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Aristotle's Account of Time: A Moderate Realism

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Abstract

This dissertation proposes an interpretation of Aristotle's theory of time as a whole from a study of *Physics* IV. 10-14. It addresses interpretive issues and objections pertaining to Aristotle's view about the nature of time, its existence, as well as its unity and universality. In response to these problems, the interpretation of some ancient and medieval commentators – Themistius, Simplicius, Philoponus, Albert the Great and in particular, Thomas Aquinas – is by and large defended against recent interpretations. It is argued that by defining time as "the number of movement with respect to the "before" and "after" (*Phys.* IV. 11, 219b1-2), Aristotle means that time is the number of quantitative parts of motion counted by successive instants, and that he defines time in this way because it is perceived by numbering motion which respect to succession. It is also argued that on Aristotle's account, there is one time because it is the quantity of a first motion in nature, and that time is universal because by this motion, it measures the existence of mobile beings located anywhere. Furthermore, it is argued that according to Aristotle, time exists objectively as it depends upon motion for its existence, although it depends upon the mind to exist perfectly, as an actualized quantity. On the whole, this thesis shows forth that the main interest and significance of Aristotle's conception of time is to exhibit the relation of time with, on the one hand, natural beings, motion, nature and matter, and, on the other hand, its relation with the mind.

Keywords:

Aristotle, Natural Philosophy, Time, Instant, Simultaneity, Motion, Nature, Matter, Number, Continuous, Realism.

Summary for Lay Audience

My dissertation is a comprehensive study of Aristotle's conception of time, which this philosopher expounds in *Physics* IV. 10-14. Three fundamental questions arise concerning time: What is it? Why is it universal and one? Does it exist, and if so, how? The dissertation discusses how Aristotle answers these questions, addressing interpretive problems and objections related to his theory. On the whole, my thesis shows forth that the main interest and significance of Aristotle's conception of time is to exhibit the relation of time with, on the one hand, natural beings, motion, nature and matter, and, on the other hand, its relation with the mind.

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Introduction

According to ancient philosophers, philosophy was born of wonder. Speaking about the first philosophers, today known as the pre-Socratics, Aristotle writes:

> It is owing to their wonder that men both now begin and at first began to philosophize; they wondered originally at the obvious difficulties, then advanced little by little and stated difficulties about the greater matters, e.g. about the phenomena of the moon and those of the sun and the stars, and about the genesis of the universe. And a man who is puzzled and wonders thinks himself ignorant.[1]

That wonder is what generates philosophical inquiry was also the view of Plato and Socrates. For example, in Plato's *Theatetus*, Socrates says:

> This is an experience which is characteristic of a philosopher, this wondering: this is where philosophy begins—nowhere else. And the man who made Iris the child of Thaumas was perhaps no bad genealogist.[2]

Objects that are liable to cause the greatest wonder are ones that are most familiar to us, but are also most difficult to know with precision; we assume that we know them on account of familiarity, until reflecting about what they are and why they exist makes us aware of our ignorance. These are the typical philosophical subjects, and we can hardly find a better one of this kind than "time". Is there, indeed, an object more familiar than time, and yet so entangled with mystery? The wonder caused by pondering over time is well echoed in these lines of Augustine:

> What is time? Who can easily and briefly explain it? Who can even comprehend it in thought or put the answer into words? Yet is it not true that in conversation we refer to nothing more familiarly or knowingly than time? And surely we understand it when we speak of it; we understand it also when we hear another speak of it. What, then, is time? If no one asks me, I know what it is. If I wish to explain it to him who asks me, I do not know.[3]

Augustine here evokes one of the mysteries about time: its nature, what it is. But this is not the only puzzle about time. We intuitively know that time exists; yet, it does not take much to make us doubt that it does: it is easy to convince ourselves that its parts,

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[1] *Met*. I. 2, 982b11-18.
[2] *Theat*. 155d. Trans. Levett and Burnyeat. The translators note that 'Thaumas' means wonder, while Iris, the messenger of the Gods, is the rainbow which passes between earth and heavens. Cf. Hesiod, *Theogony*, 265.
[3] Augustine, *Confessions* XI. 14, 17. Trans. Hammond and Watts.

the past and the future, don't exist. As for the present, it is so evasive, so fleeting that we cannot even grasp it.

Another mysterious aspect of time is its universal unity. Time is everywhere in the universe, and all things exist simultaneously in time. But this is rather strange when we think seriously about it. Why is it the case that things exist in time, exist in a present that is never the same? And how can there be a unique time everywhere? How can a single thing exist simultaneously in different locations of space? Moreover, the discourse of modern science challenges our intuition that there is an absolute time, simultaneously the same everywhere; according to the theory of relativity, time and simultaneity are relative to the observer.

On account of these puzzling questions and others, time has been a constant subject of inquiry throughout the history of philosophy. Perhaps it is the case more today than ever before. Time is indeed a subject of predilection for the two prevalent philosophical traditions in contemporary philosophy: analytic philosophy and phenomenology. Accordingly, it may seem natural for one who wonders about the mysteries of time to turn, in hope for answers, to contemporary philosophy. Yet, this would be to assume that progress, in philosophy, simply follows the course of time. If this assumption is to some extent legitimate for empirical science[4], it is debatable that it also holds for a discipline like philosophy. It is a matter of fact that the history of philosophy is a continuous dispute about more or less the same questions, in which some positions held in the past are sometimes defended against new theories. Moreover, the one who studies contemporary philosophy of time will discover that there is a variety of answers given to the problems laid out above.[5]

Perhaps then, one could turn to modern science, to physics, psychology or even neuroscience. Yet, if these disciplines can contribute to our understanding of time, it is doubtful that they can really be of assistance to answer the kind of questions posed before. For example, modern physics does not tell us what time essentially is, but

[4] Although some philosophers of science, and even some scientists, would probably dispute that.
[5] A first obvious difference is between the theories of time elaborated in the two mains schools of contemporary philosophy mentioned above: analytic philosophy and phenomenology. Within each of these schools, there is also a significant diversity of views.

rather tells us how we measure it. The conclusions drawn by the theory of relativity about temporal simultaneity also seem to concern the measurement of time rather than time itself. Likewise, neuroscience and empirical psychology could perhaps tell us why we are more or less aware of the passage of time in certain conditions, or perceive it as fast or slow at certain ages or in some circumstances; but they could not for all that draw conclusions as to whether time exists objectively or subjectively.

In this work, I propose to study time from the perspective of an ancient philosopher: Aristotle. The reason is simple. Aristotle developed a theory of time which, I think, sheds much light on the kind of questions posed before. He expounds this theory in his treatise entitled the *Physics*, book IV, chapters 11 to 14. This text, which constitutes a treatise on time in itself, has been commented for centuries. Therefore, this project would be unjustified and vain if this text was completely understood. As a matter of fact, Aristotle's views on time, as on so many other topics, are still debated in ancient philosophy scholarship. Furthermore, as is the case for philosophy itself, the interpretation of a philosopher's thought is not necessarily more adequate because it is more recent. Therefore, Aristotle's theory of time leaves room for some reinterpretation.

As my previous introductory remarks suggest, the main questions which arise when we reflect about time are the following: what is it? Does it exist, and if so, how? Why is time everywhere yet one (what explains temporal universality and simultaneity)? These questions are also the main ones addressed by Aristotle in his inquiry concerning time, and which interpretative issues turn upon. Accordingly, I have divided my dissertation in chapters addressing these problems.

An introductory chapter presents the context of Aristotle's theory of time as well as background material relevant to studying it and understanding my interpretation of it. This chapter also introduces to Aristotle's inquiry concerning time by presenting and discussing his dialectical investigation of the topic, a preliminary which forms the basis of his formal, analytical inquiry.

The exposition and discussion of Aristotle's theory of time proper begins in the second chapter, which studies how Aristotle conceives of the nature of time. This chapter focuses on understanding Aristotle's definition time – "the number of movement with respect to the before and after"[6]. It is controversial to know what this definition means and why Aristotle defines time in this way. According to one popular view in the recent scholarship, Aristotle defines time as the number of motion (with respect to the before and after) because it is the measure of motion, and motion is measured by a number.[7] Other scholars deny that 'number' is synonym of 'measure' in the definition.[8] For example, according to a recent influential view[9], Aristotle conceives of time essentially as an order of motion; he defines it as a number because this order is perceived and introduced by counting motion by instants before and after.

For my part, I maintain, following the interpretation of some ancient and medieval commentators[10], that Aristotle defines time as "the number of movement with respect to the before and after" because it is perceived by numbering motion with respect to succession. This definition means that time is the number of quantitative parts of motion counted by successive instants. On account of this nature, time does have the property to measure motion with respect to succession, and thereby measures how fast and slow motion is; yet, being the measure of motion is not what defines the nature of time.

The third chapter treats of the unity and universality of time. Given the way Aristotle defines time, which implies that it is something that belongs necessarily to motion, it poses the particular problem, on his account, to understand why there is a single time in nature while many motions happen simultaneously. In recent scholarship, the dominant view claims that Aristotle sees the reason for time's unity in its essence as a

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[6] *Phys.* IV. 11, 219b1-2. My translation.
[7] References to the proponents of this interpretation, and a detailed exposition and discussion of their particular views can be found in p.94-99.
[8] References to the proponents of this interpretation, and a detailed exposition and discussion of their particular views can be found in p.102-106.
[9] Ursula Coope, 2005. I expound her view in detail and discuss it in p. 106-108.
[10] Themistius, Simplicius, Philoponus, Albert the Great, Thomas Aquinas. For quotes and references, see p.81-82.

number, in virtue of which it has universality over simultaneous motions.[11] I contend that this interpretation is not satisfactory because it is inconsistent with Aristotle's view that time is a number intrinsic to motion, and because it overlooks a fundamental distinction made by Aristotle between the notions of 'identical numbers' and 'equal numbers'. Based once again upon my reading of some ancient and medieval commentators[12], I defend an alternative interpretation. I maintain that according to Aristotle, there is one time because time follows a first motion in nature, of which it is the quantity. Moreover, I argue that according to Aristotle's theory, there is time everywhere because what exists anywhere is mobile, and time measures the existence of mobile beings as mobile.

The fourth chapter treats of time's existence. Toward the end of his inquiry concerning time, Aristotle asks whether it exists objectively, independently of the mind, and provides an answer in which he seems to deny that it does. According to one type of interpretation, largely shared in recent scholarship, Aristotle's view would be that time does not exist independently of the mind because it is what is countable in motion, and something is not countable without a mind capable of counting, an intellect.[13] According to another interpretation, more prevalent among ancient and medieval commentators[14], the latter reason is only an objection raised by Aristotle against the objective existence of time, whose conclusion he does not endorse; his position would be that time exists objectively in motion.

I argue that the former interpretation is better for it is consistent with Aristotle's assertion that there is a real time in which natural things exist as well as with his realist conception of numbers, while the latter is not. In particular, I defend Thomas Aquinas' interpretation of Aristotle's position.[15] According to this view, Aristotle

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[11] References to the proponents of this interpretation, and a detailed exposition and discussion of their particular views can be found in p.154-160.
[12] Simplicius, Philoponus, Albert the Great, Thomas Aquinas. For quotes and references, see p.147, 150-151.
[13] References to the proponents of this interpretation is given at p.215, and a detailed exposition and discussion of particular views can be found in p.237-243.
[14] References to the proponents of this interpretation can be found at p.215.
[15] The detailed exposition of Aquinas' interpretation, as well as quotes and references, can be found in p.147, 150-151.

thinks that time has objective reality since as a concrete number, it depends upon its subject, motion, for its existence, and motion exists objectively. Nonetheless, because motion does not exist simultaneously, time depends upon the mind's act of numbering motion to exist perfectly, in full actuality, as a quantity whose parts coexist. Outside of the mind, time exists as a continuous quantity, but in an imperfect mode, successively in the present instant. I explain that the strength of this interpretation is to discover in Aristotle's position the solution to a more fundamental problem about time's existence, one that he raises at the very beginning of his inquiry but never addresses explicitly – time is composed of parts that don't exist in actuality, being divisible into past and future.

The upshot of my interpretation is that Aristotle defends a moderate realist position according to which time exists objectively, yet depends upon the mind to exist perfectly.

Chapter 1: Preliminaries

The purpose of this introductory chapter is to lay out the ground for the study of Aristotle's theory of time. I will thus present the context of Aristotle's inquiry into time by situating its place in the treatise of the *Physics*. Moreover, I will introduce preliminary elements of Aristotle's natural philosophy and metaphysics relevant to the study of his theory of time. Finally, I will introduce Aristotle's theory by presenting and commenting on the dialectical discussion the author carries on the subject matter prior to beginning his formal inquiry into it.

Part I: The Place of the Inquiry of Time in the *Physics*

Aristotle's inquiry concerning time takes place in the *Physics*. The latter is Aristotle's introductory treatise to the philosophy of nature, a philosophical science concerned with mobile being.[16] Accordingly, it will be beneficial to have an overview of the subject, content and logical organization of the *Physics* so as to see how the topic of time fits into it.

The *Physics* is divided into eight books, and begins with a methodological preamble that is of importance in order to understand its subject, content and structure:

> When the objects of an inquiry, in any department, have principles, causes, or elements, it is through acquaintance with these that knowledge and understanding is attained. For we do not think that we know a thing until we are acquainted with its primary causes or first principles, and have carried our analysis as far as its elements. Plainly, therefore, in the science of nature too, our first task will be to try to determine what relates to its principles. The natural way of doing this is to start from the things which are more knowable and clear to us and proceed towards those which are clearer and more knowable by nature; for the same things are not knowable relatively and knowable without qualification. So we must follow this method and advance from what is more obscure by nature, but clearer to us, towards what is more clear and more knowable by nature. Now what is to us plain and clear at first is rather confused masses, the elements and principles of which become known to us later by analysis. Thus we must advance from universals to particulars.[17]

Aristotle advances two methodological considerations in this passage. To know scientifically is to demonstrate the properties of a subject by its proper causes and

[16] That mobile being is the proper subject of natural philosophy, according to Aristotle, will become clear when I explain his definition of nature. See Part II.
[17] *Phys.* I. 1, 184a10-24.

principles. Accordingly, the first task of natural philosophy is to discover the principles and causes proper to its object, mobile beings. Second, he states that there is a logical order to follow in the inquiry of the causes and principles, an order that follows our natural way of learning. We learn by going from what is more general, more confused, for this is better known to us, to what is more specific, more distinct, for this is less known to us.

In accordance with these principles, the *Physics*, as the first treatise of natural philosophy, must establish the principles and causes proper to mobile beings, starting from the most general knowledge that we have of them. This is what Aristotle does in the first two books. The first book investigates the principles of change. The second book defines the subject of natural science by defining nature (since natural beings are beings caused by nature and which move by nature). It also establishes the principles of natural science, that is the genera of causes by which it ought to explain the properties and motions of natural beings.

In accordance with the principle that we learn from the general to the particular, the *Physics*, as the first treatise of natural science, must also treat of what is common to natural beings: motion.[18] The subsequent books of the *Physics* thus treat of motion in general. Books III and IV treat of motion in itself, whereas books V and VI treat of its divisions: book V of its formal divisions (its species); book VI of its material divisions (its quantitative parts). Books VII and VIII speak of motion in relation to its efficient causes.[19]

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[18] Aristotle explains why it is so at the beginning of *Parts of animals* (*PA.* I. 4, 644a24-b7). He discusses whether, in the study of animals, it is better to begin the inquiry by treating of what belongs universally to all kinds, or to study them individually. He reflects that since animal kinds share many attributes in common, beginning by studying every kind separately will generate repetitions for common characters will be encountered in every individual case. Aristotle thus concludes that it is better to start the inquiry about animals by looking at what is general, then move on to consider what is particular. Aristotle applies this methodological at all scale in the study of nature. He thus thinks that the whole science of nature should begin by investigating what belongs and relates to all natural beings.

[19] Book VII investigates how motion is related to mobile things and movers. Its first part argues that there is a first motion in the universe, a first mobile being and a first unmoved mover. The second part treats of the order according to which motions, mobile beings and movers are related to one another in the universe. The subject of book VIII is to show what is the first motion and the prime mover, i.e. what are their characteristics.

At the beginning of Book III, Aristotle announces the plan he will follow in Books III and IV. This is a key passage to understand the specific context of the inquiry concerning time in Aristotle's *Physics*:

> Nature is a principle of motion and change, and it is the subject of our inquiry. We must therefore see that we understand what motion is; for if it were unknown, nature too would be unknown. When we have determined the nature of motion, our task will be to attack in the same way the tasks which come next in order. Now motion is supposed to belong to the class of things which are continuous; and the infinite presents itself first in the continuous – that is how it comes about that the account of the infinite is often used in definitions of the continuous; for what is infinitely divisible is continuous. Besides these, place, void, and time are thought to be to be necessary conditions of motion. Clearly, then, for these reasons and also because the attributes mentioned are common to everything and universal, we must first take each of them in hand and discuss it. For the investigation of special attributes comes after that of the common attributes.[20]

In Book II, Aristotle defines nature as a principle of motion (and rest). Accordingly, the first thing he does in Book III is to define motion. Then, he treats of what relates necessarily to motion. As we will see further, motion is continuous and as such, is infinitely divisible. It is thus relevant, in the context of an inquiry into motion, to treat of the infinite. Aristotle carries out such an investigation in Book III: he examines whether the infinite exists, how it exists and what it is. Furthermore, motion presupposes the location of natural things in a place. This is obvious in the case of the most fundamental kind of change – locomotion – which is change in respect of place.[21] Hence, at the beginning of Book IV, Aristotle treats of place: as he did for the infinite, he examines whether it exists, how it exists and what it is. Now, a discussion about place calls forth the discussion of a related topic: that of void. Indeed, it is a common opinion, in Aristotle's time as it is today, that void is a certain place, a sort of receptacle for things. Accordingly, an inquiry about whether void exists follows logically the inquiry about place in Book IV. Finally, there is no motion without time. Thus, following the inquiry into place and void, in Book IV, Aristotle will inquire into time.[22]

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[20] *Phys*. III. 1, 200b7-24. Trans. Hardie and Gaye.

[21] All kinds of change presuppose locomotion. Aristotle shows it in book VIII, and I will present his arguments further in this chapter.

[22] In his commentary on Aristotle's *Physics*, Thomas Aquinas observes that while in book III, Aristotle treats of what follows motion intrinsically – the infinite – in book IV, he treats of what follows motion extrinsically – place, void and time. Cf. L.III. Lect.1, no.3 (ed. Marietti). The infinite follows motion

Such is therefore the context in which Aristotle inquires into time in the *Physics*: time is examined as something that relates necessarily to motion, as it is the object of the *Physics* to treat of motion as what belongs to mobile being in general.

Part II: Preliminary Notions of Natural Philosophy

As explained before, different topics are investigated according to a logical order by Aristotle in the *Physics*. His inquiry concerning time, which takes place in Book IV, presupposes other notions he has treated of in previous books: nature, motion, rest, to name the main ones. It also makes reference, without presupposing them directly, to other notions that are covered in subsequent books: the qualitative divisions of change, the principle that there is a first movement. The present section aims at introducing these elements of natural philosophy.

Nature

After inquiring into the principles of change in the first book of the *Physics*, Aristotle, in the second book, defines the subject of natural philosophy and the causes by which it demonstrates. Indeed, as explained before, the *Physics* is Aristotle's introductory and general treatise of natural philosophy, and it is appropriate, at the beginning of a science, to define its subject and the causes by which it demonstrates. The subject of natural philosophy is natural beings. Now, natural beings are beings that are caused by nature. These are beings such as animals and plants, and their parts, as well as simple bodies such as fire, water, earth and air. Aristotle thus seeks what characterizes natural beings, the subject of natural philosophy, by defining nature.

What is proper to natural things, and distinguishes them from artificial things is that they have in themselves a principle that causes them to change and rest in one or several of the following respects: with respect to place (e.g. the falling of heavy bodies dropped in the air); with respect to their bodily quantity (e.g. the growth of plants and animals); with respect to their qualities (e.g. the alteration undergone by natural elements as they interact with one another). Artifacts do not have such an

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intrinsically since motion is divisible in an infinity of parts. Place follows motion extrinsically because it measures a mobile being by containing it. Now, if it is the case for place, it also the case for void, supposing it exists. Finally, time measures motion extrinsically. This will be explained in chapter 3.

innate impulse of change and rest in themselves. They change by themselves only incidentally, insofar as they are composed of natural things which have such a principle. For example, a ball falls on the ground because it is made of a natural material (e.g. wood).

From this observation of what distinguishes natural beings from artificial things, Aristotle concludes that "nature is a principle and cause of being moved and being at rest in that to which it belongs primarily, in virtue of itself and not accidentally."[23] This is his definition of nature.

Before explaining this definition, let us immediately observe that Aristotle speaks of nature as a principle of motion (being moved), not a principle of change. The Greek word for 'motion' is *kinesis*, and the Greek word for 'change' is *metabolè*. There is a distinction between motion and change, which Aristotle makes in *Physics* V. 1. Before he makes this distinction in book V, he uses the term 'motion' in the broad sense of 'change'. This is the case in the definition of nature and in the definition of motion that we will see below. I will explain further the distinction between motion and change. Until then, let us assume that these terms are broadly equivalent.

