo* that ought to incite interest among scholars in this challenging work, all the more so since Falcon (2012) on Xenarchus now contributes significantly to our understanding of its reception in later thought. Inciting scholarly interest can only be served well by unorthodox perspectives. Whether or not the 'heretical' theses I argue for in Kouremenos (2010) "may cause more than a few readers to turn a deaf ear", as a reviewer has ominously predicted (K. Bemmer: BMCR 2012.06.25), the reservations in his review or in the others that have appeared to date (see esp. that by A. Gregory, *CR* 62 [2012] 414–415) have not forced me to reconsider. These reservations concern mainly the first thesis, which is the most contentious. Regarding it, the situation is as follows. On the one hand, we have a canonical view that in the *de Caelo*, too, the first simple body is assumed to make up all luminaries and fill up the entire heavens; in the entire *de Caelo* this is bizarrely stated only in B 7. On the other hand, we have a number of passages in the *de Caelo*, including the first lines of the third book, which can be shown not to square with the canonical view. What are we supposed to do with them? One solution is the first thesis advanced in Kouremenos (2010), on which B 7 of the *de Caelo* is an addition to the main body of the work made in the light of Aristotle's evolved view on the cosmological role of the first simple body in the beginning of the *Meteorologica*. What solution will be advocated by those who consider developmental hypotheses passé or are simply wary of assigning too much interpretive weight to a number of isolated passages? Will they push all recalcitrant passages under the carpet just to save the canonical view? If the problem lies with the number of isolated passages, which number would be large enough? It is preferable to adopt the only available solution, until it is argued convincingly that the passages at issue can be understood more satisfactorily by being brought into line with the canonical view.