Let us go back to the definition of nature as "a principle and cause of being moved and being at rest in that to which it belongs primarily, in virtue of itself and not accidentally." The terms "in virtue of itself and not accidentally", or, equivalently, "*per se* and not accidently", mean that nature belongs essentially to the being in which it is a principle of change. This distinguishes nature from causes which belong accidentally to the being that they cause to change. Aristotle gives the example of a physician who would cure himself. The medical art is the principle of the change that healing is. However, this principle belongs accidently to the patient for it is not as physician that he is cured, but as a sick person. If the medical art belonged per se to the patient, all patients would be physicians. Therefore, although it is by himself that the patient is cured, the medical art is not a natural cause of the healing. This criterion distinguishes natural beings from artifacts because artifacts are not caused by nature

[23] *Phys*. II. 1, 192b21-23.

and do not have a nature of their own. Although artifacts may undergo change whose principle is internal to them, such a principle does not belong to them in virtue of being what they are, but in virtue of being composed of something else which is natural. To take the same example as before, a ball does not fall on the ground as ball, but because it is made of wood. Wood falls by nature because it falls in virtue of what it is essentially, a natural body.

Aristotle writes that nature is a principle that belongs *primarily* to what changes and rest. "Primarily" must be understood in the following way.[24] A principle implies a reference and a relation to what it is the principle of. A principle of change is relative to a change and defined in reference to it. A natural being may have many natural movements that refer to different principles. For example, a horse can sense, digest and fall down a hole. These movements are natural because they have their principle in the horse per se. However, being different specific movements, they have different specific principles which don't belong all to the horse primarily. Falling down is not a movement whose principle belongs to the horse primarily, but belongs to it as natural body. It is indeed a principle that the horse shares with rocks, for example. Likewise, digestion is a movement whose principle does not belong to the horse primarily, but that belongs to it as a vegetative being. It is a principle that it shares with plants. However, sensation is a principle that belongs to the horse as what it is primarily, an animal. Indeed, although the horse is a natural body and a vegetative being, being animal is what it is primarily as horse. Therefore, sensation is a natural movement for the horse as horse.

Change

Nature is a principle of motion. Therefore, after having defined nature in book 2 of the *Physics*, Aristotle defines motion in book 3.

[24] I follow the interpretation of Simplicius. Cf. Simplicius, *On Aristotle Physics 2*, trans. Barrie Fleet, [Ancient Commentators on Aristotle] (London: Duckworth, 1997), 504, 1–25.

He begins by presenting preliminary divisions.[25] The first division is that "some things are in actuality only, others in potentiality and in actuality."[26] By "things which exist in actuality only", Aristotle likely has in mind a being like the prime mover of the universe. Indeed, in *Physics* VIII. 7, he maintains that the prime mover is immaterial and fully in actuality. Natural beings are not only in actuality, but also in potentiality. For example, if something black may become white, it is potentially white; or if someone may go up a mountain, they are potentially on the summit of the mountain. In sum, this first division amounts to a general division between 'being in potentiality' and 'being in actuality'[27].

The second division is a division of being between the different ways in which being is said, sometimes called "genera"[28], or "categories" of being. Something can exist as a substance, a quantity, a quality, in a place, in relation, etc.

The third division concerns the category of relation: things can be in a relation of excess and defect, agent and patient, and in general of motor and mobile.[29] Aristotle seems to present this division because insofar as motion involves something that can move and something that is being moved, it seems to be a relation.

Aristotle writes that "there is no such thing as motion over and above the things."[30] In other words, motion is not an extra genus apart from the categories of being, or a more universal genus common to these categories, but it is reducible to being in its different senses. Indeed, every change is a change in respect either of substance, quantity, quality, or place, which are different senses of being. As a genus, motion is divisible according to these categories: generation is a change in respect of substance; alteration is a change in respect of quality; growth is a change in respect of quantity; locomotion is a change in respect of place. Moreover, in each of these categories,

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[25] It may be the case that Aristotle seeks the definition of motion by following the method of division he describes in *APo*. II. 13, 97a24-b7 and in *Met*. VII. 12. Yet, it is not clear to me how exactly the definition of motion is concluded from the divisions he presents.
[26] Cf. *Phys.* III.1, 200b26.
[27] For Aristotle's exposition of this distinction, see in particular *Met.* V. 7, 1016a35-b9; IX. 6, 1048a30-b9.
[28] These categories are genera by analogy since 'being' is an analogous notion.
[29] Cf. *Phys.*. III. 1, 200b26-32.
[30] *Ibid.* 200b32-34.

'being' can be said in 2 ways, according to a certain opposition: in the category of substance, something can be said to have a substantial form or be deprived of a substantial form; in the category of quantity, something can be said, generally speaking, complete or incomplete; in the category of quality, something can be said, for example, white or black; in the category of place, something can be said, for example, located at the top or at the bottom. Now, species of motion are also divisible according to these contrarieties. For example, generation is a change toward substance, and corruption toward privation of substance; growth is a change toward complete quantity, whereas decay is a change toward incomplete quantity.[31] From this, Aristotle concludes that "there are as many types of motion or changes there are of being"[32], by which he means that the divisions of motion are reducible to some of the divisions of being.

Furthermore, the division between being in potentiality and being in actuality applies to all categories of being, including the ones to which change is reducible. Aristotle thus formulates the definition of motion in terms of this general division of being between being in potentiality and being in actuality. He writes: "The actuality of what is potentially, as such, is motion."[33]

He specifies this definition according to the divisions of change, as they follow the divisions of being:

> The actuality of what is alterable, as alterable, is alteration; of what is increasable and its opposite, decreasable (there is no common name for both), increase and decrease; of what can come to be and pass away, coming to be and passing away; of what can be carried along, locomotion.[34]

He then proceeds to explain the general definition by giving an account of each of its parts. In particular, it needs to be explained why change is defined as "an actuality";

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[31] Aristotle explains, in *Phys*. V. 1, 224b6-10, that the species of change are denominated after their point of arrival rather than by their point of departure. He gives the example of corruption, which is named such because it is a movement towards nonbeing (a certain nonbeing), and of generation, which is named such because it is a movement toward being (a certain being).
[32] *Phys.* III. 1, 201a8-10. Trans. Hardie and Gaye.
[33] *Ibid.*201a11.
[34] *Ibid.* 201a12-14.

why it is defined as the actuality of "what is potentially"; and why it is defined as the actuality of what is potentially "as such".

In the definition "the actuality of what is in potentiality as such", the term "actuality" implies a reference to the state of potentiality in which the changing object was before it started changing. Aristotle justifies the idea that change is an actuality by way of examples: "When what is buildable, insofar as we call it such, is in actuality, it is being built, and that is building. Similarly with learning, doctoring, rolling, jumping, ripening, aging."[35] A subject that can change has the potentiality to be in another state and to be changing toward that state. When the potentiality to change is actualized, the subject is changing, and when it is not actualized, the subject is at rest. Hence, change is an actuality.

In the definition, the term "potentially" implies a reference to the state of full actuality in which the changing object is when the change is completed. What is changing is in the process of acquiring a determination it is deprived of. It would not change if it already had, in full actuality, the determination which is the end of the change, or if it did not have the capacity to receive it. Change is thus the actuality of a subject in potentiality. Aristotle shows this by observing that everything that is changing is in potentiality in some respect; even the things that are moving other beings, he argues, are themselves moved by something else, which implies that they are in potentiality.

Aristotle then justifies the last part of the definition: motion is the actuality of something which is potentially *as such*. A mobile subject is in potentiality, but insofar as it is a subject of a certain kind, it is also in actuality, in that respect. Aristotle gives the following example. Bronze is in potentiality a statue; but it is in actuality as bronze. Although it is the same thing that is bronze and potentially a statue, being bronze and being potentially a statue are different. Therefore, it is necessary to specify in which of these respects motion is the actuality of the subject. Motion is not the actuality of the subject insofar as it is a being of a certain kind: "It is not the actuality of bronze as bronze which is motion." If it was the case, the essence of

[35] *Ibid.* 201a15-19.

bronze would be the generation of the statue. Change is the actuality of the subject insofar as the latter is in potentiality. Without this precision, the definition could designate the state of the changing object before it started to change. Indeed, prior to changing, something is both in potentiality and in actuality, but it is not in actuality with respect to being in potentiality; it is in actuality with respect to being what it is (essentially or accidentally): a bronze, the color white, a determinate quantity, being in a determinate location, etc.

Aristotle finally shows that the definition is correct by applying it to a particular example: building a house (the motion by which materials are arranged together into the shape of a house). According to the definition, such a motion is "the actuality of the buildable as buildable". Aristotle wants to show that the definition designates the motion of building, not the state which precedes it, nor the result which follows it. When the buildable, that is what has the potentiality of being built, is reduced to actuality insofar as it has this potentiality, the house is being built and it is then that motion happens, not before. Indeed, before, the buildable is only in potentiality of being built. Moreover, it is the process of the house being built that is the actuality of the buildable as buildable, not the house which is the result of this process. Indeed, when the house exists, the buildable no longer exists for its potentiality has been completely actualized: it is built. However, when the buildable is in actuality, as buildable, it is still buildable since it has not been built yet: it is only being built.

This analysis is applicable to any instance of change. The definition always designates the state of the changing object between the state where it is completely in potentiality, and the state where it is completely in actuality. Accordingly, Aristotle writes that change is an incomplete actuality, that is an intermediate, transitional state between full potentiality and full actuality:

> [Change] cannot be classed as a potentiality or as an actuality… It is thought to be a sort of actuality, but incomplete, the reason for this view being that the potential whose actuality it is is incomplete. This is why it is hard to grasp what change is. It is necessary to class it with privation or with potentiality or with simple actuality, yet none of these seems possible. There remains then the suggested mode of definition, namely that it is a sort of actuality.[36]

[36] *Phys*. III. 2, 201b27-202a3.

Divisions of Change

Having defined motion in book III, Aristotle, in book V, looks at its different forms. Change is a universal phenomenon, and the forms it displays may seem to be virtually infinite. Aristotle puts order into this multiplicity, showing that it is possible to bring it down under a few divisions.

Absolute vs. Relative

Every change involves a passage between two terms. This is reflected in the Greek name for change, *metabolè*. This word indeed contains the prefix *meta,* a preposition that has the sense of "after". What is after the change is different than what precedes it. The terms of a change are opposed to one another. This opposition can be of two kinds, which defines a first division of change.

The terms of a change can be opposed as contradictories: being and non-being. For example, something that did not exist comes to be, or something ceases to exist. Changes of this kind are absolute, substantial changes.

The terms of a change may also be opposed as the contraries of the same genus. These may be absolute contraries: e.g. change from black to white, from cold to hot, from small to big, etc. Or the terms may be contraries in a relative manner. That is, one of the terms may be an intermediate, but be considered as a contrary relatively to the other term. For example, grey is white relatively to black, and the central note is low relatively to the highest (so a change of sound between the central note and the highest happens between contraries). Changes whose terms are opposed as contraries are relative, accidental changes. They involve a subject that changes in a certain respect, in respect of one of its accidents.

Species of Change

As has been explained before, there is no change apart from the categories of being. Moreover, change involves an opposition between two terms. Therefore, Aristotle

divides change into as many species as there are categories of being which lend to opposition.

Generation and Corruption

There is an opposition of contradiction between being and nonbeing in the category of substance. Therefore, substantial change is one species of change. In this category, something may come to be from non-being. This change is called generation. Conversely, something may cease to be from being. This change is called corruption.

In the other categories of being, which are accidents, opposition is found between the contraries of the same genus. In *Metaphysics* X. 4, Aristotle gives a general definition of contrariety as the maximal difference between things which can differ from each other according to the more or less. According to this definition, there is contrariety in the genus of quality, quantity, and place, so these are the categories that define other kinds of change.[37]

Locomotion

The more obvious kind is change in respect of place: locomotion (*phora*). We can get the intuition that locomotion involves contrariety since we say that something can change from left to right, bottom to top, which are contraries. More rigorously, the terms of a movement of locomotion are contraries because the place of departure and the place of arrival are separated by a distance. Insofar as they are extremities of the distance, they are contraries, according to the definition of contrariety given above.

Alteration

A change may also happen in respect of quality. This kind of change is called alteration (*alloïôsis*). In *Metaphysics* V. 14, Aristotle asserts there are three kinds of qualities: one kind concerns mathematical beings; another kind is quality which is a

[37] Cf. *Phys.* V. 2, 226a22ff.

specific difference of the substance.[38] Alteration does not involve these kinds of qualities; it involves another kind which Aristotle calls "passive qualities."[39] These are sensible qualities of matter and natural bodies such as heat and cold, whiteness and blackness, heaviness and lightness, etc.[40] Change can happen in respect of passive qualities because they admit of contrariety according to the more or less. For example, something can be more or less hot, more or less white.

Growth and Decrease

Change in respect of quantity is another kind. There is indeed room for contrariety in the genus of quantity. In particular, there is, for living beings, a complete, mature size towards which they grow naturally until they have attained it. This achieved size constitutes a certain maximum quantity relatively to their essence. Oppositely, it is possible for living beings to shrink from their achieved size, as we observe they often do as they are aging; by doing so they move towards the contrary of their achieved quantity. These contrary terms define two species of quantitative change: a movement toward complete quantity is a movement of growth (*auxêsis*), and a movement away from complete quantity is a movement of decrease (*pthisis*).

In sum, there are 4 species of change: substantial change (generation and corruption); change in respect of quantity (growth and decrease); alteration; locomotion.

Subdivisions of Species

These species may be further divided. Generation and corruption, as well as growth and decrease, can be considered as divisions of substantial change and change in respect of quantity.

Alteration and locomotion, for their part, are divisible according to specific differences found in the genera of beings in which they take place. A change of color is a kind of alteration that differs specifically from a change of temperature, for color

[38] An essential property that may serve to define the kind of substance because it differentiates it from beings of the same kind, e.g. to be two-footed for an animal.
[39] Cf. *Phys*. V, 2, 226a27-28.
[40] Cf. *Met*. V, 14, 1020b9-11.

and temperature are different sorts of qualities. And a change of color can be further divided according to specific differences of color.[41]

The species of locomotion is also divisible. Aristotle affirms that rectilinear motion is a different species of motion than circular motion since a circular path is specifically different from a straight path (for a circle is not the same figure as a line).[42] A motion whose path is neither rectilinear nor circular is called a mixed movement.

Motion vs. Change

As contraries, the terms of a non-substantial change are separated by a continuous interval of which they are the extremities. Accordingly, an accidental change happens gradually; the subject does not change immediately from one term to the other, but must cross the interval in order to arrive at the end term of the change. On account of this feature, a relative change is called a 'motion' (or 'movement'). Motion indeed designates a change that happens gradually from one contrary to another. Aristotle explains that substantial change, generation and corruption are not movements because they don't happen between contraries. Their terms are contradictories, being and not being, and there is no intermediate between these. Thus, they happen at once.[43]

In the *Physics,* Aristotle does not distinguish between 'change' and 'motion' until he shows that generation and corruption are not movements, in *Physics* V.2. Before then, he uses 'motion' in the broad sense of 'change'. This is the case in his inquiry into time, which is in book IV. In the context of the present work, whose topic is time, I will thus follow Aristotle's practice of using the term 'motion' in the broad sense of 'change', which may designate all kinds of change. This might seem odd since in our vocabulary, the term 'motion' designates almost exclusively one species of change: locomotion. Although reading 'motion' in the wider sense of 'change' implies a certain shift from the common use of the term, we should note that it still makes sense

[41] e.g. Blackening and whitening are different species of alteration. Cf. *Phys.* V. 4, 227b7-11.
[42] *Phys.* V, 4, 227b17-20.
[43] Nervertheless, substantial change results from alteration and presupposes locomotion.

to call other kinds of change ‘movements’: it makes sense to speak of a movement of growth, of alteration and even of a movement of generation.

In fact, even when Aristotle uses ‘motion’ in the loose sense of change, it designates primarily locomotion since he has reasons to think that change in respect of place is prior to other species of change, as will be explained after. Using the term ‘motion’ in its general sense implies this priority of locomotion, without excluding other kinds of change. This offers an advantage to treat of time. Time will be defined by motion understood in the broad sense of ‘change’; but we will see that it is defined more strictly by locomotion.

Priority of Locomotion

Aristotle argues that locomotion is prior to other species of change[44] according to three senses of the word ‘prior’: it is prior in respect of time, it is prior in respect of being, and it is prior in respect of the good.[45]

Locomotion is prior in time. Alteration is temporally preceded by locomotion for a movement of locomotion is necessary to bring the agent into contact with the patient. Growth is preceded by alteration for a living being grows by transforming the food it ingests into what is similar to itself, which involves a movement between contrary qualities. Decrease, generation and corruption are also preceded by alteration. Hence, locomotion is temporally prior to all change.

Locomotion is also prior in respect of being. According to the definition of *Categories*, 12, one thing is prior in being to something else if the order in which they

[44] Aristotle does not say explicitly that locomotion is prior to generation (and corruption). This is likely because generation is not strictly a movement, and because generation presupposes alteration. Generation happens as a result of alteration of a substance, and the treatise in which Aristotle treats of generation and corruption – *On Generation and Corruption* – accounts for this sort of change largely by explaining how alteration works. Therefore, if locomotion is shown to be prior to alteration, it will also be prior to generation. Moreover, 2 of the arguments he offers to the effect that locomotion is prior clearly show that it is prior (both in respect of time and being) to generation (cf. VIII. 7, 260b16-261a13). Towards the end of these arguments (261a8-10), he explicitly says that generation cannot be first among changes.

[45] These senses are three of the five chief senses of the term “prior” that Aristotle distinguishes and explains in *Categories* 12.

occur cannot be reversed.[46] To put it differently, what is prior in being does not depend upon something else, the posterior, to exist, while the latter depends upon former. Locomotion is prior in being to other species of change for there is no necessity that what is moved with respect to place be also altered or changed with respect to quantity, whereas these kinds of change cannot take place without locomotion. Change of quantity obviously presupposes locomotion: it is impossible for something to grow or to decrease without having its body changing in location. Alteration too involves locomotion. Aristotle explains that the passive qualities of matter in respect of which alteration of substances takes place are some form of the rare and the dense; it is thus through some process of rarefaction and condensation that things are being altered. Now, rarefaction and condensation involve locomotion:

> All affections have their origin in condensation and rarefaction: thus heavy and light, soft and hard, hot and cold, are considered to be forms of density and rarity. But condensation and rarefaction are combination and separation… and in being combined and separated things must change in respect of place.[47]

In addition, locomotion is prior to other species of motion in respect of the good. One of Aristotle's arguments is that locomotion involves the least change in one's intrinsic being. A change of place is more accidental than a change of quality or quantity, which are accidents more related to the essence of the substance.

Rest

Nature is a principle of motion and rest, so in order to know natural beings, it is necessary to know what rest is. Rest is defined by Aristotle as a modality of immobility. There are three ways according to which something can be said to be immobile, Aristotle says.[48] In one way, something may be immobile in the sense that it is difficult for an agent to move it, in other words because it is resistant to being moved. In another sense, something is immobile in the manner that a sound is invisible, that is, if it does not have the potentiality to move. Finally, something may be immobile if it has the potentiality to be moving, but it does not actually move – at the time, the place and the way it has the natural potentiality to.

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[46] *Cat*.12. 14a33-35.
[47] *Phys*. VIII. 6, 260b7-14. Trans. Hardie and Gaye.
[48] Cf. *Phys.* V. 2, 226b10ff.

Being at rest is being immobile in this latter way. Thus, rest is a privation of motion, Aristotle says.[49] Indeed, privation is the absence of something in a subject which is naturally apt to possess it, in the way and at the time at which it is natural for the subject to possess it.[50] For example, blindness is a privation of sight for a human being, for it is natural for a human being to possess the sense of sight. Likewise, something is at rest if it has the potentiality to move in virtue of its nature, but this potentiality is not actualized.

Privation is what distinguishes rest from being immobile in the sense of not having the potentiality to move. Rest also differs from being immobile in the sense of being hardly movable insofar as rest is a complete absence of motion. Something that is hardly movable is said to be immobile because it is relatively at rest, as compared to what is easily movable.

Prime Mover

Since the *Physics* is a work that treats of motion in general (since motion defines nature and mobile beings), Aristotle treats of the cause of motion in books VII and VIII. In particular, he maintains that there is a unique and first efficient cause to motion in nature. The argument he presents is subtle and difficult, but it is worth giving a sense of the reasons that lead him to conclude that there is such a cause.

Book VIII of the *Physics* begins by an argument to the effect that movement is eternal in the universe:[51] it is impossible that there was a time when there was no movement, after which movement would have begun; and it is impossible that there will ever be a future time at which movement will cease to be. Having established this premise, Aristotle goes on to argue that there must be a first cause to movement in the universe. He presents three arguments.[52] The first two are essentially the following.

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[49] *Ibid*. 226b15.
[50] Cf. *Cat*. 10, 12a26-34.
[51] Cf. *Phys*. VIII, 1-2.
[52] *Ibid*. 5, 256a4-b28. Another similar argument, which I will not present, is found in *Phys.* VII. 1, 242a50-243a32.

If something is moving, it is moving either because it is moved by itself or by something else, a mover causing its motion. A mover cannot move something else without being itself moved, either by itself or by something else. If it is moved by another mover, the latter in turn moves either in being moved by itself or by a prior motor; and so on. Aristotle concludes that the motion of natural beings is caused by a first mover which is not moved by something else.[53] If there was an infinite chain of movers and moved objects, there would be no motion because there would be no cause of motion altogether.

Aristotle then argues that the first cause of the motion is rather an immobile mover than a mover that moves in being moved by itself. He shows that in a being that is moved by itself, there is a part that is mover and immobile and a part that is moved.[54] Therefore, the first mover is either a motor that moves itself by having a moving part that is immobile, or a mover that is absolutely immobile.[55] He argues that it must be a mover that is itself absolutely immobile because the first mover is the first cause of motion in the universe, and motion has been shown to exist continuously, eternally.[56] The immobile part of a mover is movable by accident; as such, it is contingent, which means that it can possibly exist or not exist. Therefore, an 'a self-mover mover' cannot move continuously, and thus be the cause of the continuous and eternal motion in the universe. Neither can it be the case that several contingent 'automobile movers' cause motion, succeeding each other in existence, for a prior cause would be needed to explain that they come into existence and into nonexistence eternally, and this cause would be an eternal mover.

Hence, the prime mover must be a mover that moves in being itself absolutely unmoved, neither by another mover, nor by itself (per se or by accident). Only such a

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[53] Aristotle gives the following example. A stone may be moved by a man through a series of intermediate causes: the stone may be moved by a rod, which is moved by the hand, and the hand by the man which moves himself. Even though the stone is immediately moved by the rod, the man is the cause which explains the movement of the stone because it is the first principle of the movement. Cf. *Phys.* VIII. 5, 256a4-b28.
[54] Cf. *Phys.* VIII. 5, 258a18-27.
[55] *Ibid*. 258b4-9.
[56] *Ibid*. 6, 258b10-259a13.

mover will exist necessarily, be eternal and produce an eternal motion.[57] Besides, Aristotle argues that there is only one such mover because it is sufficient to explain eternal motion, and an effect should be explained by a minimal number of causes. The following passage sums up Aristotle's conclusion that motion is caused by a prime mover, immobile and eternal:

> Since there must always be motion without intermission, there must necessarily be something eternal…that first imparts motion, and this first mover must be unmoved…There must necessarily be some such thing, which, while it has the capacity of moving something else, is itself unmoved and exempt from all change, both unqualified and accidental.[58]

First Motion

If there is a prime mover, there must be a first movement and a first mobile thing of which it is the movement. The prime mover indeed causes motion in nature by moving a first moving thing, which, in being moved, moves another moving thing, which in turn moves something else, and so on. This chain of causality ends with the movement of bodies that are moved without being movers for something else.[59]

Aristotle goes on to seek the identity of that movement, to specify what kind of movement it is. He argues that it must be a movement that is infinitely continuous, that is eternal:

> We must consider whether it is or is not possible that there should be a continuous motion, and, if it is possible, which this motion is, and which is the primary motion; for it is plain that if there must always be motion, and a particular motion is primary and continuous, then it is this motion that is imparted by the first mover, and so it is necessarily one and the same and continuous and primary.[60]

Since the prime mover is eternal and moves without being moved, it always moves in the same way, causing a motion that is simple, uniform, continuous and eternal:

> The motion imparted by the unmoved will always be imparted in the same way and be one and the same, since the unmoved does not itself change in relation to that which is moved by it… The unmoved mover, since it remains simple and unvarying and in the same state, will cause motion that is one and simple.[61]

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[57] *Ibid*. 259b21-28.
[58] *Phys*. VIII, 6, 258b10-15. Trans. Hardie and Gaye.
[59] Cf. *Phys.* VIII. 6, 259b34-260a4.
[60] *Ibid.* 7, 260a20-26. Trans. Hardie and Gaye.
[61] *Ibid*. VIII, 6, 260a3-19.

Therefore, in order to specify the identity of the first movement, Aristotle seeks what kind of movement has the following characteristics: continuity, simplicity, primacy.

The First Motion Is a Circular Movement

The first movement is prior to other movements. Hence, it must be a movement of locomotion. Indeed, as explained before, Aristotle argues that locomotion is prior to other species of movements; it is prior temporally, in being and in respect of good.

Furthermore, only a movement of locomotion can be infinitely continuous, eternal.[62] Aristotle shows that a movement cannot be continuous if the direction of the movement is reversed.[63] Because generation and corruption, growth and decrease, and alteration happen between opposite terms, a change of these kinds cannot happen continuously for it would involve a reversal of direction. This is also generally true for locomotion: rectilinear and mixed movements cannot be infinity continuous.[64] Yet, there is one type of locomotion which is an exception here: circular motion.

Aristotle argues that circular movement can be eternal because there is nothing impossible which follows from it.[65] In circular movement, the beginning and the end of the movement touch one another instead of being opposed to one another, as in other movements. Consequently, there is nothing to prevent a circular movement from going on infinitely: a moving object undergoing such a movement can come back to its starting point without reversing its direction.

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[62] *Ibid*. 261a28-b28.

[63] Cf. *Phys*., VIII, 7, 261b6-7. The argument is essentially the following. Because the changes are opposite to each other, the same state, which is the actual term of one change, will also be the actual principle of the change toward the opposite. But the same state cannot be, in actuality, both a principle and a term of change at the same time, but only at different times. Therefore, the subject must finish to change before it starts changing in the opposite direction. It will thus be in the same state at two different instants of time; between these two instants, there will be an interval of time in which the subject rests in the same state.

[64] In particular, it is not possible for a rectilinear movement to be eternal. Indeed, there is no physical magnitude that is infinite in actuality (Cf. *Phys*. III. 5, 205b24-206a7). Accordingly, in order for a mobile to be transported on a straight path infinitely in a continuous way, it would have to reverse the direction of its movement, which would imply coming at rest at the turning-point.

[65] Cf. *Phys.* VIII. 8, 264b9-265a12.

Not only is there nothing in the nature of circular movement which prevents it from being eternal, but it even befits its nature to be so. Aristotle argues dialectically[66] that there is no determined beginning and end of a circular movement because every point on the path of a circular movement is potentially and equally beginning, middle and end of the movement. Therefore, there is no reason why the movement would begin at some point and stop at another. Rather, the moving object is at each point at the beginning, middle and end of its movement, so to speak.

Aristotle finally confirms that the first movement is a circular movement by arguing that it is prior to other kinds of locomotion (and thereby to any other kind of movement).[67] His main argument is that circular movement is simpler and more perfect. As opposed to rectilinear movement, which reaches its end by moving away from its principle, circular movement is simple because it attains its end in returning to its principle. Moreover, because circular movement is simple and eternal, it is more perfect. Now, what is simpler is prior, in the order of being, and what is perfect is prior, in the order of the good. Thus, circular movement, in virtue of being simpler and more perfect, is prior to rectilinear movement; and if it is prior to rectilinear movement, it is also prior to mixed movement and to any other kind of movement.

The Designation of the First Motion

In the context of the *Physics*, Aristotle is content with a rather general description of the first movement.[68] He specifies what kind of movement it is – a circular movement – but does not designate what particular movement it is. A movement is individualized by the moving object, the subject which undergoes it, so designating the first movement in nature requires designating a first moving object. It is in the *De*

[66] *Ibid.* 9, 265a28-b9.
[67] *Ibid*. 265a13-28.
[68] The first movement is described as circular, eternal, mostly simple and regular (because caused by a first immobile motor which always moves in the same way). It is also described as being the movement of an object that is incorruptible, eternal (*Phys.* VIII. 6, 260a1) for only a body which is such could undergo a movement that is eternal. Furthermore, it is described as the movement of an object which, in being moved, is the cause of the other movements in the universe. The eternity of the first movement is presented as the cause of the eternity of movement in the universe, and the fact that the first moving body is moved by something else is said to explain why the things moved by it are not always moving, and why there is generation and corruption.

Caelo, a work in which Aristotle elaborates on the structure of the universe, that he points out what he considers to be the first movement and the object that undergoes it.

In books I and II of the *De Caelo*, Aristotle represents the universe as being composed of a series of concentric spheres with the Earth at the center.[69] The orbit of the moon marks the boundary between the sublunary region of the universe, where the earth is located, and the heavens, where the celestial bodies are located. The celestial spheres rotate around the Earth, which remains immobile. Celestial bodies are attached to celestial spheres, undergoing circular movements as they are carried by the spheres in their movement of rotation.[70] The stars are attached to the outermost sphere of the universe, and the planets to spheres located between the stars and the moon[71]. Aristotle thinks that the movement undergone by celestial bodies and spheres is eternal. Consequently, he thinks that they are composed of an incorruptible element, different from the four elements of the sublunary world, an element whose natural movement is circular locomotion.[72]

According to this system, movement in the universe is communicated by the outermost sphere to the spheres below[73] through contact all the way down to the sublunary region. The outermost sphere, which Aristotle calls "first heavens"[74], is thus the first moving body. As such, it is moved immediately by the prime mover, as Aristotle explicitly asserts in *Metaphysics* XII.8:

> The first heavens must be eternal. There is therefore also something which moves them. And since that which is moved and moves is intermediate, there is a mover which moves without being moved, being eternal, substance, and actuality.[75]

The movement of the outermost sphere is thus the first movement of the universe according to Aristotle's system. This is the eternal, circular movement of the

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[69] Cf. *DC.* II. 4, 287a3-11.
[70] *Ibid*. 289b31-3.
[71] Several spheres and their movement account for the movement of each planet in Aristotle's system. Cf. *Met*. XII. 8, 1073b10-1074a18.
[72] Cf. *DC.* I. 2, 269a4-b16.
[73] *Ibid*. 1073b25-27. Each sphere is also moved by a motor of its own, an immobile intellect. This is necessary, Aristotle argues, to explain its eternal motion (Cf. 1073a32-b3).
[74] Cf. *DC.* II. 6, 288a15.
[75] Cf. *Met.* XII. 8, 1072a21-26.

heavenly sphere, by which the sun and the stars complete their rotation around the earth in what we call ‘a day’.

Part III: Quantity, Number, Measure

There are other notions which, although they don’t pertain properly to natural philosophy, play an important role in Aristotle’s conception of time: the notions of ‘quantity’, ‘number’ and ‘measure’. This section will provide some introduction to these concepts.

Quantity

Definition

Aristotle defines quantity in the following way:

> We call ‘quantity’ the entity which is divisible into two or more parts, of which each is itself, by nature, apt to constitute one entity and a “this” [τόδε τι].[76]

According to this definition, a quantity is a sort of whole divisible into a multiplicity of parts. The definition ascribes to quantity characters that seem intended to distinguish it from other sorts of wholes. The parts of a quantity are apt by nature to constitute one entity, that is an individual thing, something indivisible in itself; and are apt to constitute a “this”, that is something that can be pointed to, which exists by itself. This definition distinguishes parts of a quantity from the parts of a definition – e.g. matter and form – which cannot exist without each other, but compose together an indivisible substance. Moreover, the parts of a quantity differ from the parts of a mixed body. Indeed, inasmuch as the elements of a mixed body belong to it, they are not one by nature or by themselves for they have the nature of the body they compose; a change such as an alteration is required in order for them to become an individual. On the contrary, the parts of a quantity only need to be detached from the whole in order to exist individually.

Another important character of quantity implied by the definition is that its parts are homogeneous, that is of the same kind. A quantity is “more of the same thing”. In

[76] *Ibid.* V, 13, 1020a7-9. My trans.

sum, a quantity is a whole divisible into a plurality of homogeneous and individual parts.

Quantity by Essence vs. Quantity by Accident

In *Metaphysics* V. 13, after he defined quantity, Aristotle explains there are quantities by essence (*per se*) and quantities by accident. Quantities by essence are things of which quantity is part of the definition. We can name as instances of this category figures and numbers,[77] which are the objects of mathematics. Quantities by accident are things whose quantity is not part of their definition. Aristotle distinguishes two types of quantities by accident. Some things are called quantities by accident because they belong to something that is a quantity by essence, or belong to a subject that has a quantity. In this sense, "musician" and "white" are given as examples of quantities by accident. We can say of a musician that he measures 2 meters because his body has this size, or that the white measures 3 m² because the wall that is painted in white has this size. Other quantities are said by accident for another reason. Here is how Aristotle presents it:

> Some are quantities in the way in which movement and time are so; for these are called 'quantities' and 'continuous' because the things of which these are attributes are divisible. I mean not that which is moved, but the space through which it is moved; for because that is a quantity movement also is a quantity, and because this is a quantity time is so.[78]

A quantity is by definition a whole divisible into homogeneous individual parts. Some things are divisible in such parts, so they are quantities, but through the divisibility of something else. They are called quantities by accident because it is not by themselves, in virtue of what they are essentially, that they are quantities, but on account of something else that is a quantity by essence.

[77] For example, as we will see shortly, number is defined as a multiplicity – a discrete quantity – measured by one. A line can be defined as a finite magnitude – a continuous quantity – of one dimension, etc.
[78] *Met.* V. 13, 1020a27-35. Trans. Ross.

Movement is a Quantity

Movement is a quantity in this way. It is not a quantity by essence; it is not defined as a quantity, but as the actuality of what is in potentiality, as such. However, movement is divisible into homogeneous and individual parts through the divisibility of what is a quantity by essence. It is clear in the case of the species of locomotion. A moving object which moves from one place to another moves through a spatial interval delimited by those two places. Such a spatial interval forms a magnitude. Magnitude is a quantity by essence. Insofar as the movement of the object happens over magnitude and thereby covers magnitude, it is also divisible; it is divisible through the divisibility of the magnitude. For example, because the magnitude is divisible into two parts that we can name part A and part B, the movement is also divisible into 2 proportional parts that we can name A′ and B′. Thus, movement is a quantity because it is divisible into homogeneous and individual parts (the parts of a movement are movement), but it is not a quantity *per se*.

Other species of movement are also quantities insofar as they are divisible, although this is not as obvious as in the case of locomotion. Growth and decay are quantities by accident for their object is the quantity of a body, that is a magnitude; a movement of growth or decay is thus a quantity through the divisibility of the body.

As for alteration, it takes place in a body that is divisible. Although the passive, sensible qualities which are the objects of alteration are indivisible in themselves[79], the body in which they exist is divisible in parts that are altered when alteration takes place.[80] Thus, ultimately, alteration is a movement that is also divisible through the divisibility of the body.

[79] Taken in itself, abstractly from a subject, a quality does not admit of more and less - e.g. white, inasmuch as it is what it is, cannot be more or less white; but something white can be more or less white.
[80] Cf. *Phys*. VI, 4, 235a18-20; 5, 236b6-8.

Continuous & Discrete Quantities

Just after defining quantity, Aristotle writes:

> A quantity is a plurality if it is numerable, a magnitude if it is measurable. We call a plurality that which is divisible potentially into non continuous parts, a magnitude that which is divisible into continuous parts.[81]

Some quantities are divisible into parts that are continuous to one another; others are divisible into parts that are discontinuous, discrete. According to this essential difference, quantity is a genus divisible into two species: magnitude (continuous quantity) and plurality (discrete quantity). In *Metaphysics* V. 13, Aristotle mentions 'number' as a kind of discrete quantity, whereas figures such as line, surface and body are mentioned as kinds of continuous quantities. In *Categories* 6, he adds 'speech' as a kind of discrete quantity, and 'time' and 'place' as kinds of continuous quantities.[82]

2 Definitions of Continuous Quantity

In *Categories* 6, Aristotle defines a continuous quantity as a quantity whose parts are joined by a common limit.[83] This definition is congruent with how he defines the notion of 'continuity' in *Physics* V. 3: he says that those things are "continuous", or in continuation, whose extremities are one and the same.[84]

Assuming this definition of continuity (and other related concepts such as 'together', 'contiguous' and 'consecutive'), Aristotle proves in *Physics* VI. 1[85] that a continuous quantity is not composed of parts that are indivisible. For example, a line, which is

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[81] *Met.* V. 13, 1020a9-12. Trans. Ross.
[82] The reason why some of the examples of quantity given in the *Categories* – time, place and speech – are not found in the *Metaphysics* seems to be that in the *Categories*, which is a treatise of logic, quantity is regarded as what is measurable: 'quantity' is what answers the question 'how much?', or 'how many?'. Accordingly, kinds of quantities are distinguished according to specific differences in the unity that serves to measure them. Thus, when Aristotle wants to justify that speech is a quantity, he says that it is measured by brief or long syllables. Also, the reason he gives for treating movement as a quantity by accident is that it is measured by time (cf. Cat., 6, 5b3-7). Furthermore, place is mentioned as a distinct quantity besides magnitude in the *Categories*, and this seems to be accounted for by the fact that place is an extrinsic measure of bodies (being the limit of the surrounding body) whereas magnitude is an intrinsic measure (it is the extent of the matter of bodies).
[83] *Cat.* 6, 4b20-5a13.
[84] *Phys*., V, 3.
[85] Cf. *Phys.* VI. 1, 231a20-231b18.

the most familiar instance of a continuous quantity, is not composed of points, which would be the case if it were composed of indivisibles – since a point is indivisible, having no dimension. His main argument is that indivisibles cannot be joined at a common boundary in order to form a continuous quantity, neither by mode of continuation, nor by mode of contact nor by mode of consecution.

From the conclusion that a continuous quantity is not composed of indivisible parts, Aristotle infers the corollary that a continuous quantity is infinitely divisible. This property of a continuous quantity provides another way to define it: the continuous can be defined as what is infinitely divisible. This is in fact how Aristotle defines the continuous in his natural treatises[86], whereas in *Categories* 6 (and implicitly in *Metaphysics* V.13) he defines continuous quantity as a quantity whose parts are united by a common limit.[87]

Movement is a Continuous Quantity

Movement is continuous. Aristotle proves it in *Physics* VI.1 as he offers a demonstration that movement cannot be composed of indivisible parts of movement. It can be shown in a simpler way that movement is continuous by the fact that it is a quantity on account of magnitude. In the passage of *Metaphysics* V.13 previously quoted, Aristotle writes that not only is movement a quantity because magnitude is a quantity, but it is also continuous because magnitude is continuous:

> Some are quantities in the way in which movement and time are so; for these are called quantities and continuous because the things of which these are attributes are divisible.[88]

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[86] See for example : *Phys.*, III, 1, 220b19-20; V, 4, 228b20; *De Caelo*, I, 1, 268a7.

[87] In his commentary to *De* Caelo, Aquinas explains that these two definitions differ by their mode of defining. Since a quantity is a certain kind of whole, it must be defined by its parts. Now, there are two ways in which a whole and its parts relate to one another: the whole is composed of its parts; and the whole is divisible in its parts. Thus, a continuous quantity can be defined by way of division or by way of composition. The definition which proceeds by way of division is an analytic definition inasmuch as it goes from the whole to its parts, or a material definition inasmuch as the parts are like the matter of the whole.[87] The definition which proceeds by way of composition is a synthetic definition inasmuch as it goes from the parts to the whole, or a formal definition since the whole pertains to the formal cause of what is made up of parts arranged together. Cf. Aquinas' Commentary on *De* Caelo. Ed. Marietti. L. I. lect.II, no.9.

[88] *Met*. V. 13, 1020a27-35. Trans. Ross.

Movement is divisible through the divisibility of magnitude, and this is why it is a quantity. Now, magnitude is infinitely divisible. Therefore, movement is infinitely divisible as well. And because what is infinitely divisible is continuous, movement is continuous.

Quantities With Vs. Without Position

Since quantity consists in a multiplicity of parts, quantities differ according to differences of their parts. In *Categories* 6, in addition to dividing the genus 'quantity' into the species 'discrete' and 'continuous', Aristotle presents another division founded upon another difference that distinguishes quantitative part: some quantities have parts which have position; and some quantities have parts which don't have position.[89] He mentions the line, the surface and the body as examples of quantities whose parts have position. Here is how he justifies the claim that the parts of a line have a position:

> The parts of a line have position in relation to one another, each of them is situated somewhere, and you could distinguish them and say where each is situated in the plane and which one of the other parts it joins onto.[90]

This description suggests that position is the location of a part in a whole defined relatively to other parts of the whole.

Among the quantities whose parts don't have position, Aristotle gives the example of number. The parts of a number do not have position for it is not possible to say where they are located with respect to each other. For example, '3' and '2' are parts of five, but it is indefinite in the number '5' whether '3' is after '2' or '2' is after '3'. Likewise, if I count a number of chairs, it does not matter which chair I count first and which chair I count last; the only thing that matters is that I count all the chairs and that I count each chair only once so that I count the right number.

As another example of a quantity without position, Aristotle mentions 'speech'. Speech can be considered as a quantity because the plurality of its uttered syllables

[89] Cf. *Cat.* 6. 5a15-18.
[90] *Ibid.* 5a17-20.

forms a quantitative whole. The syllables of speech, Aristotle explains, do not have position for they don't have permanence:

> None of its parts endures, once it has been uttered it can no longer be recaptured; and so its parts cannot have position, seeing that none of them endures.[91]

In order for parts of a quantity to have position, they must coexist. Because the syllables of a speech don't endure, they don't coexist so they don't have position in the whole. We can say that syllables have an order – e.g. this syllable is uttered 'before' that one – but this is not an order of position.

Movement is a Quantity without Position

Like the syllables which are the parts of a speech, the parts of motion do not endure. For example, when a moving body has moved over one part of its path, it has completed the part of movement covering and corresponding to this part of the path and this part of movement no longer exists. Because the parts of movement don't have permanence, they don't coexist and thereby don't have position (although they have an order). Thus, movement is a quantity without position.

Abstract and Concrete Quantity

Quantity is one of the senses of 'being', one of the many ways 'being' is said.[92] Quantity is accidental being because it does not exist by itself, but in a substance; it is an accident of substance. Fundamentally, quantity follows the material extension of natural bodies.

Thus, quantity exists concretely in the world. It is even sensible. Aristotle calls it a "common perceptible", that is something that we can perceive by many senses.[93] For example, we can perceive the quantity of a body and its shape by the sense of touch and the sense of sight.

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[91] *Cat.* 6, 5a32-35. Trans. Ackrill.
[92] *Met.* V. 7, 1017a22-30.
[93] *DA.* III. 1, 425a12-21. Aristotle explains that common sensibles, as opposed to proper sensibles, are objects of sense that are not exclusive to one sense, but can be perceived by more than one sense. The senses perceive them through the perception of their proper object of sense.

On the other hand, the objects that the mathematician studies, geometrical figures and numbers, are not found in reality. Indeed, the things that exist in reality are made of matter that have sensible qualities such as color, weight, hardness, warmness, etc. Now, mathematical objects are devoid of these. For example, the triangle the mathematician studies is not a triangle made of a particular matter such as wood, and it does not have a color. Consequently, we cannot see or touch a mathematical triangle. Neither are mathematical objects mobile, whereas everything that exists in the natural world is mobile, can change.

Aristotle explains this peculiarity of mathematical objects by the fact that mathematical quantity is abstracted from sensible matter:

> The mathematician investigates abstractions (for in his investigation he eliminates all the sensible qualities, e.g. weight and lightness, hardness and its contrary, and also heat and cold and the other sensible contrarieties, and leaves only the quantitative and continuous, sometimes in one, sometimes in two, sometimes in three dimensions and the attributes of things *qua* quantitative and continuous, and does not consider them in any other respect.[94]

The mathematician abstracts quantity from natural bodies in which it exists to study it only as quantity, leaving aside the characters which do not belong to it as quantity: sensible qualities and mobility. Aristotle explains that this abstraction is what differentiates the mathematician from the naturalist. The latter also considers quantity, but insofar as it is the quantity of a mobile being, which is the proper object of natural philosophy:

> Natural bodies have surfaces and volumes, lines and points, and these are the subject matter of mathematics… The writers on nature obviously do discuss their shape and whether the earth and the world are spherical or not. Now, the mathematician, though he too treats of these things, nevertheless does not treat of them as the limits of a natural body; nor does he consider the attributes indicated as the attributes of such bodies. That is why he separates them; for in thought they are separable from motion. [95]

As indicated in the last passage, the reason why there exists a science of quantity as quantity – mathematics – is because quantity is separable in thought from "motion", viz. from mobile, sensible matter, which is not essential to its intelligibility. This

[94] *Met.* XI. 3, 1061a29-35. Trans. Ross.
[95] *Phys.* II. 2, 193b23-33. Trans. Hardie and Gaye.

separability of quantity allows the mathematician to define its object without natural matter, which is not part of its essence:

> Odd and even, straight and curved, and likewise number, line, and figure, do not involve motion; not so flesh and bone and men – these are defined like snub nose, not like curved.[96]

Although mathematical objects are defined without sensible matter, they don't exist as separate substances because their separation from matter is the result of an abstraction by the mind:

> If its subjects happen to be sensible, though it does not treat them *qua* sensible, the mathematical sciences will not for that reason be sciences of sensibles – nor, on the other hand, of other things separate from sensibles.[97]

Mathematical objects don't exist as separate substances. It is nonetheless possible to say that they exist in a certain sense:

> Geometers speak correctly – they talk about existing things, and their subjects do exist.[98]

Mathematical objects are quantities, and quantity exists in reality. Mathematical quantity can be said to exist in an abstracted mode, in the mind, which separates it from matter in order to study it as quantity.

Thus, quantity exists in two modes. It exists concretely, in a real mode, as the quantity of material substances; and it exists abstractly, in the mind, in the way mathematical entities do.

Number

Definition

A number is a quantity, a discrete quantity. The species of quantity which is discrete is called 'plurality', and a number is in fact a plurality. "A number is many units", [99] as Aristotle writes in *Physics* III. 7, and many units form a plurality of units. Likewise, he writes in *Metaphysics* X. 6 that "each number is called a plurality

[96] *Phys.* II. 2, 194a3-6.
[97] *Met.* XIII. 3, 1078a2-4.
[98] *Ibid.* 1078a28-31.
[99] *Phys.* III. 7, 207b7-9.

because it is composed of ones."[100] A unit is the name given to an entity insofar as it is one, indivisible. Aristotle defines number as "a plurality measurable by the one". In other words, it is a plurality of units measurable by one unit. A measure is what makes known a quantity. A quantity is a whole, and a whole is knowable by its parts. A number is a quantity composed of units of the same kind, so it is knowable, measurable by one of its units. For example, we measure '3' by one unit, counting three times '1'. Since a number has a definition, Aristotle considers that number is an entity having an essence, and thus a formal unity.[101] The matter of a number is the units that compose it and its form consists in the relation of measurability between the plurality of units and one of them.

Because a number is measurable, it is also a finite quantity. Indeed, what is infinite is not measurable. In this sense, Aristotle writes in *Metaphysics* V.13, after dividing quantity between the species 'plurality' and 'magnitude', that a finite plurality is a number:

> A magnitude continuous in one dimension is a length, in two dimensions a surface, in three dimensions a depth. A finite plurality [πλῆθος πεπερασμένον] is a number [ἀριθμὸς], a finite length a line, a finite breadth a surface, a finite depth a body.[102]

Concrete Number vs. Abstract Number

Because quantity exists in two modes, abstractly and concretely, so it is for numbers, since a number is a quantity. When we think of a number, we primarily think of entities such as '2', '3', '4', etc, that is mathematical numbers, objects studied by arithmetic. These are pure, abstract quantities. As a matter of fact, number has been defined as a plurality measurable by one, and there is no sensible matter in this definition. For example, the number '3' is a plurality of three simple units measurable by one unit. Because an abstract number does not have sensible matter, it does not exist separately in reality, only in the mind.

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[100] *Met*. X. 6, 1056b22-24.
[101] *Ibid.* V. 14, 1020b7-9.
[102] *Met*. V. 13, 1020a10-13.

In reality, numbers exist in a concrete mode, as the quantity of a subject. Indeed, a number is a finite plurality; plurality is a species of quantity, and quantity exists as an accident of substances (it is a predicate of 'being'). A discrete quantity, a plurality of things, is a number, a number of things. Aristotle writes:

> What is one is indivisible whatever it may be, e.g. a man is one man… A number is a plurality of ones and a certain quantity of them.[103]

A substance is one insofar as it is indivisible. A man is indivisible as man, so it is one. If there are many men, a plurality of 'one man', there is a number of men; and this number exists as the quantity of men.

The following is another passage which shows that Aristotle thinks numbers exist in a concrete mode:

> We know the number by what is numbered, e.g. the number of horses by one horse as the unit.[104]

A plurality of horses satisfies the definition of number: it is a plurality of units, since each horse is one insofar as it is an individual horse; and this plurality is measurable by a unit, one horse.

Thus, the notion of 'number' designates two entities: a concrete number, a number having a material, sensible subject; and an abstract number, a number without such a subject. Because sensible matter does not enter the definition of number – a plurality measurable by one – the notion of 'number' designates primarily an abstract number. Yet, numbers exist first in a concrete mode. They can exist in an abstract mode in the mind because it is possible to conceive of numbers and their units without the material subject with which they exist in reality. The following passage suggests that the units of mathematical numbers are conceived by retaining only the indivisibility of the subject, leaving aside all other characters: position, extension, sensibility, mobility. This abstraction differentiates the units of mathematical numbers from the units of a concrete number:

> Each question will be best investigated in this way – by supposing to be separate what is not separate, as the arithmetician and the geometer do. For a man *qua*

[103] *Phys.* III. 7, 207b5-7. Trad. Hardie and Gaye.
[104] *Phys.* IV. 11, 220b18-20.

> man is one indivisible thing; and the arithmetician supposes one indivisible thing, and then considers whether any attribute belongs to a man *qua* indivisible. But the geometer treats him neither *qua* man nor *qua* indivisible, but as a solid.[105]

In sum, 'number' can designate an abstract number or a concrete number – a number having a subject. These entities are not different kinds of numbers, but rather correspond to different modes of existence for numbers.

The Notion of 'Same Number'

The notion of 'same number' plays an important role in Aristotle's account of time. So much so that Aristotle offers remarks about it at the end of his inquiry, as a sort of appendix. He writes:

> It is rightly said that the number is the same of dogs and sheep if the two <groups> are equal, but that the ten is not the same no more than the decades are the same, in the same way as the equilateral and scalene are not the same triangle, although their figure is the same because both are triangles. For we call the same what does not differ by a specific difference, and not what differs; for example, one triangle differs from another by a specific difference (that is why they are different triangles), but not by a difference of figure, but they are comprised under the same one division… They are thus the same figure, that is a triangle, but they are not the same triangle. Likewise, the number of these things is the same (their number indeed does not differ by a difference of 'number'), but the ten is not the same. In effect, the things of which it is predicated [λέγεται] differ: the ones are dogs, the others are horses.[106]

The point of this passage is to show that there is a distinction between saying that numbers are equal and identical. In order to understand Aristotle's explanation, it will be helpful to make two preliminary remarks.

One of them is the distinction between the notions of 'identity' and 'equality'. In *Metaphysics* V. 15, Aristotle presents these, along with the notion of 'similitude', as different relations that follow unity.[107] Similitude is defined as a relation between

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[105] *Met.* XIII. 3, 1078a21-26. Trans. Ross.
[106] *Phys*. IV. 14, 224a2-15. My trans. We note that in the last line (223a3), Aristotle has inadvertently written "horses" whereas he should have written "sheep", to be consistent with the first line.
[107] *Met.*, V, 15, 1021a12-14.

things whose quality is one; equality as a relation between things whose quantity is one; identity as a relation between things whose substance is one.[108]

The other remark is a distinction between two ways in which things are said to be one. Aristotle distinguishes these ways in *Metaphysics* V. 6:

> Those things are called one whose genus is one though distinguished by opposite differences; and these are called one because the genus which underlies the differences is one (e.g. horse, man, and dog are one, because all are animals)…These are sometimes called one in this way, but sometimes it is with respect to a genus more remote that they are said to be the same thing: it is in the case where they are the last species of their genus – the genus above the proximate genera, e.g. the isosceles and the equilateral are one and the same figure because both are triangles, but they are not the same triangle.[109]

In one way, things are said to be one because they are individuals of the same species or species of the same genus. For example, "horse, man, and dog are one, because all are animals." Likewise, scalene and equilateral are one insofar as they are species of the same genus: triangle. In another way, things are said to be one relatively to a genus or a remote genus as they do not differ by a specific difference of it. In this sense, scalene and equilateral are one as the same figure. Indeed, they don't differ by a specific difference of the genus 'figure'; they are the same species of figure, being both triangles.

In the passage of *Physics* IV.14 previously quoted, Aristotle has written that "the number is the same of dogs and sheep if the two <groups> are equal, but the ten is not the same … in the same way as the equilateral and scalene are not the same triangle, although their figure is the same because both are triangles." If concrete numbers are equal, their quantity is one, the same, so they *have* the same number. For example, 10 dogs and 10 sheep are equal numbers, so their quantity, their number is the same: 10. Yet, they are not the same number. Indeed, a concrete number is the compound of a number and a subject, so concrete numbers are not identical, substantially one, unless both their number and their subject is the same. 10 dogs and 10 sheep are numbers

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[108] Things can be identical either in form (specifically identical), in matter (materially identical) or in both matter and form (numerically identical, i.e. absolutely identical). Indeed, although 'substance' designates primarily the compound of form and matter, it is said also of form and even of matter.
[109] *Met*. V. 6, 1016a24-33. Trans. Ross, slightly modified.

whose subject differs specifically: dogs and sheep. Therefore, they are not the same number although they are equal: they are not the same number ‘10’.

In order to make this clear, Aristotle proposes a comparison with triangles – the same example he used, in *Metaphysics* V. 6, to illustrate what it means for things to be one relatively to a remote genus. Scalene and equilateral are both triangles, but they are not the same triangle for they differ by a specific difference of the genus ‘triangle’. As we have seen, it is relatively to the remote genus ‘figure’ that they can be said to be identical in this way. So it is for the numbers ‘10 dogs’ and ‘10 sheep’. They are identical relatively to the remote genus ‘number’ since they don’t differ by a specific difference of that genus; they are the same species of number: ‘10’. However, they differ by a specific difference of ‘10’, so they are not the same number: they are not the same ‘10’.

Thus, the notion of ‘same number’ is equivocal because it can refer to the equality of numbers or their identity, and these are distinct relations. If concrete numbers are equal, they are the same number in the sense that their quantity is the same. Yet, they are not identical numbers unless their subject is also the same. In other words, the equality of concrete numbers does not mean and imply their identity. To speak strictly (so as to avoid confusing these relations), if equal numbers don’t have the same subject, we should say that they *have* the same number, not that they *are* the same number (for they are not identical numbers).

Measure

The notions of ‘quantity’ and ‘number’ are intimately related to the one of ‘measure’. Number is defined as a plurality measurable by one. Furthermore, in ancient Greek, quantity is called *ποσὸν*, an extension of the interrogative adverb meaning ‘how much?’, ‘how many?’ Likewise, the Latin word *quantitas*, from which comes the English ‘quantity’, is derived from the interrogative adverb *quantum*, which has the same meaning as the Greek *ποσὸν*: ‘how much?’, ‘how many?’ These adverbs refer to the measure of a quantity, which is expressed by a number. The fact that quantity is named in Greek and Latin after these adverbs indicates that quantity is what answers

the question ‘how much?’, or ‘how many? It indicates that quantity is what is measurable, what we know by the measure.

The Measure is a ‘One’

As a matter of fact, Aristotle defines ‘measure’ as “that by which quantity is known.”[110] He shows that the measure of quantity is ‘the one’, a unit:

> Quantity as quantity is known either by a one or by a number, and all number is known by a one. Therefore all quantity as quantity is known by the one, and that by which quantities are primarily known is the one itself; and so the one is the starting point of number as number. And hence in the other classes too ‘measure’ means that by which each is first known, and the measure of each is a one – in length, in breadth, in depth, in weight, in speed … In all these, then, the measure and starting-point is something one and indivisible, since even in lines we treat as indivisible the line a foot long.[111]

A number is by definition a quantity, a plurality measurable by one. Continuous quantities are measurable by a number, but that number is itself measurable by a certain unit. Therefore, the ultimate measure of continuous quantities is also a certain unit. For example, if a line measures 15 cm, the number ‘15 cm’ is measured by 1 cm, so the line is ultimately measured by something one, the centimeter. Because every quantity is measured by a certain unit, something one, Aristotle concludes that the measure of quantity as quantity is the one.

Aristotle explains why the one is measure as follows:

> Thus, then, the one is the measure of all things, because we come to know the elements in the substance by dividing the things either in respect of quantity or in respect of kind. The one is indivisible just because the first of each thing is indivisible.[112]

A quantity is a whole, and a whole is known by the elements, the parts of which it is composed. Insofar as a whole is divisible into its parts, the parts are indivisible and as such, they are one. Indeed, “the essence of the one consists in indivisibility”, Aristotle writes elsewhere. Moreover, as opposed to a substance or a mixed body, the parts of a quantity are homogeneous (to put it roughly, a quantity, it is just more of the same). Therefore, a quantity is knowable by one part of it, which, as indivisible, is one. Now,

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[110] *Met.* X. 1, 1052b20.
[111] *Ibid.* 1052b21-33. Trans. Ross.
[112] *Ibid*., 1052b17-20.

the measure is that by which quantity is knowable. Hence, the measure of quantity is a unit, something one.

Absolute vs. Relative Measure

A number is a plurality of units, so the measure of a number is a unit that is absolutely indivisible. Continuous quantities don't have actual parts and are infinitely divisible, so the unit which measures a continuous quantity is something posited as indivisible. Aristotle explains that the measure-unit of a continuous quantity is indivisible by perception. We indeed choose as a unit of measure a quantity that is as small as possible so that the measure is as precise as possible. In this regard, the measure-unit of a continuous quantity is an imitation of the numerical unit, which, in virtue of its absolute indivisibility, is a perfect, exact measure:

> Everywhere we seek as the measure something one and indivisible; and this is that which is simple either in quality or in quantity. Now where it is thought impossible to take away or two add, there the measure is exact. And that of number is most exact; for we posit the unit as absolutely indivisible; and in all other cases we imitate this sort of measure… So that the first thing from which, as far as our perception goes, nothing can be subtracted, all men make the measure, whether of liquids or of solids, whether of weight or size; and they think they know the quantity when they know it by means of this measure.[113]

Homogeneity of the Measure

In addition to being simple (absolutely or relatively indivisible), the measure must be of the same kind as the quantity measured:

> The measure is always homogeneous with the thing measured; the measure of spatial magnitudes is a spatial magnitude, and in particular that of length is a length, that of breadth a breadth, that of articulate sounds an articulate sound, that of units a unit.[114]

This is important because the measure is what makes quantity known. Thus, in order to make known a quantity of a certain kind, the measure-unit must be a quantity of the same kind. For example, we could not measure movement by weight, or volume by length, or pressure by temperature.

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[113] *Met*. X. 1, 1052b33-1053a8. Trans. Ross.
[114] *Ibid*. 1053a24-26.

‘Intrinsic’ Measure vs. ‘Extrinsic Measure’[115]

A distinction that, as we will see further, bears on Aristotle’s conception of time is between the notions of ‘intrinsic’ and ‘extrinsic’ measure.

As its name suggests, an intrinsic measure is in the subject that it measures. For example, the magnitude of a body measures that body intrinsically[116] because the magnitude is in the body as an accident in its subject. Likewise, we can say that a number is measured intrinsically by one of its units because the unit is in the number as a part of it; and more generally, we can say that a quantity is measured intrinsically by one of its parts.

We can use the quantity of something to measure the quantity of other things. For example, we can use the magnitude of a body to measure other bodies. The magnitude then measures other bodies extrinsically because it is not in these bodies; the measured bodies have a magnitude of their own. The measure-unit, the defined quantity that we use to measure other quantities (e.g. the metre, the gram, etc) is an extrinsic measure.

In sum, whereas an intrinsic measure is in the subject that it measures (as an accident or a part), an extrinsic measure is exterior to the subject that it measures.

Part IV: Time: Dialectical Inquiry

The previous sections have presented the context and conceptual apparatus that form the background of Aristotle’s theory of time. This section will introduce to Aristotle’s theory proper by studying what can be considered as a preliminary, a preamble to his formal inquiry into time: the dialectical investigation he carries on that topic.

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[115] Charles De Koninck explains this distinction. Cf. Charles De Koninck, "Un paradoxe du devenir par contradiction", in *Oeuvres De Charles De Koninck*. Tome 1, Volume 2, Philosophie De La Nature Et Des Sciences. Ed. Thomas De Koninck and Yves Larochelle (Québec Que.: Presses de l'Université Laval, 2012), 277.

[116] The magnitude of a body can be said to measure the body insofar as it delimits the body, and in this regard makes its quantity known.

Dialectic: a Fitting Method to Begin the Inquiry

Aristotle's discussion on time in *Physics* IV begins by the words:

> Following what has been discussed we must go on to [the topic of] time. It is first good to puzzle on both sides [διαπορῆσαι] about it, and to go through exterior reasons [ἐξωτερικῶν λόγων], as to whether it is among the things that exist or the things that do not exist, and what is the nature [φύσις] of it.[117]

In this passage, Aristotle announces his intention to begin his inquiry into time by using the dialectical method. Although he has not used this term, 'dialectic' (διαλεκτική), there are two important characteristics of this method which signal this intention[118]. First, he uses the verb *διαπορῆσαι*. This verb expresses the characteristic act of dialectic, which typically consists in giving reasons against both contradictory positions about a problem.[119] Second, he writes he is about to examine "exterior reasons" [ἐξωτερικῶν λόγων]. It is characteristic of the dialectical method to reason from *endoxa* [ἔνδοξα], a term which can be approximately rendered as "reputable opinions". *Endoxa* are principles exterior to things in the sense that they are grounded in representations about things rather than in things themselves.[120] When the dialectician admits an *endoxon* as a principle for an argument, he does not do so because he has the evidence that reality is such, but because this is an idea that is admitted by most people about the subject, or by most people who are acquainted with the subject. Because dialectical arguments admit exterior principles, they can be said to be exterior reasons.

From Aristotle's intention to conduct first a dialectical inquiry, we can draw the following consequence for the general structure of his inquiry on time: it will contain

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[117] *Phys.* IV. 10, 217b30-32. All translations from *Phys.* IV.11-14, in which Aristotle treats of time, are from mine unless indicated otherwise.

[118] Aristotle's conception of dialectic is a controversial topic in scholarship, and it is beyond the scope of this thesis to discuss the controversial issues about it. My characterisation of the dialectical method, in its opposition to the analytic (or scientific) method of inquiry, is based upon the following, excellent work: Yvan Pelletier, *La dialectique aristotélicienne: les principes clés des Topiques*, Collection Noêsis (Montréal: Bellarmin, 1991), chaps 1–2.

[119] Aristotle uses the same word when speaking about the usefulness of dialectic for philosophical sciences in *Top*., I, 2, 101a34-36: "διαπορῆσαι, ῥᾷον ἐν ἑκάστοις κατοψόμεθα τἀληθές τε καὶ τὸ ψεῦδος [being capable to puzzle on both sides of a subject, we will discern more easily the true from the false]".

[120] In *Top.* I. 1, 100b1ff., Aristotle says that as opposed to the principle of demonstrations, the *endoxa* which are the principles of dialectical arguments are not true in themselves, but admitted as true for reasons "exterior" to them, namely the fact that they are admitted by most people.

a part in which time will be discussed on a dialectical mode of argumentation, followed by an analytic, scientific part, in which time will be treated in a demonstrative mode of argumentation.

Aristotle begins inquiring about time on a dialectical mode because he thinks dialectic is useful for science.[121] Examining a subject by the means of dialectic can give sense of what is true and false about the subject investigated; it can give a sense of the conclusions that could eventually be demonstrated and of the principles that could be used for doing so. Furthermore, dialectic is helpful to identify what is problematic about a subject matter. In *Metaphysics* III.1, Aristotle says that solving a philosophical problem is comparable to untying a knot: it is impossible to untie the knot unless we know how it is made. Likewise, it is impossible to look for a solution to a problem unless we know what the problem consists in.[122]

Since Aristotle sees the dialectical investigation of time as a preliminary to his scientific inquiry into the subject, it is fitting to study it at the end of this introductory chapter. The scientific part of his inquiry will be studied in the subsequent chapters.

In the passage previously quoted, Aristotle wrote there are two questions that must be discussed about time using dialectic: "whether it is among the things that exist or the things that do not exist", and "what is the nature [φύσις] of it". 'Nature' (φύσις) here has the sense of 'what it is' (τί ἐστὶν), or 'essence' (οὐσια)[123]. To seek the nature of time is to seek what it is. Aristotle thus intends to address these two questions in his dialectical inquiry : what is time? and does it exist?

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[121] Cf. Top., I. 2, 101a34-36. My interpretation of the way Aristotle conceives of the usefulness of dialectic for science (another disputed issue beyond the scope of this dissertation to discuss), is based upon: Yvan Pelletier, 'La nécessité de la dialectique'. *Peripatetikos* 1, no. 11 (2016): 27-59.

[122] Cf. *Met.* III.1, 995a24-b3.

[123] The notion of 'nature' has several senses that are extended from its first meaning of being a principle of motion and rest for the things in which it resides primarily and not by accident. According to one of the senses, 'nature' designates the essence of natural substances, the 'what it is'. In an even more extended sense, it can also designate the essence of anything. Time is not a natural substance, but is has a nature in the sense that it has an essence that can be defined. Aristotle seeks to define this essence in the present inquiry.

A Mysterious Existence

The first difficulty which presents itself as we reflect about time concerns its existence. From a certain point of view, it seems obvious that time exists, and we can point out many signs of its existence. For example, the word ‘time’ permeates our language; now, words signify our concepts, and most of our concepts represent things that exist in the world. It would be odd if the word ‘time’, that we use so often, corresponded to nothing in reality. Another sign that time exists is that we measure it, and we are constantly worrying about lacking it. Furthermore, everything in the universe seems to exist in time, and be subject to the effects of time: “aging”, decaying.

In spite of the obvious existence of time, Aristotle shows, using dialectic, that there are reasons to doubt that it really exists. He presents the following argument as a first objection against the existence of time:

> One could suppose that time either does not exist altogether, or that it exists hardly [μόλις] and obscurely [ἀμυδρῶς]. Indeed, some part of it has passed and is not, another part of it will be and is not yet. Yet time – both infinite time and any time taken – is composed of these. Now, it seems impossible that what is composed of nonexistent things could partake of existence [οὐσίας].[124]

In order to judge whether something exists, we must have some conception of it; we must minimally have a nominal definition of the thing, a knowledge of what its name signifies. If we were to spell out what we mean by ‘time’, we might say: “time is the duration of things”, or “time is the flux of the present instant”; but we would probably say first that “it is a quantity, a whole composed of parts that we call “past” and “future”, delimited by an instant that we call “the present”. The previous argument assumes this latter meaning of time to argue that it does not exist. Time is a quantitative whole; however, its parts, the past and the future, do not exist: the past does not exist anymore, and the future does not exist yet. As for the present, it is not a part of time, but its limit. Indeed, if time is a continuous quantity, no continuous quantity is composed of indivisibles, as explained in Chapter 1; an instant is not a part

[124] *Ibid*., 217b32-218a3.

of time more than a point is a part of a line.[125] Now, it is impossible that a whole exists if it is composed of parts that do not exist. Thus, this argument prompts us to conclude, as opposed to what we are inclined to believe, that time does not exist.

As opposed to the past and the future, the present instant seems to exist. Therefore, one could maintain that if time does not exist as a whole, it nevertheless exists in the present instant. This opinion would fit with the view that time is the flow of the present instant, that the past is the present instant regarded as it was before, and the future as it will be after. Now, Aristotle presents a paradox suggesting that time cannot exist in the present instant. In ancient Greek, there was one word to refer to the present instant: *νῦν*, which means 'now'; Aristotle thus calls the present instant "τὸ νῦν", the 'now'. The paradox about the 'now' is the following: it must be either identical or different over time; but neither of these possibilities seems possible since they each involve aberrations. The argument presented by Aristotle can be broken down into two parts. First, it is argued that it is impossible for the now to be other over time:

> Nor is it easy to see whether the 'now' that appears to divide the past and the future is always one and the same or is perpetually different. For if it is perpetually different, and if no two sectional parts of time can exist at once (unless one includes the other, the longer the shorter), and if the 'now' that is not, but was, must have ceased to be at some time or other, so also no two 'nows' can exist together, but the past 'now' must have perished before there was any other 'now.' Now it cannot have ceased to be when it was itself the 'now,' for that is just when it existed; but it is impossible that the past 'now' should have perished in any other 'now' but itself. For we must lay it down as an axiom that there can be no next 'now' to a given 'now', any more than a next point to a given point. So that if it did not perish in the next 'now,' but in some subsequent one, it would have been in existence coincidently with the countless 'nows' that lie between the 'now' in which it was and the subsequent 'now' in which we are supposing it to perish; which is impossible.[126]

It seems reasonable to think that the 'now' is never the same over the course of time. This is coherent, for example, with our impression that time is a flow of instants that succeed one another before our consciousness: it seems that coming from the future, an instant becomes present, 'now', before vanishing immediately into the past and

[125] Aristotle offers 3 different arguments to prove that time is infinitely divisible and thereby not composed of instants in *Phys*. VI. 1, 232a18-2, 233a22.
[126] *Phys.* IV. 10, 218a8-22. Trans. Wickseed and Cornford.

being replaced by a new instant. But Aristotle raises the following objection. The 'now' that is replaced by another 'now' must disappear, perish, and it must do so either in itself or in another now; but neither of these alternatives is possible. The now cannot disappear in a past instant next to it because between two instants, there is an interval of time in which there are other instants. Before perishing, the now would thus be simultaneous to other nows, which is impossible. But neither can it perish in itself – for it would be destroyed when it exists, a contradiction.

Since it is impossible for the now to be different, there remains the other possibility – that it be identical over time. In fact, this alternative also seems plausible from a certain point of view: since it is always "now", what, after all, could really be the difference between one instant of time and another? What is, for example, the difference between an instant of time at 3 o'clock and an instant of time at 2 o'clock? At 2 o'clock, it was "now', and at 3 o'clock, we again say that it is "now". But again, Aristotle raises objections against this alternative:

> But neither can it continuously persist in its identity. For nothing which is finite and divisible is bounded by a single limit, whether it be continuous in one dimension only or in more than one; but the 'now' is a time limit, and if we take any limited period of time, it must be determined by two limits, which cannot be identical. Again, if simultaneity in time, and not being before or after, means coinciding and being in the very 'now' wherein they coincide, then, if the before and the after were both in the persistently identical 'now' we are discussing, what happened ten thousand years ago would be simultaneous with what is happening today, and nothing would be before or after anything else. [127]

As a continuous quantity, time is divisible into parts. Now, a part of time is delimited by two instants, two 'nows'. But if there is more than one 'now', the now is not identical. Furthermore, events that are simultaneous in time happen in the same now. Therefore, if the now was identical over time, all events that happen in time would be simultaneous. This is obviously absurd.

By the end of this whole argument, it seems that the now can be neither identical nor different over time. But if the now exists, one of these alternatives must be true. Therefore, this argument persuades us that the now does not exist. In doing so, it also persuades us that time cannot exist in the now.

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[127] *Phys.* IV. 10, 218a22-30. Trans. Wickseed and Cornford.

In sum, according to these arguments, time can exist neither as a whole composed of past and future, nor in the present instant. Together, they thus make a case against the existence of time. Aristotle concludes:

> One could suppose that time either does not exist altogether, or that it exists hardly [μόλις] and obscurely [ἀμυδρῶς].[128]

Because the arguments presented against the existence of time are dialectical, their conclusion is not certain. Moreover, as mentioned before, sensible experience strongly testifies in favor of the existence of time. These considerations suggest that rather than showing that time does not exist altogether, these dialectical arguments show that it exists "hardly [μόλις] and obscurely [ἀμυδρῶς]". It will be the object of chapter 4 to clarify how time exists.

An Obscure Nature

Having discussed the existence of time, Aristotle turns to the discussion of the other question he had said the inquiry of time must address: what is time? It is characteristic of dialectic to probe existing opinions about a subject matter. Aristotle begins discussing what time is by examining two opinions that have been handed down (παραδεδομένων[129]) about it:

> Some say that [time] is the movement of the whole, others the sphere itself.[130]

These opinions are likely to be the ones of philosophers, astronomers or wise people who lived prior to Aristotle. According to Alexander of Aphrodisias, Eudemus and Theophratus, the opinion that time is the movement of the sphere comes from Plato.[131] As for the opinion that time is the sphere of the heavens itself, it would be, according to Simplicius, the opinion of Pythagorean philosophers.[132]

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[128] *Phys*. IV. 11, 217b32-33.
[129] "Τί δ' ἐστὶν ὁ χρόνος καὶ τίς αὐτοῦ ἡ φύσις, ὁμοίως ἔκ τε τῶν **παραδεδομένων** ἄδηλόν ἐστιν, καὶ περὶ ὧν τυγχάνομεν διεληλυθότες πρότερον." *Phys.*, 10, 218a31.
[130] *Phys*., IV, 10, 218a33-b1.
[131] This is what Simplicius reports in his commentary. Simplicius himself does not think it is Plato's view. See Simplicius, *On Physics* IV.10, Diels. 703,10-704, 6.
[132] Simplicius think these Pythagoreans themselves may have developed the view as a result of a misunderstanding of Archytus, who said that time was an interval in the nature of the whole. See Simplicius, Diels. 700, 19-22.

"The sphere" or "the whole" these opinions talk about refers to the Cosmos, the universe. It was typical for Ancient Greeks to conceive of the universe as having a spherical shape, with the heavens rotating around the earth fixed at the center.[133] The opinion that time is the sphere of the universe itself is quickly dismissed by Aristotle as too naïve (εὐηθικώτερον) to be worth refuting. As for the view that time is the circular movement of the sphere of the universe, he shows it cannot express the nature of time by the following arguments. First, time is divisible, and every part of time is a time. Circular movement is also divisible, but a part of the circular movement is not a circular movement. Therefore, if time were the circular movement of the universe, a part of the circular movement of the universe would be the whole movement of the universe, which is absurd. Second, supposing that there were other universes, each undergoing a circular movement, there would be many simultaneous times. Now, this contradicts the fact that there is only one time.

The fact that these opinions are the only ones that are reported by Aristotle to have been handed on, and that they are easily refutable indicate that it is not an easy task to say what time is. Likewise, the compelling arguments against the existence of time reveal, as mentioned before, not only that its existence is puzzling, but also its nature. In particular, these arguments show that our common conceptions of time as a whole composed of past and future, or as a flow of the present instant are problematic since they involve paradoxes. As a result, Aristotle writes:

> What time is, that is what is its nature, is obscure from the opinions handed on to us as well as from what has been said previously [concerning its existence].[134]

The fact that time is a mysterious reality is bewildering if we think, as remarked before, that anyone seems to know with familiarity what time is and to have the certitude that it exists. This paradox is well echoed by Augustine, in the lines I have quoted in the introduction.[135]

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[133] For a detailed example of this, see *De Caelo*, particularly book II.
[134] *Phys*. IV. 10, 218a32-34.
[135] Cf. P.1

A Most Probable Idea: Time is Something of Motion

Even though the previous two opinions on the nature of time are incorrect, Aristotle finds some truth in them. He remarks that the opinion which claims that time is the sphere of the universe is motivated by the fact that all things are in time as they are in the universe. This is a valuable observation which will prove useful further on in Aristotle's inquiry, as we shall see in chapter 3. As for the opinion which contends that time is "the movement of the whole", it has the merit of pointing to a more legitimate opinion, one that is likely to be admitted by most people: the view that time is a certain motion:

> Since time seems mostly to be a certain motion and change, that is what must be examined.[136]

Time seems mostly to be a certain motion since it has much resemblance to motion, as Simplicius explains:

> The concepts of time and change seem in a way the same. For time seems to indicate some flow and procession, it has its being in becoming, which is a property of change, and it is an attribute that is similarly continuous and without limit.[137]

This resemblance of time with movement is reflected in common language, for we speak of time as we speak of movement. We say, for example, that time flows, passes by, quickly or slowly, etc. Moreover, if we were asked to show what we mean by the word 'time', we would probably point out to a certain movement, preferably one that is regular, such as the movement of a pointer on a clock. We also use a movement of this kind to know what time is. If the ancient Greeks were asked what time is, they would probably have pointed out to the movement of the celestial bodies around the earth – particularly the one of the sun – for this movement is the main one they used to have a sense of what time it is; moreover, they thought this movement was real.

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[136] *Phys*. IV. 11, 218b9-10.

[137] Simplicius, *On Physics* IV. 10, Diels. 705, 9-12. Trans. Urmson. Simplicius also perceives and articulates the connection between the opinion that time is a certain motion with the 2 previous opinions Aristotle has examined: "Aristotle investigates three opinions about time, leaving aside the more mythical. He considers them all together, having distinguished them. For time is either change or that which primarily changes, or the sphere of the whole. If it is change it is either all change or change of the whole; for the concept of time does not admit of changelessness or anything involving it." Diels. 700, 22-27. Trans. Urmson.

We thus understand that the view that time is the movement of the whole is not stupid at all: it reflects the common opinion that time is a certain regular movement. Since this latter opinion is the one most likely to be true about the nature of time, Aristotle continues his dialectical investigation by probing it. In keeping with the method of dialectic, the way to do so is to see whether it can resist objections. Aristotle finds two.

First, motion exists in a subject that is moving, and the latter moves from one place to another. Thus, a motion is related to some place. Moreover, different motions can happen simultaneously in different regions of the universe. But time is everywhere, even where there is no motion happening. Thus, time cannot be a motion; if it was, there would be time only where the subject of the motion that it is would be moving.

Second, motion is slow or fast, while time does not have these properties but rather determines them: generally speaking, a motion that is fast is one that covers a long-distance in a short time; and a motion that is slow is one that covers a short distance in a long time. Since the speed of a motion is defined by time, time cannot be a motion.

These objections show that time must be different from motion since it cannot be a motion. In accordance with the method of dialectic, Aristotle then examines a thesis which is opposite to see whether it makes more sense: the view that time would be so different from motion as being independent of it. He also finds an objection against such a position:

> When the state of our minds does not change at all, or we have not noticed its changing, we do not think that time has elapsed [γεγονέναι], anymore than those who are fabled to sleep among the heroes in Sardinia do when they are awakened.[138]

If we are not aware of movements in our mind – sensations, images, thoughts, feelings, etc – we are not conscious of the passage of time. Aristotle gives an example taken from a myth which must have been familiar to the people of his

[138] *Phys*. IV. 11, 218b21-25.

time.[139]Although this myth is foreign to us, it speaks of an experience anyone can relate to: when we awake from deep sleep, we are not conscious of the time that has passed during our sleep. Aristotle observes why it is the case:

> They join the 'now' [νῦν] that is prior to the 'now' that is posterior and make them one 'now', removing the interval because of their absence of sensation [ἀναισθησίαν]. As, then, if the 'now' was not other but one and the same, there would be no time, when it is hidden [λανθάνει] from us that the 'now' is other, then there does not seem to be time in the interval.[140]

Aristotle notices that the characters of the fable have not perceived time for they have joined the 'now' before their falling asleep to the 'now' after their waking; in other words, they have perceived these instants as the same rather than different ones. Accordingly, they have suppressed the interval of time bounded by these two nows and have not perceived it. This is, Aristotle observes, because time is an interval bounded between two nows; therefore, if we do not perceive the now as before and after, we do not perceive time.

In addition, Aristotle notices that it was hidden [λανθάνει] to these people that the now before and after their sleep was different because of their absence of sensation [ἀναισθησίαν]. Aristotle means an absence of sensation of motion, for he says before: "When the state of our minds does not change at all, or we have not noticed its changing, we do not think that time has elapsed."

Thus, there is no perception of time if there is no perception of motion in the mind. But if there is no perception of motion in the mind, there is no perception of motion altogether, for perception of motions exterior to the soul implies some motion in the soul as well. Indeed, sensation is a certain motion. It is possible to perceive motion in the mind without perceiving motion outside, but it is not possible to perceive motion outside without perceiving motion inside. Hence, it can be observed more generally

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[139] According to Simplicius, the anecdote refers to a sort of ritual practice. People went to sleep in a sacred place in the hope that during their sleep, as they are unconscious, a divinity would infuse in their minds the knowledge of a future event, the cure to some disease or the solution to some problem. Simplicius claims the sacred place in question in the fable Aristotle refers to is the tomb of the children of Heracles, whose bodies would have remained uncorrupted. Simplicius, *Simplicius on Aristotle's Physics 4.1-5, 10-14*, trans. J. O. Urmson, Ancient Commentators on Aristotle (Ithaca, N.Y: Cornell University Press, 1992), secs 707, 28–708, 21.

[140] *Phys*. IV. 11, 218b25-29.

that there is no perception of time without perception of motion whatsoever, whether it is perception of motion inside or outside of the soul. From this observation, Aristotle concludes that there is no time without motion:

> If, then, not being aware that time has elapsed follows for us when we do not distinguish any change, but that the soul seems to remain in a 'now' unique and indivisible, and when we perceive and distinguish a change, then we say that time has elapsed, it is obvious that there is no time without movement or without change.[141]

If time was independent from motion, we could perceive one without perceiving the other. Therefore, the fact that we perceive time when and only when we do perceive motion shows that there is no time without motion.

The fact that there is no time without motion indicates that the nature of time is closely related to the one of motion. Since it is impossible that time be motion itself, Aristotle concludes that it is 'something of' motion – somehow related to motion:

> That time is neither movement nor without movement, this is obvious. Since, then, we seek what is time, we must begin from there, grasping what it is of movement.[142]

To seek what something is is to seek its definition. Since time is something of motion, its definition must be sought by specifying what it is of motion; this is the sense of the phrase "we must begin from there, grasping what [time] is of movement". Now, to grasp the nature of something by showing its essential definition is an operation that belongs to science.[143] Thus, in implying that the search for the definition of time "must begin" by seeking out what time is of movement, Aristotle announces that the scientific part of the inquiry is about to begin. Accordingly, this phrase also marks the end of the dialectical part.

The proposition that time is something of motion is the outcome, the fruit of the dialectical inquiry. It has emerged, from the discussion of opinions, as a proposition

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[141] *Phys.* IV. 10, 218b29-219a1.
[142] *Ibid*. 10, 219a1-3.
[143] In *Apo*. II. 1, Aristotle mentions the "what it is" as one of the four things about which there is scientific knowledge. I will explain in what sense he thinks there is scientific knowledge of a definition in Chapter 2.

most probably true regarding the nature of time. It will provide the foundation for the search of the definition of time in the scientific part of the inquiry to follow.[144]

[144] The dialectical investigation about time thus exemplifies the usefulness of dialectic for philosophical science.

Chapter 2: The Nature of Time

Having discussed time in a dialectical mode, Aristotle inquires about it in an analytic, scientific mode. Arguably, science differs from dialectic in the following, essential manner: whereas dialectic uses common and probable principles to draw probable conclusions about a problem, science uses proper and necessary principles to demonstrate necessary, certain conclusions about a subject matter. Accordingly, in the scientific part of his inquiry, we should expect Aristotle to use proper principles and to proceed by demonstration in order to attain certain necessary conclusions about time.[145]

In the dialectical part, we have read that there are two questions he deems essential to address about time: what it is; and whether it exists. Whereas Aristotle began the dialectical part by discussing the existence of time, in the scientific part, he first asks what time is. His inquiry will lead him to define time as "the number of motion with respect to the before and after". The interpretation of this definition has been a subject of discussion since Antiquity. It is the subject of this chapter to explain what Aristotle thinks time is.

In the first part of the chapter, I will explain why Aristotle defines time the way he does by arguing that the definition follows from a demonstration in three steps. In the second part, I will clarify the meaning of this definition, addressing a number of ambiguities and difficulties which have proved an obstacle to its understanding among recent commentators. The third part of the chapter will treat of the 'now'. Time and the 'now' are indeed so closely related that knowing the one requires knowing the other. From Aristotle's account of the now, I will attempt to formulate a clear definition of the now, and show that the now has certain properties that follow from its nature.

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[145] Aristotle's conception of science, and its application to his philosophical works, particularly ones of natural philosophy such as the *Physics*, is debated in the secondary literature. Once more, discussing the issues of this debate is largely beyond the scope of this dissertation. The description of science I offer here and of its difference from dialectic is based upon: Aquinas, *Commentary to Aristotle's Posterior Analytics*, Bk I, L. 4, 10, 11, 13, 17.

Part I: The Definition of Time

Aristotle wants to know scientifically what time is, its nature. Accordingly, he will seek to define time. Indeed, to know scientifically is to know something through its causes[146], and the definition is a statement that formulates the essence of something by specifying its causes (material, formal, final, effective).[147] To know the essence of something is thus to know its definition.

Aristotle formulates his definition of time after a long process of reasoning. Now, as I have explained in the introduction of this chapter, we should expect Aristotle to argue on a scientific mode in this part of his inquiry. It is thus reasonable to suppose that he formulates the definition of time as the conclusion of a demonstration.

An Epistemological Problem

The latter proposal faces an objection that is epistemological in nature. It is doubtful that there can be a demonstration of a definition. Definitions typically play the role of premises in demonstrations rather than standing as their conclusion. Strictly understood, a demonstration consists in showing that an attribute necessarily belongs to a subject as its property on account of its definition.

Aristotle himself raises and discusses the problem of whether it is possible to demonstrate a definition in *APo.* II. He comes to the conclusion that strictly speaking, there is no demonstration of a definition; nonetheless, he maintains that in some cases, it is possible to manifest a definition through a demonstration:

> Of some things there is something else that is their explanation, of others there is not. Hence it is clear that in some cases what a thing is is immediate and a principle; and here one must suppose, or make certain in some other way, both that they are and what they are (which the arithmetician does; for he supposes both what the unit is and that it is); *in those cases which have a middle term and for which something else is explanatory of their substance, one can, as we said, make them clear through a demonstration, but not by demonstrating what they are*.[148]

[146] Cf. *Apo*, I. 2, 71a9ff.
[147] Not all definitions require these four causes.
[148] *APo*. II. 9, 93b21-29. Trans. Barnes.

A strict definition must state the causes of existence of the thing defined. In this sense, there is no difference between saying what something is and why it is. Now, a demonstration consists in showing that something is as a consequence of its cause. Consequently, Aristotle explains that for some things, there is little difference between their definition and the demonstration that they exist. In fact, he writes that in these cases, the definition is "a sort of demonstration of what the thing is, differing in position from the demonstration"[149]. By "differing in position", Aristotle means that the order of the terms in the definition of what the thing is differs from their order in the demonstration of why it is. He gives the following example. Provided that the cause of thunder, a sound in the clouds, is the extinction of fire in the clouds, a demonstration that there is thunder would be something like:

There is extinction of fire in the clouds. Now, the extinction of fire in the clouds produces a sound, and a sound in the clouds is thunder. Therefore, there is thunder.

Now, if we were to define what thunder is, we would have to state its cause in the definition; we would say that "thunder is a sound caused by the extinction of fire in the clouds". We see that there is very little difference between this definition and the previous demonstration, which basically argues that "there is thunder because the extinction of fire in the clouds produces a sound". The definition simply differs from the demonstration "by the aspect"[150], the position of the terms 'thunder', 'sound' and 'extinction of fire in the clouds' being different.

Because the definition of some things simply differs from the demonstration of their existence by the aspect, it seems that it would be possible to show their definition through a demonstration. Aristotle appears to say that such a demonstration is even necessary to know the definition:

> Without a demonstration you cannot become aware of what the thing is (in cases where the explanation is something else), yet there is no demonstration of it.[151]

[149] *Ibid*. 94a1-3.
[150] *Ibid.*10, 93b13-15.
[151] *Ibid*. 9, 93b18-20.

This discussion suggests that it is plausible that Aristotle thinks some definitions are demonstrable. On the other hand, we have seen there are also indications which suggest he thinks it is not possible, strictly speaking, to demonstrate a definition; moreover, the view according to which Aristotle would think definitions are demonstrable is controversial in the secondary literature. Given that it is beyond the scope of this dissertation to enter into a discussion of this complex and controversial issue, I shall rest content in holding the following position, which appears reasonable in view of the previous discussion: Aristotle thinks it is possible to manifest the truth of certain definitions through arguments, which, in virtue both of the character of their premises and of their formal rigor, are akin to demonstrations (or at least more like demonstrations than like dialectic arguments). Hereafter, I shall refer to these arguments as 'demonstrations' on account of this likeness that they bear with demonstrations understood in a strict sense. In other words, I shall call them demonstrations by analogy. Thus, it can be assumed that I hereafter use the term 'demonstration' in an analogical sense when I refer to arguments which conclude a definition.

In its strict and chief sense, a demonstration consists in showing that something must be as a necessary effect from its proper cause, which can be a material, formal, efficient or final cause. For example, many demonstrations of the science of geometry show that a property belongs to a figure in virtue of a formal cause implicit in its definition. For example, it can be shown that a triangle, that is a figure enclosed by three straight lines, has its interior angles equal to two right angles because, in virtue of its definition, one of its exterior angles is equal to the two interior opposite angles.[152] In the *Posterior Analytics*, Aristotle writes that besides a demonstration that provides the knowledge of the cause, of the 'why' (τὸ διότι), there is another type of demonstration, less rigorous, which only provides knowledge of the fact (τὸ ὅτι), that is, which only demonstrates that something is the case.[153] Aristotle distinguishes different modes of this type of demonstration. One of them consists in inferring a cause from its immediate effect (because if the effect is immediate, it will be

[152] Cf. Euclid. *Elements*. Book 1, Proposition 32.
[153] "Τὸ δ' ὅτι διαφέρει καὶ τὸ διότι ἐπίστασθαι". *APo*. I. 13, 78a22.

convertible with the cause).[154] Aristotle explains that it is often necessary to proceed this way for although causes are better known *per* se, by nature, their effects are often better known to us.[155] Here is an example given by Aristotle of a demonstration by the effect: planets are near the earth because they do not twinkle. Being near the earth is the cause of the planet's not twinkling. Indeed, objects do not twinkle on account of their proximity, not the converse. However, for us, the fact that planets are not twinkling is better known than its cause.

If Aristotle thinks, as I contend, that it is possible to manifest certain definitions through an argument akin to a demonstration, we may expect such an argument to be of the latter kind of demonstration. Indeed, because the definition states the causes of existence of the thing defined, to show what the definition of something is will consist in inferring the cause why it is from the fact that it is. Let us take up a former example. We know the fact that there is thunder before knowing the definition of thunder (for we do not know its cause). Yet, we know something vague about thunder – namely that it is a sound in the clouds. From the fact that thunder is a sound in the clouds, we can deduce that its cause is the extinction of fire in the clouds (provided that we also know that the extinction of fire causes a sound, and that there are signs of fire in the clouds when it thunders). This argument shows what thunder is: a sound produced by the extinction of fire in the clouds. Thus, the definition of thunder is known through an argument which infers its cause from the fact that it is. In the following, I will show that Aristotle proceeds similarly to define time.

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[154] *APo*. I. 13, 78a26-b11.

[155] Charles De Koninck comments: "When the only knowledge accessible to us is not a proper means of proof, unlike the definitions of mathematics, which are such proper means, our only resource is to look backwards, doing our best to find our way from properties to definition instead of from definition to properties. In the study of nature this is usually the only way in which we can make progress. For example, we know the alternation of day and night before we know the reason for it – a reason which took some time to discover… The expression of the observed regularity, as a general proposition reached by induction, becomes a substitute for the definition required by science." Charles De Koninck, *Abstraction from Matter* (Québec: Presses universitaires de l'Université Laval, 1957), 139.

Defining Time

The natural mode of learning for human reason is to progress from confused to distinct knowledge.[156] This applies not only to the act of reasoning, which consists in deducting new knowledge (expressed in the conclusion) from pre-existing knowledge (expressed in the premises), but also to the act of defining. Defining is done by taking a vague but true notion of what the thing is, its genus, and by refining this notion gradually in seeking the one or many characteristics that differentiate the thing we want to define from others belonging to the same genus. The process Aristotle will follow to define time will roughly obey this pattern.[157] He will start from the knowledge that time is something to do with movement, which he will support with argument; from this vague notion of what time is, he will ask what aspect of movement it has to do with; finally, he will determine precisely how time is related to movement in this respect. What will allow Aristotle to progress from one stage to another is, at each step, a demonstration. Each demonstration can be seen as one part of a whole demonstration from which he concludes the definition of time. Thus, Aristotle will discover and set forth the definition of time by a demonstration in three steps which gradually specify what time is.

Time is 'Something' of Movement

In the dialectical part of his inquiry, the discussion about the nature of time has led to an important conclusion: time is (as Aristotle puts it) 'something' of movement. The principle of a definition, as explained earlier, is some, confused notion of what the thing is, that can be specified to arrive at the precise conception of its essence. The proposition that time is something of motion thus provides Aristotle with a foundation, a starting point to seek the definition of time: "Since, then, we seek what is time, we must begin from there, grasping what it is of movement." [158] However, so

[156] Cf. *Phys.* I. 1, 184a16-b14.
[157] I do not mean that the method he will use to define time is the method of division he describes in *Apo*. II. 13, consisting in discovering the definition by dividing the genus into its species. I simply mean that defining always implies a progress that can be generally describes as going from a general notion of the thing to a distinct notion which is formulated in the definition. I don't think Aristotle uses the method of division to define time.
[158] *Phys.* IV.10, 219a1-3. The translations of *Physics* IV are mine unless indicated otherwise.

far, the conclusion that time is something of motion has been established in a dialectical mode. Hence, it has not been established by an argument that has the rigor required for science. Now that Aristotle treats of time in a scientific mode, he will confirm this conclusion by providing a demonstration:

> We perceive movement and time together [ἅμα]. Indeed, if it is dark and if we perceive nothing through our body, but a certain movement takes place in our soul, immediately [εὐθὺς] it seems to us that a certain time has also elapsed. And when some time seems to have passed, at once [ἅμα] it seems that some movement has also happened. So that time is either movement or something of movement. Since then, it is not movement, it is necessarily something of movement.[159]

No doubt, this argument is very similar to the one presented just before in the dialectical discussion: whereas there, it was argued that time is something of movement because we do not perceive time when we do not perceive motion, here it is argued that time is something of movement because we perceive time and movement together. In spite of this similarity, we can see that the latter has the form of a demonstration from the fact to the cause: from the fact that movement and time are necessarily perceived together, Aristotle proves that time is something of movement for it is the proper reason which accounts for such a fact.

To show that time and movement are necessarily perceived together, Aristotle points to the following case: when we do not perceive movement from the exterior, such as when it is dark, we immediately perceive time if we are aware of a movement happening in our soul, and conversely. Aristotle takes a case involving perception of movement in the soul exclusively, with no movement being perceived outside, and there seem to be two reasons for that.

First, if it is the case that time is perceived along with movement, the more clearly and certainly we perceive movement, the more clearly and certainly we should notice that time is perceived with movement. Now, movements of the soul such as changes of thoughts, images, feelings, etc, are better known to us for they are internal and intimate. Accordingly, the perception of time with internal movements of the soul shows more clearly that time is perceived along with movement.

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[159] *Ibid.*219a3-10.

Second, the perception of movements of the soul is immediate, whereas the perception of exterior movements is mediated by some affection of the body. Consequently, the perception of time with movement is immediate in the soul. This immediacy is signified by the use of the terms "εὐθὺς" [immediately, directly] and "ἅμα" [together, at once, simultaneously] in the text: "if a certain movement takes place in our soul, immediately [εὐθὺς] it seems to us that a certain time has also elapsed. And when some time seems to have passed, at once [ἅμα] it seems that some movement has also happened".

This immediacy is key for the argument: the fact that time and movement are perceived together in the soul in an immediate way provides evidence that the nature of time is also immediately, intimately related to the one of movement: time must be either movement itself or something of movement, an aspect of it. There could be no other possible explanation for this immediacy in the joined perception of time and motion.

Now, the arguments provided in the dialectical discussion have excluded the possibility that time be the same as motion: movement exists in the things in motion, which are many, whereas time is unique and everywhere; moreover, motions have a speed which is determined by time, while time is neither fast nor slow. Thus, it can be concluded with certitude that time is something of movement.[160]

Because time is something of movement, we can also say that time follows movement. Indeed, in *Metaphysics* V. 11, where Aristotle distinguishes between different senses of 'prior' (or 'before'), he explains that what something is dependent upon for its being is said to be prior to it[161]; accordingly, what depends upon something else to exist can be said "to follow" it (in being). Since time is something of movement, it depends upon movement. Thus, we can say that time follows movement.

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[160] For an interpretation of this argument similar to mine and a good critique of other recent interpretations, See Lorenzo Lazzarini, 'Why Is Time "Something of Motion" for Aristotle?', *Philosophical Inquiry: International Quarterly* 39, no. 2 (2015): 2–14.
[161] *Met.* V, 11, 1019a2ff. Cf. also *Cat*. 12, 14a29-35.

An objection: Why is it time that depends upon motion rather than the opposite?

To the conclusion that time is something of movement, one could object that time and motion would also be perceived together if motion was something of time. While it has been shown that time is not identical with motion, it has not been shown that motion is not something of time; therefore, it cannot be concluded with certitude that time is something of motion.

In answer to this objection, the following can be replied. In the dialectical inquiry, Aristotle has argued that because we do not perceive time unless we perceive motion, there is no time without motion. This is equivalent to concluding that time depends upon motion. Thus, the proposition that motion would depend upon time has been implicitly excluded by the dialectical inquiry. Aristotle assumes this premise in his demonstration, along with the proposition that time is not identical with motion. This is why he can infer, from the fact that time and motion are perceived together, that time is something of motion.

More fundamentally, Aristotle does not see the need to show that motion does not depend upon time for such an idea is simply paradoxical, the very opposite of an *endoxon*, of how people spontaneously think about time. In fact, the proposition that motion would depend upon time (that motion follows time) is a modern *endoxon*, not an ancient one. We, moderns, tend to think of time as being independent from motion and more fundamental than it. We are inclined to think that even if there were no motion in the universe, there would still be time; and we conceive of time, along with space, as a condition for motion – perhaps under the influence of the physico-mathematical scheme of Newtonian physics.

Such a conception would not make sense for Aristotle and the ancient Greeks, who would not even have envisioned its possibility. As we have seen, when Aristotle considers opinions about the nature of time in the dialectical discussion, he notes that people tend to conceive of time as a certain motion. The question is thus whether time

is identical to motion or something of motion; the idea that motion would be something of time is not an alternative.[162]

Nonetheless, since the idea that time follows motion tends to run opposite to the modern representation of the world, it seems appropriate to explain what reason Aristotle would have to think that it is time that follows motion, not motion that follows time. In terms of Aristotle's ontology, there are basically two kinds of things that exist in the world: substances and accidents.[163] A substance is an individual concrete thing that can be pointed out, e.g. a horse. Time, generally conceived as a whole composed of past and future delimited by the present instant, is not such an entity; it is not a substance. However, if we were asked to designate what 'time' refers to, the best we could do is to point to a substance in motion – e.g. the pointer of a clock, or the sun in the sky. This indicates that time depends upon a substance in motion to exist, that it exists as something of a substance through motion. This point will be argued for and developed in chapter 4, whose subject will be specifically to discuss how time exists. At this step, it is sufficient to grasp that it is time that follows motion, not motion that follows time, for the existence of time seems rooted in a substance in motion.

Time is Something of Movement with respect to the 'Before' and 'after'

Having shown that time is something of movement, Aristotle goes on to ask what it is of movement. He will argue that time follows movement with respect to a certain aspect of it: the 'before' and 'after'. This presupposes that he shows first that the 'before' and 'after' are in movement, and are formally distinct from movement.

The 'Before' and 'After' in Movement Follow the 'Before' and 'After' in Magnitude

Aristotle writes:

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[162] The dependence of time on motion is also reflected in the order that Aristotle follows in the *Physics*. The main theme of the physics is the study of natural beings in general. It focuses on the study of motion for nature is a principle of motion and natural beings are essentially mobile. After defining motion, Aristotle studies the infinite, place, void and time because these follow necessarily from movement. Thus, when Aristotle undertakes the study of time, it is already understood for him and the reader who has studied the previous books that movement is more fundamental than time.

[163] See chapter 1 for the exposition of the notions of 'substance' and 'accident'.

> Since what is moved is moved from something to something and every magnitude is continuous, movement follows [ἀκολουθεῖ] magnitude. Indeed, because magnitude is continuous, movement too is continuous, and because movement is continuous time too is continuous. In effect, however much movement there is, it seems to us that as much time has passed. The 'before' and 'after' are in place first. There they exist through position. Because the 'before' and 'after' exist in magnitude, it is necessary that they also exist in movement, in an analogous way. But in time too, the 'before' and 'after' exist for the one always follows [τὸ ἀκολουθεῖν] the other.[164]

In chapter 1, we have seen that Aristotle, in *Metaphysics* V. 14, distinguishes between 'quantities by essence' and 'quantities by accident'. Quantities by essence are entities of which quantity is part of the definition; quantities by accident are entities whose quantity is not part of their definition. Magnitude is a quantity by essence; it is one of the species of quantity (the specie 'continuous'). Because movement happens over magnitude, it is divisible in homogeneous parts through magnitude. Movement is thus a quantity by accident, being a quantity on account of magnitude. Furthermore, because magnitude is a continuous quantity, being infinitely divisible, so it is for movement.

In the previous passage of *Physics* IV.10, Aristotle reaffirms that. The relation of causality between magnitude, movement (and time) being quantities is here expressed by the notion of "following": movement "follows [ἀκολουθεῖ] magnitude". In the present context, this verb has the sense of an ontological dependence; it is in the same sense that previously, it was said that because time is something of movement, it "follows" movement.[165] Movement is a quantity and is continuous because magnitude is so; thus, movement depends upon magnitude for being a continuous quantity, and can be said to follow magnitude in that respect. Aristotle reasserts this relation of dependence and causality more explicitly in a further passage:

> Movement *follows* [ἀκολουθεῖ] magnitude and time movement, because they are quantities and continuous and divisible. Movement has these properties *because* magnitude is such, and time has them because of movement.[166]

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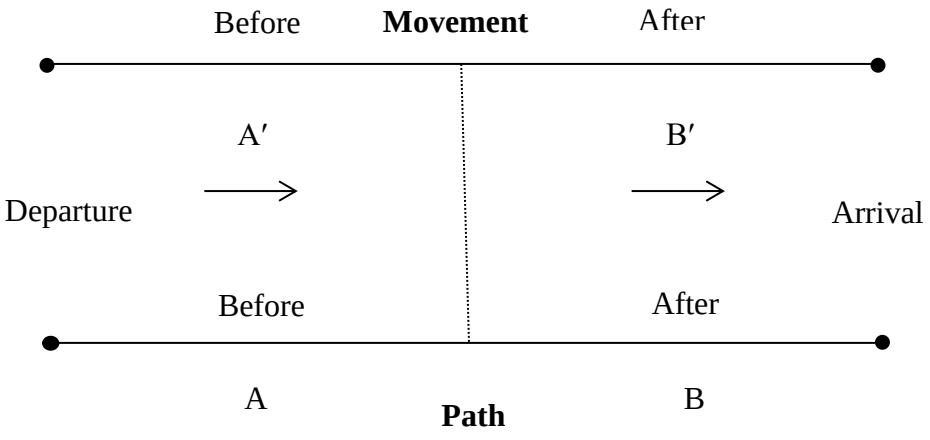
[164] *Phys.* IV. 10, 219a10-19.

[165] See, once again, the different senses of 'prior' (or 'before') in *Met.* V. 11, 1019a2ff.; *Cat.* 12, 14a29-35.

[166] "Ἀκολουθεῖ γὰρ τῷ μὲν μεγέθει ἡ κίνησις, τῇ δὲ κινήσει ὁ χρόνος, τῷ καὶ ποσὰ καὶ συνεχῆ καὶ διαιρετὰ εἶναι· διὰ μὲν γὰρ τὸ τὸ μέγεθος εἶναι τοιοῦτον ἡ κίνησις ταῦτα πέπονθεν, διὰ δὲ τὴν κίνησιν ὁ χρόνος." *Phys.*, IV, 12, 220b25-28. My translation.

In the passage that we study (quoted before the precedent), Aristotle argues that motion (and time) inherits another property in virtue of following magnitude as quantity: its quantitative parts have an order expressed by the terms ‘before’ and ‘after’. He writes that “because the ‘before’ and ‘after’ exist in magnitude, it is necessary that they also exist in movement.” The same claim is expressed as he writes that the ‘before’ and ‘after’ in motion (and time) “follow” [τὸ ἀκολουθεῖν] the before and after in magnitude, where they exist first (through position).

In order to appreciate this claim, let us observe that the parts in which magnitude is divisible have an order of position expressed by the terms ‘before’ and ‘after’. Because motion (and time) is divisible through magnitude, its parts have a corresponding order. For example, on the figure below, the path of a moving body is divided in two equal parts, A and B, to which correspond two proportional parts in movement, A′ and B′. Part A of the magnitude is located before part B because it is closer to the point of departure on the path. Because part A is before part B on the path, so the corresponding part A′ is before the corresponding part B′ on the movement.



Whereas the terms ‘before’ and ‘after’, applied to the parts of magnitude, express an order of position, they do not express an order of position when applied to the parts of motion. Indeed, as explained in chapter 1, movement is a quantity whose parts don’t

have position for they don't have permanence and thereby don't coexist.[167] For example, when the moving object undergoes part B′ of the movement, part A′ is done and does not exist anymore. The parts of movement however have an order of succession: to say that part B′ of the movement is after part A′ simply means that part B′ of the motion is completed by the moving object immediately after part A′. Because the parts of motion do not have an order of position like the parts of magnitude that they follow, Aristotle says that the 'before' and 'after' are in movement in a way analogous [ἀνάλογον] as how they exist in magnitude.

Thus, Aristotle has shown that the 'before' and 'after' are in movement because they follow the 'before' and 'after' in magnitude. Once again, he has argued in a demonstrative mode: the 'before' and 'after' exist in movement because movement follows magnitude as a quantity, and the quantitative parts of magnitude are ordered in this way. Since the before and after in magnitude are the cause[168] of the fact that they are in movement and time, this demonstration is a strict one, one that shows the effect from the cause.[169]

The 'Before' and 'After' is Formally Distinct from Movement

Having shown that the 'before' and 'after' in movement follow the 'before' and 'after' in magnitude, Aristotle infers that the 'before' and 'after' is an aspect of movement different from movement itself. He writes:

> The 'before' and 'after' in movement is movement [ὃ μέν ποτε ὂν κίνησις]. But its being [εἶναι] is different and is not movement.[170]

Aristotle's point in this passage is that in a certain respect, the before and after is identical with movement but in another respect, designated by the term 'being'

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[167] Cf. *Cat.* 6, 5a15-33.

[168] It must either be as a formal or material cause that the 'before' and 'after' in magnitude is cause of the 'before' and 'after' in motion and time since it cannot be as a final or effective cause. However, what exact sense of 'cause' is involved is a difficult question beyond the scope of this work.

[169] This does not contradict what I have said before, namely that we could expect Aristotle to manifest the definition of time in demonstrating from the fact to the cause. If Aristotle has shown that the 'before' and 'after' are in movement by a demonstration from the cause to the fact, this was only a prerequisite for what he wants to demonstrate at this step: that time is something of motion with respect to the before and after. As we shall see, he does so by demonstrating from the fact to the cause.

[170] "Ἔστι δὲ τὸ πρότερον καὶ ὕστερον ἐν τῇ κινήσει ὃ μέν ποτε ὂν κίνησις [ἐστιν]· τὸ μέντοι εἶναι αὐτῷ ἕτερον καὶ οὐ κίνησις." *Phys.* IV. 11, 219a19-21.

[εἶναι], it is different. Aristotle here presupposes a distinction between different modalities of 'identity' and its opposite, 'otherness'. These modalities, which have been encountered in chapter 1 while treating of the notion of 'same number'[171], are presented by Aristotle in *Metaphysics* X, 3[172]. There, he maintains that 'unity', a notion that consists essentially in the indivisibility of being, is followed by three sorts of relations: equality, similitude and identity. To be equal is to be one in quantity; to be similar is to be one in quality; to be identical is to be one in substance. Now, there are 3 senses of 'substance': in its strict and chief sense, 'substance' designates the composite of matter and form; but it can also designate the matter, or designate the form. Accordingly, there are three modalities of the relation of identity. Things which have the same matter are said to be numerically identical (for they are then one in number) or identical in subject (for they have the same subject). For example, insofar as Socrates is both a philosopher and a human being, we can say that 'philosopher' and 'human being' are identical in subject. In another way, things which have the same form, the same essence, the same definition, are said to be specifically identical or identical in being (for being designates primarily the essence). For example, insofar as Socrates and Plato are both human beings, they are identical in being. In another way, things which have both the same matter and form can be said to be identical in substance (for the compound of matter and form is the chief sense of 'substance'); they can also be said to be absolutely identical, or identical with themselves. For example, as a substance, Socrates is identical with himself.

In sum, identity is one of the relations following unity, and it declines in three modalities: identity in subject; identity in being; identity in substance. To these correspond three correlative modalities of 'difference', the opposite of 'identity'[173]: difference in subject; difference in being; difference in substance.

Aristotle maintains that the 'before' and 'after' is motion, but that its being is not motion. What is before and after in movement are the quantitative parts of

[171] P. 56.
[172] *Met.* X. 3, 1054a20-35. Cf. also the following passages, upon which I also draw to outline Aristotle's division of the different senses of identity: *Met.* V. 6, 1016a18-20; 9, 1018a5-8.
[173] As 'identity' is a relation following unity, so 'difference' is a relation following the opposite of unity; multiplicity. Things can be multiple in subject, being or substance.

movement. A part of movement is said before another because it is closer to the principle of movement.[174] Now, each part of movement is a movement. Thus, movement is the subject of the before and after, so the before and after is identical with motion in subject. This is why Aristotle writes that the before and after is motion.[175] In fact, every motion is composed of before and after since something changes by passing from what is before to what is after; this will become clearer shortly, as Aristotle will show that motion is perceived by the before and after.

Although the before and after in motion is movement, the being (εἶναι) of the before and after is distinct from motion, Aristotle says; in other words, the before and after are not formally identical with motion. The reason that implicitly supports this claim is what Aristotle has shown previously: the before and after in motion follow the before and after in magnitude. In other words, the before and after are not in motion in virtue of what motion is essentially, but because they are in magnitude. As explained before, since motion is a quantity on account of magnitude, it is a quantity by accident, not a quantity by essence.[176] The before and after are the quantitative parts of motion. Therefore, since it is an accident of motion to be a quantity, it is also an accident for motion that there is before and after in it. In fact, we can see that the before and after is not the essence of motion since motion is by definition "the actuality of what is potentially, as such."[177] Thus, although the before and after is identical with motion in subject, it is not identical with motion in being.

Time Follows the 'Before' and 'After' in Movement

Having shown that movement is formally distinct from its quantitative parts – the 'before' and 'after' – Aristotle shows that time follows movement in that respect: the before and after:

> But we know time also, precisely, when we determine [ὁρίσωμεν] movement, determining [ὁρίζοντες] it by the 'before' and 'after'; and we say that time has

[174] Cf. *Met.* V. 11, 1018b9-23.
[175] He expresses this identity in subject by the formula "ὃ μέν ποτε ὄν", writing: "Ἔστι δὲ τὸ πρότερον καὶ ὕστερον ἐν τῇ κινήσει *ὃ μέν ποτε ὂν κίνησις <ἐστιν>*" *Phys.*, IV, 11, 219a19-21. The formula "ὃ μέν ποτε ὄν" will reoccur and will be analysed further.
[176] *Met*. V. 13, 1020a27-33.
[177] Cf. Chap.1.

> passed when we have had a perception of the 'before' and 'after' in movement.[178]

Aristotle writes that we perceive time "when we determine [ὁρίσωμεν] movement by the 'before' and 'after'". The verb *ὁρίζειν*, that I translate by "to determine", literally means to delimit, to define the limits, to mark off the limits. For example, to determine (*ὁρίζειν*) a territory means "to mark off" the boundaries of a territory.

Motion is Determined by Marking off *Momenta* Before and After

Movement is a continuous quantity, and a continuous quantity is determined by two limits. For example, a line is determined by two points. In *Physics* VI, Aristotle calls '*κινήματα*' (in singular form '*κίνημα*')[179] the limits which determine a quantity of movement. The Latin translation for this word is '*momenta*' (singular form '*momentum*')[180] and hereafter, I shall use this term, more evocative and intuitive for us[181], to refer to what Aristotle calls '*κίνεματα*'. The *momentum* is the counterpart, in motion, of the point in magnitude. For example, if we imagine a body moving over magnitude, a *momentum* is a potential division in the motion of the moving body that corresponds to a point on the magnitude; it corresponds to the moving body insofar as it is before and after in different positions as it moves over magnitude.

Like points on a line, *momenta* of motion are not determined for they do not exist in actuality. Indeed, motion is continuous, not divided. However, motion is divisible. Therefore, we can determine *momenta* in motion. A quantity of motion is determined by two *momenta*, one before and one after. Therefore, we determine motion by

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[178] "Ἀλλὰ μὴν καὶ τὸν χρόνον γε γνωρίζομεν ὅταν ὁρίσωμεν τὴν κίνησιν, τῷ πρότερον καὶ ὕστερον ὁρίζοντες· καὶ τότε φαμὲν γεγονέναι χρόνον, ὅταν τοῦ προτέρου καὶ ὑστέρου ἐν τῇ κινήσει αἴσθησιν λάβωμεν." *Phys*. IV, 11, 219a22-25.

[179] For the occurrence of *κίνεματα*, see: *Phys*. VI. 1, 232a9; 10, 241a3-7. The word *κίνημα* originally designates in the Greek language a small, quick movement. Aristotle uses the word in this common sense in *De Mundo* (400a8) to designate strong and chaotic movements caused by winds and tempests in the sublunary region of the cosmos. In the context of the *Physics*, Aristotle extends the meaning of the term to designate the limits of movement – for these are indivisible, having no extension, and as such, they are like infinitesimal movements.

[180] Like the Greek word *κίνημα,* the word momentum can designate a movement of short length, whereby its meaning can be extended to designate an infinitesimal division of movement.

[181] Although we must not confuse its sense with the technical sense that it is given in *Physics*: the mass of a moving object multiplied by its velocity.

determining one *momentum* before and one *momentum* after; this is why Aristotle writes that "we determine motion by determining the before and after."

Time is Perceived with the 'Before' and 'After' in Movement

Moreover, the mind determines *momenta* in motion by perceiving them as potential divisions; they then become actual in the mind. The mind determines two *momenta* of motion by perceiving one as before and one as after. Therefore, the mind determines motion by perceiving the before and after in motion. By doing so, it also perceives time. Hence, we perceive time by perceiving the before and after in motion, that is by perceiving one *momentum* before and one *momentum* after. For example, we perceive the time which a moving body takes to move from one position to another when we perceive it being before in one position and after in another. If we do not perceive the body being before and after, we do not perceive it in motion but at rest. We do not perceive the time of the motion either. But when we perceive the body being before and after, we perceive its movement and we also perceive an interval of time. Hence, we perceive time when we perceive the before and after in movement.

Time Follows Movement with respect to the 'Before' and 'After'

Because time is perceived by the before and after, it must follow motion with respect to the before and after. Aristotle does not draw this conclusion explicitly at this step, but assumes it until he finally concludes the definition of time, as we shall see soon. However, it follows implicitly from what he has argued so far. To be precise, the argument that supports this conclusion is the following. It has been shown previously that time follows movement because we perceive time with movement. Therefore, time must follow movement with respect to that, which, once it is perceived in movement, gives the perception of time. Now, we perceive time when we perceive the before and after in movement. Hence, time follows movement with respect to the before and after, that is with respect to its quantitative parts.

We can see that this argument is a demonstration inferring a cause from a fact: the fact that we perceive time if and only if we perceive the before and after in motion

proves that time follows motion with respect to the before and after; indeed, this is the proper cause that explains such a fact.

Time is the Number of Movement with Respect to the 'Before' and 'After'

Having shown that time is something of movement with respect to the before and after, Aristotle concludes the definition of time by showing what it is of movement with respect to the before and after. His argument is contained in the following passage:

> We say that time has passed when we have had a perception [αἴσθησιν] of the before and after in movement. We determine [ὁρίζομεν] it by grasping [ὑπολαβεῖν] one as different from the other, and by grasping something other in between. Indeed, when we know the extremes as different from the middle, and the soul says that the 'nows' [τὰ νῦν] are two, one 'before' and one 'after', we also say that time is: time, indeed, seems to be what is determined [ὁριζόμενον] by the 'now'; and may this be assumed. When we perceive the now as one, and not as before and after in movement, or when we perceive the same now as belonging to some before and some after in movement, it does not seem that any time has passed because neither does it seem that there has been movement. But when <we perceive> the before and after, then we say time <has passed>. **This indeed is time, the number [ἀριθμὸς] of movement with respect to the before and after**.[182]

Overview of the Argument

Let us try to reformulate and analyse this argument. We perceive time, Aristotle says, when we determine movement by the before and after. We do so by "grasping [ὑπολαβεῖν] one as different from the other, and by grasping something other in between." As explained before, a quantity of motion is determined by two *momenta*, one before and one after. Therefore, what Aristotle means is that we determine movement when we distinguish[183] two *momenta* of motion and a quantity of motion which they delimit.

Aristotle explains that we perceive time when we do so because we then perceive two instants and an interval in between. Now, time is "what is determined by the now"; in other words, it is an interval bounded by two instants. Therefore, by perceiving two

[182] *Phys*. IV. 11, 219a23-b2.
[183] 'To distinguish' is what I take to be the sense of "grasping [ὑπολαβεῖν]"something as different from another.

instants and an interval in between, we perceive time for we perceive an interval of time determined by two instants.

Aristotle observes that it is necessary, in order to perceive time, to perceive two nows, one before and one after: “When we perceive the now as one … it does not seem that any time has passed because neither does it seem that there has been movement.” If we perceive only one now, or two nows as the same one, we do not perceive time for we perceive no quantity of movement. Indeed, we don’t perceive two instants of time because we do not distinguish two *momenta* of motion. Therefore, we perceive no motion because we do not determine a quantity of motion.

In sum, we perceive time by perceiving an interval determined by two instants, and in order to do so, it is necessary and sufficient to determine movement by distinguishing one *momentum* before, one *momentum* after and a quantity of motion they delimit. From this, Aristotle concludes that time is “the number [ἀριθμὸς] of movement with respect to the before and after.”

An Interpretative Problem

No doubt, this conclusion that time is “a number” is something of a surprise. It is puzzling because time is a continuous quantity. As Aristotle points out, it is the interval between two nows. This interval corresponds to a quantity of movement, and motion is continuous. Time is thus a continuous quantity of motion. Accordingly, we do not see why it is defined as a number, a discrete quantity. This seems to involve a contradiction. This problem has puzzled modern commentators in particular, and has been fairly debated. I will present and discuss popular interpretations further on. Before that, though, I should continue to explain why I think Aristotle defines time as he does in showing how the definition follows from a demonstration.

Why Time is Defined as a Number

Most likely, Aristotle must assume a premise which allows him to conclude that time is a number – the number of movement with respect to the before and after. Let us observe that the conclusion that time is a number is not totally at odds with what he

has argued before. He has said that we perceive two instants and an interval of time by distinguishing two *momenta* and a quantity of motion in between. This means that time is a quantity of motion (and instants are *momenta* insofar as they determine a quantity of motion.)[184] Now, a number is a quantity. It remains to be understood by what additional, implicit premise Aristotle concludes that this quantity of motion that time is is essentially a number.

To divide the Continuous is to Number it

In *Metaphysics* V.13, where Aristotle defines quantity, he writes that a plurality, a discrete quantity, "is numerable [ἀριθμητὸν]."[185] To number means to count, to measure the quantity of a number by counting how many units it has. A plurality of things is a number, a concrete number. Indeed, we have seen that a number consists of a finite plurality of entities that are one; it is defined as a plurality measurable by one unit. A plurality is numerable because the mind can measure its number by counting how many units it has.

In the same passage of *Metaphysics* V. 13, after writing that a discrete quantity is numerable, Aristotle writes that a continuous quantity is measurable; and in *Metaphysics* X. 1, he writes that a quantity is measurable by a number (measurable by one unit).[186] We can measure a continuous quantity by counting a number of its parts. To do so is to number the continuous. A passage from *Physics* VIII. 8 shows this. In the context of this passage, Aristotle refutes the argument of Zeno's paradox, which contends that it is impossible for a body to move over a certain distance since magnitude is infinitely divisible, and it is impossible to cross an infinite number of segments.[187] Aristotle objects to this argument:

> In the act of dividing the continuous distance into two halves one point is treated as two, since we make it a beginning and an end; this is what does both the one who is numbering [ἀριθμῶν] and the one who is dividing in halves. But if

[184] It is clear that the nows have for subject the *momenta* of movement in the following passage, where the nows are said to be before and after in movement: "when we perceive the now as one, and not as before and after in movement…"
[185] *Met*. V. 13, 1020a8-10.
[186] *Met*., X.1, 1051b21-23.
[187] Zeno argues that in order to move over the distance, the moving body must first cover half of the distance, then half of this latter distance, and so on indefinitely, since magnitude is infinitely divisible.

> divisions are made in this way, neither distance nor the motion will be continuous… Although what is continuous contains an infinite number of halves, they are not actual but potential halves.[188]

The one who counts the halves of the distance numbers [ἀριθμῶν] the distance.

This passage also shows that numbering the continuous implies dividing the continuous. One can count the halves of the distance because he has divided the distance in halves. In fact, the reason why it is possible to number the continuous is because its division generates a number. There are two species of quantity. Magnitude is a quantity whose parts are continuous; plurality is a quantity whose parts are discrete, divided from one another.[189] It follows that if we divide a continuous quantity, we obtain a discrete quantity, a plurality. Now, a finite plurality is a number. Therefore, dividing a continuous quantity generates a number.

Dividing and numbering the continuous is also to determine its quantity. The following passages show that Aristotle considers that a determined quantity is a numbered quantity, a quantity that is measured by a number. In *Categories* 6, he writes that expressions such as "four-foot long" and "five-foot long" signify quantities for they signify determined (ἀφωρισμένων**)** quantities.[190] And in *Physics* III.V, he argues that "it is not possible that the infinite be a quantity – for it would be a determined quantity (ποσὸν τι), e.g. of two or three cubits; since these are the things which quantity signifies."[191] Aristotle thinks that a determined quantity is a numbered quantity because as his definition shows, a quantity is an entity divisible in two or many homogeneous parts[192], that is in a number of parts. This is also reflected in the Greek word for 'quantity', "*ποσὸν*", which, as mentioned in chapter 1, literally means "so much", "so many"[193] – a sign that a quantity is determined as an entity, as a 'being' insofar as it is numbered.

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[188] *Phys*., VIII, 8, 263a22-b3. Trans. Hardie and Gaye, slightly modified.
[189] Cf. Chap. 1. Section "Quantity".
[190] *Cat*. 6, 5b11-16
[191] *Phys*. III, 5, 206a3-5.
[192] *Met*. V, 13,1020a7.
[193] Quantity, 'το ποσὸν', seems to be a substantiation of the interrogative pronoun 'πόσος', which literally means 'how many, how much?'

The continuous is not divided, not determined, not numbered; it does not contain an actual number of parts. However, it is numerable and determinable because it is divisible. The mind can divide the continuous by distinguishing potential divisions in it, as the following text shows in the case of a line:

> The point is not always the same for the intellect, since it is other and other when one divides the line, but in so far as <the line> is one it is the same in every respect.[194]

When the mind divides a continuous quantity, there is a number of parts of the continuous that exists for the mind.

To 'number' a continuous quantity primarily means measuring the continuous by counting a number of its parts. In a second, restricted and related sense, it can also serve to designate what is presupposed by this operation and is ordered to it: the act of dividing the continuous in a number of parts that can be counted; or the act of distinguishing these parts and perceiving them as units that form a number.

How the Definition is Concluded from the Premises

This allows us to understand why Aristotle concludes that time is a number. He has argued that time is perceived by determining motion with respect to the before and after. This is done when we perceive two *momenta* as different and a quantity of movement they determine. In doing so, we number movement because we determine its quantity. Motion is a continuous quantity. However, it is numerable because it is divisible in parts that form a number. By distinguishing two *momenta* of motion, one before and one after, we number movement because we divide and determine movement. We then perceive a numbered quantity of movement. When we do not distinguish the before and after in movement, we do not perceive time. Neither do we number movement for we do not determine and divide movement. Since then, it is sufficient and necessary to number movement and perceive a numbered quantity of movement in order to perceive time, Aristotle concludes that "time is the number of movement with respect to the before and after".

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[194] *Phys.* IV. 13, 222a15-16. Trans. Hardie and Gaye. Slightly modified.

Meaning of the Definition

Time is defined as a number because we must number movement in order to perceive it. Now, what is the meaning of this definition? What is this number which time is?

A Number of Parts of Movement

A number of movement with respect to the before and after is a number of successive parts of motion. Indeed, numbering movement with respect to the before and after divides movement into a plurality of parts. Hence, defining time as the number of movement (with respect to the before and after) means this: its nature is to be a number of successive parts of movement. In other words, time is the before and after numbered in motion, the before and after insofar as they form a plurality, a number distinguished by the mind. Aristotle writes: "Time is not movement but this by which movement has a number."[195]

A Number that Measures Movement

As a sign that time is a number, Aristotle gives the following argument:

> We judge the more or less by a number, and the more or less movement by time. Thus, time is a certain number.[196]

Time is that by which we measure the quantity of movement, and the measure of a quantity is a number. Time, is for example '5 seconds', '4 minutes', '2 hours'; these are numbers, and they measure the quantity of movement. For example, if we say that a movement lasts 5 minutes, we mean that it is measured by a time of 5 minutes. In chapter 3, we will see that time measures movement in two different, related ways: extrinsically and intrinsically. A quantity is intrinsically measurable by a number of its parts. For example, if we divide a line into equal segments, we can measure its quantity by counting the number of segments. Likewise, a number of equal parts of movement measures intrinsically its quantity (provided the movement is regular). Since time is a number of parts of movement, and we measure the quantity of

[195] "Οὐκ ἄρα κίνησις ὁ χρόνος ἀλλ' ᾗ ἀριθμὸν ἔχει ἡ κίνησις". *Phys.*, IV, 11, 219b2-4.
[196] "σημεῖον δέ· τὸ μὲν γὰρ πλεῖον καὶ ἔλαττον κρίνομεν ἀριθμῷ, κίνησιν δὲ πλείω καὶ ἐλάττω χρόνῳ· ἀριθμὸς ἄρα τις ὁ χρόνος."*Phys.*, IV, 11, 219b2-5.

movement by time, we can conclude that the full meaning of the definition of time is the following: time is a number of parts of movement measuring its quantity with respect to the before and after.

Confirmation by Ancient and Medieval Commentators

We can now see a full answer to the question posed before: why does Aristotle define time as a number? The answer is: because we perceive time by numbering movement, so time must be the before and after numbered in movement, a number of successive parts measuring its quantity (with respect to the before and after).

Some ancient and medieval commentators have understood that determining movement with respect to the before and after – the condition in which we perceive time – is to number movement, and this is why Aristotle concludes that time is a number. For example, Simplicius writes:

> The concept of time is gained by taking separately the before and after in change. They are taken separately when they are taken as different entities, i.e. when numbered. For number is not found in what is one and altogether the same, but in what contains different things. So time is the number of change, since it can be numbered in respect of before and after.[197]

Likewise, Aquinas explains that Aristotle concludes that time is the number of movement because we perceive time by numbering movement with respect to the before and after:

> Time is nothing but the number of motion with respect to the before and after. Indeed, we perceive time when we number [numeramus] the before and after in motion. Thus, it is manifest that time is not motion, but follows motion with respect to being numbered [numeratur]. Therefore it is the number of motion.[198]

And Philoponus comments that time is the number of movement because it is the before and after numbered in movement:

> Time is what it is about movement that has been numbered, not in so far as it is movement, but insofar as it has been numbered according to prior and posterior.[199]

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[197] Simplicius, *Simplicius on Aristotle's Physics 4.1-5, 10-14*, secs 713, 17–23. Simplicius, *On Physics* IV.11, Diels. 713, 17-23. Trans. Urmson.
[198] Aquinas, *On Physics* IV, lect. XVII, no.9. My Trans.
[199] Philoponus, *On Physics* IV.11, Diels. 723, 4-10. Trans. Broadie.

Themistius[200] and Albert Magnus[201] have also understood Aristotle's definition in this way.

Summary of Part I

In this section, I have argued that Aristotle's definition of time is the conclusion of a demonstration in three parts, each part being itself a demonstration *quia* (from the fact to the cause). The first part has demonstrated that time is something of motion. The evidence is the fact that time and motion are necessarily and immediately perceived together (it being assumed that time is not the same as motion and that motion is more fundamental than time). The second part has demonstrated that time is something of motion in a certain respect: it follows motion with respect to the before and after. The evidence is the fact that in order to perceive time, it is necessary to perceive the before and after in movement. The final part has demonstrated what time is of movement with respect to the before and after: its number. The evidence is the fact that in order to perceive time, it is necessary and sufficient to number movement with respect to the before and after and to perceive a numbered quantity of motion.

Thus, Aristotle has manifested the definition of time through a demonstration that proceeds from the fact to the cause: he has inferred the essence of time as the cause explaining the fact that we perceive its existence in specific conditions. Since the definition follows from the demonstration, the latter explains why time is defined the way it is: time is the number of movement with respect to the before and after because in short, it is necessary and sufficient to number motion with respect to the before and after in order to perceive time. Moreover, I have explained what the definition of time precisely means: time is a number of successive parts of motion measuring its quantity (with respect to the before and after).

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[200] "Time is therefore the before and after in change, when it is distinguished as belonging to one thing in succession to another, i.e. when it is counted." Themistius, *On Aristotle's 'Physics 4'*, trans. Robert B. Todd, Ancient Commentators on Aristotle (Ithaca, N.Y: Cornell University Press, 2003), secs 148, 10.

[201] Cf. Albert's Commentary to Aristotle's *Physics.* Lib.4. Tract.3, Cap.6.

Part II: Clarifying Time's Definition

Many ancient and medieval commentators think that Aristotle defines time as a number because time is perceived by numbering motion, as shown by the previous quotations from their commentaries. Modern commentators, for their part, generally find Aristotle's definition troubling if not puzzling. In particular, they find the definition problematic because, as mentioned before, a number is a discrete quantity, and time is a continuous quantity: it is the interval determined by two nows, as Aristotle writes.[202] By and large, scholars have either proposed to interpret 'number', in the definition, in a non-standard sense, or interpreted it strictly but raised objections about it.[203] In this section, I propose to clarify Aristotle's definition of time by addressing this problem and other related ambiguities, questions and objections often raised about the definition.

An Objection: We don't Perceive Time by Perceiving a Number

In Part I, I have argued that defining time as the number of motion with respect to the before and after means that it is a number of parts of motion determined by successive instants (corresponding to *momenta*). We may doubt that it is so. According to the general reasoning of Aristotle, since time is something of motion, time is this which we perceive in motion when we perceive time. But we perceive time by perceiving a quantity of motion determined by two instants. This is not a number of parts of motion. Thus, it seems that 'number', in the definition of time, does not designate a plurality of parts of motion.

As a result, some scholars have understood that time is a number in the sense that it is a stretch of motion, a length of motion, which defined as a unit, can be counted to measure other motions. For example, according to Mark Sentesy, time is a number-unit generated when the soul marks off an extent of motion, which is usable as a standard of measure:

> A number is generated when the soul takes nows to define or mark off a unit. The temporal-unit is generated in the following way: one marks off motion twice, and when one grasps the two divisions together, the divisions define the

[202] *Phys*. IV. 11, 219a29-30.
[203] Examples of these general positions will be presented and discussed throughout the section.

> extent between them. This determinate extent is a unit usable as a standard of measure… Taking this measure as though it were indivisible and using its limits to mark off other motions is to use it as a unit. To use this unit to count, that is, to use it as a number, is to use it as time.[204]

Tony Roark has a similar view. In his book *Aristotle on Time*, he writes: "When Aristotle says that time is a number of motion, he is saying (minimally) that time is motion's determinability, its susceptibility to being divided into determinate quantities, undetached parts of arbitrary length."[205] According to this statement, it seems that Roark understands that time is a number of parts of motion determined by the mind. However, it is not clear anymore as he explains why time is defined as a number. He says that Aristotle uses the term 'number' in his definition to implicate the sort of determinacy imposed by the mind on motion, and adds that time, a number of motion, is, in this sense, a determinate, unitary movement."[206] In other words, Roark in fact thinks that time is a unit of motion defined by two instants, not a plurality of parts of motion. The reason he gives touches precisely on the consideration described before: "Aristotle surely isn't telling us that we perceive time only when we engage in acts of subvocalized counting."[207]

Roark is correct to understand that to number motion is to determine motion. However, I think he fails to see that the act of numbering motion is essentially ordered to the act of counting. It is true that we perceive time by perceiving a continuous quantity of motion determined by two *momenta* (corresponding to two instants), which is not a number of parts of motion. However, let us consider the following. By distinguishing two *momenta*, we number motion and perceive a numbered quantity of motion: we perceive one quantity of motion, one part of motion. In order to perceive time, it is sufficient to perceive only one part of motion. But motion is divisible in many parts, and it is possible to perceive more parts in motion and to count them. This is what we do when we measure motion; we measure

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[204] Mark Sentesy, 'The Now and the Relation Between Motion and Time in Aristotle: A Systematic Reconstruction', *Apeiron* 51, no. 3 (2018): 5, https://doi.org/10.1515/apeiron-2017-0043.
[205] Cf. Tony Roark, *Aristotle on Time: A Study of the Physics* (Cambridge ; New York: Cambridge University Press, 2011), 116.
[206] Roark, 113.
[207] Roark, 116.

motion by time, a number of parts of motion.[208] The fact that we perceive time by numbering motion and by perceiving a numbered quantity of motion, one part of motion, shows that time is a number of parts of motion.

In 223a28-29, Aristotle is quite explicit about the fact that time is a number of parts of motion; he writes: "the before and after are in motion, and time is these *qua* numerable." In other words, time is the before and after insofar as they are numerable, the parts of motion insofar as they form a number determinable by the mind. Roark comments this passage in saying that Aristotle has inadvertently written something inconsistent:

> Aristotle slips at 223a28-29 when he says, "the before and after are within motion and time is these *qua* numerable". Given his earlier remarks in *Phys.* IV.11, he ought to have said "time is what is bounded by these *qua* numerable."[209]

In fact, it is rather his interpretation and the one of Mark Sentesy which are inconsistent with the passage.

How can Time be Defined as a Discrete Quantity?

Aristotle does not define time as the number of parts of motion but as the number of motion (with respect to the before and after). This is because it is motion that is the subject of time. Motion is continuous; it does not have an actual number of parts. We then touch upon the difficulty, mentioned before, which makes Aristotle's definition of time so hard to understand. Time is continuous; as Aristotle writes, it is the interval between two instants.[210] As we have seen, this interval corresponds to a quantity of movement, and movement is a continuous quantity. Time is thus a continuous quantity of movement. Therefore, how can it be defined as a number, a discrete quantity? This seems to involve a sheer contradiction since 'discrete' and 'continuous' are different species of quantity, and species of the same genus are opposed as contraries.[211]

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[208] The question of how we measure motion by time will be addressed in detail further.
[209] Roark, *Aristotle on Time*, 115.
[210] *Phys*. IV. 11, 219a29-30.
[211] Cf. *Met.* V. 10, 1018a20-30.

The Distinction between 'Numbering number' and 'Numbered Number'

I contend that the solution to this problem lies in a distinction which Aristotle makes between two senses of 'number'. Shortly after concluding the definition of time, he writes:

> Since number [ἀριθμός] is twofold (we call indeed 'number', what is numbered [τὸ ἀριθμούμενον] and what is numerable [τὸ ἀριθμητὸν], and also this by which we number [ᾧ ἀριθμοῦμεν]) time is what is numbered, not this by which we number. What is numbered and this by which we number are indeed different.[212]

Number refers to two entities, Aristotle says: "what is numbered [τὸ ἀριθμούμενον]" (or "what is numerable [τὸ ἀριθμητὸν]"); and "this by which we number [ᾧ ἀριθμοῦμεν]". What is this distinction?

The Notion of 'Numbering Number'

In the present context, to number means to count the quantity of something. We count the quantity of something by a number. In chapter 1, I have explained that Aristotle conceives of two modes of existence for numbers: abstract and concrete. A concrete number is a plurality of things that are one. An abstract number is a simple plurality of units, a number without a subject. Although an abstract number exists in the mind only (as the result of abstraction), the mind can apply an abstract number to a concrete quantity to know it, to measure it. The following passage of *Physics* IV, 7 supports this idea: "We know how many horses there are by the use of the number."[213] We count a concrete quantity by the means of an abstract number. For example, we can count a quantity of '6 horses' by a number of six abstract units. We then know the number of horses by applying to it the abstract number '6'. Hence, "this by which we number" is an abstract number; this is why it is called 'number'.

[212] *Phys*. IV. 11, 219b5-9.
[213] *Phys.* IV, 7, 220b19-22. Trans. Hardie and Gaye.

The Notion of 'Numbered Number'

'Number' also designates "what is numbered [τὸ ἀριθμούμενον]", or "what is numerable [τὸ ἀριθμητὸν]"), Aristotle says. What is numerable, this is what is measurable, countable by an abstract number. This can designate 2 things.

A Concrete Number

In *Metaphysics* V, 13, where Aristotle defines quantity, he writes that a plurality, a discrete quantity, "is numerable [ἀριθμητὸν]."[214] To take a previous example, we can count a quantity of horses. A plurality of homogeneous things is a number, a concrete number, as explained in Chapter 1. A concrete number, a plurality, is thus numerable. In this sense, Aristotle writes in *Physics* III. 5, that "a number or what has a number is numerable [ἀριθμητὸν]"."[215] Hence, 'number' construed as "what is numbered" or "what is numerable" can designate a concrete number.

The Number of a Continuous Quantity

There is not only discrete quantity which is numerable. Continuous quantity is also numerable because it is divisible in parts by the mind, and the mind can count these parts. Because 'number' designates 'what is numbered' or 'what is numerable', 'number' can designate what is continuous. Of course, a continuous quantity is not a number. Yet, we can say that what is continuous, insofar as it is numerable, has a number, or, equivalently, that there is a number of what is continuous. The reason why we can speak of the number of a continuum is precisely because the continuum is numerable, so that it is potentially a number. When a continuous quantity is numbered by the mind, there is a number of its parts that exists for the mind. For example, when we measure a line by counting its parts, the quantity of the line is known by a number of its parts, although the line is continuous in reality.

[214] *Met*. V. 13, 1020a8-10.
[215] *Phys*., III, 5, 204b7-9.

Summary of the Distinction

In sum, 'number' designates, on the one hand, "this by which we number", that is an abstract number; on the other hand, it designates "what is numbered and numerable", which can be either a plurality of things, a concrete number, or the number of a continuous quantity. Because both "this by which we number" and "what is numbered and numerable" are numbers, we can call "this by which we number" a "numbering number", and "what is numbered and numerable" a "numbered number" (or "numerable number").

Time is a 'numbered number'

Aristotle writes that "time is what is numbered, not this by which we number". Time is the number of movement. It is thus a numbered number, not a numbering number, an abstract number. Consequently, it can have the nature of a number even though motion is continuous. Indeed, whereas a numbering number is necessarily a discrete quantity, a numbered number can be the number of a continuous quantity. Motion is continuous, but it is numerable with respect to the before and after and as such, it has a number. Indeed, when movement is numbered by the mind, the before and after form a number of parts for the mind. Time is such a number that exists potentially in movement. Hence, by the means of the distinction between numbering number and numbered number, Aristotle has shown that time can have the nature of a number even though movement, of which it is the quantity, is continuous. Simplicius comments:

> It is in no way surprising if, holding time to be what is numbered in change, he [Aristotle] did not say 'that which is numbered' but 'the number'. For that which is numbered is called a number, just as what is measured is called a measure; for example, abstract number, the number of cattle, the number of horses. Again, there is a wooden quart and one of corn, a gallon jar and a gallon of wine. And we eat the quart and drink the gallon, but not the wooden one or the clay one, but of corn and wine. Also the number of numbers would not suit time, for that is discrete and not continuous. But what is numbered can also be continuous, like the eleven-foot spear.[216]

[216] Simplicius, *On Physics* IV.11, Diels. 714, 4-12. Trans. Urmson. For a parallel account, see Themistius, *On Physics* IV.11, Diels. 148,25-149,3.

Time is Materially Continuous, Formally Discrete

Aristotle explains that because time is the number of a continuous quantity, motion, it is continuous like motion and because of motion:

> That time be the number of movement with respect to the before and after, and that it is continuous [συνεχής] (because it is something of a continuous), it is manifest.[217]

Time is essentially a discrete quantity, a number of parts of motion; but this number exists potentially in motion, the subject of time, for motion is continuous; a number of parts of motion form a continuous quantity of motion. Thus, time is continuous on account of motion.

Because a numbered number is the number of a subject, we can distinguish two aspects in a numbered number: a material aspect, the subject that is numerable; and a formal aspect, the number of the subject. The material aspect of time is movement, a continuous quantity; its formal aspect is number, a discrete quantity. Time is thus discrete with respect to its formal aspect, number, and continuous with respect to its material aspect, motion. Hence, we can say that time is both discrete and continuous without implying a contradiction, for it is so in different respects. Philoponus writes:

> It is worth raising this difficulty: given that we say that time is continuous, how do we say, on the contrary, that it is number? For number is discrete quantity and it is impossible for the same things to be both continuous and discrete. Well, we assert that if time were number that numbers, it would indeed be impossible for it to be continuous; however, since it is not numbering but numbered number, there is no reason why it should not be continuous in one respect and number in another. Insofar as it is measure of continuous movement, it is continuous; but insofar as it has the prior and the posterior, it is number. E.g. we say that the piece of wood is 10 cubits and the road 10 stades although they are continuous.[218]

As I said before, the fact that movement, which is continuous, is the subject of time explains why time is defined as the number of movement, not as the number of parts of motion. We can say that time is a number of parts of motion, but not that it is the number of the parts of motion because such a number only exists potentially; it must be determined by the mind; it depends upon how the mind divides and numbers

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[217] "Ὅτι μὲν τοίνυν ὁ χρόνος ἀριθμός ἐστιν κινήσεως κατὰ τὸ πρότερον καὶ ὕστερον, καὶ συνεχής (συνεχοῦς γάρ), φανερόν." *Phys*. IV. 11, 220a24-26.

[218] Philoponus, *On Aristotle Physics 4.10-14*, Diels. 723, 25–724, 9. Trans. Broadie.

motion. For example, the number that measures a quantity of movement depends upon the choice of a unit of measure. We can measure movement in seconds, minutes, hours, etc.

Formal and Material "Properties"

As a numbered number, time has some characteristics that follow from its subject, motion, and some characteristics that follow from its essence of number. Aristotle presents some of these characteristics, accounting for them by the material and formal aspect of time. Albert, in his commentary, calls them properties [*proprietas*] of time.[219] Pellegrin does this as well.[220] Aquinas rather speaks of things that are said of time.[221] In fact, Aristotle does not say that they are properties of time. This is because strictly speaking, properties belong to a substance, and time is not a substance. However, insofar as these characteristics are explainable by the nature of time, they are like properties of time (for properties are caused by the essence of their subject); they can be called "properties" by analogy.

Minimal Time

Aristotle explains that in a certain way, there is a minimal time, and in another way, there is not.[222] It follows from the kind of number that time is. An absolute number [ἀριθμὸς ἁπλῶς], an abstract number, has a minimum, '1' (or rather '2', since 'one' is not a plurality). The case is different for a determined number [τὶς ἀριθμὸς], that is the number of a subject, a numbered number. If it is the number of a continuous quantity, in a certain way [ὡς] it has a minimum, and in another it does not. Insofar as it is a number, it has a minimum; but insofar as it is continuous (because it is the

[219] Cf. Albert. *On Physics* IV, Tract. 3, Cap. 9.
[220] Cf. Aristote, *Physique*, trans. Pierre. Pellegrin, 2e éd. rev., GF Flammarion ; 887 (Paris: Flammarion, 2002), 257.
[221] "Ex definition data reddit rationem eorum quae dicuntur de tempore." Aquinas, *On Physics* IV, lect. XIX, no.1.
[222] "The minimum number, in an absolute sense, it is '2'. But a determined <minimum > number, in a certain way exists and in a certain way does not. For example, there is a minimum <number> for the line in respect of multiplicity – it is '2' or '1' – but in respect of magnitude there is no minimum <of the line>; for a line is always divisible. So it is for time. The minimum time in respect of number is '1' or '2', but in respect of extent there is no minimum." *Phys.* IV.12, 220a27-31.

number of what is continuous), it doesn't because a continuous quantity is infinitely divisible. Aristotle gives the example of a line. There is a minimum to the number of a line. For example, if we measure a line in centimeters, the minimum quantity is '1 cm'. But insofar as a line is continuous, there is no minimum quantity of a line. The same is true for time since it is the number of a continuous quantity, movement. Insofar as time is a number, there is a minimal time. For example, if we measure time in seconds, the minimal time is '1 second'. But insofar as time is continuous (because movement is continuous), there is no minimal quantity of time. We can always divide motion to obtain a smaller quantity of time. The fact that we can measure time by different units corresponding to a more or less small quantity of motion – e.g. hours, minutes, seconds, milliseconds, etc. – is a consequence of that.

In sum – and to put it differently – we can say that time has a minimum with respect to its formal aspect, but not with respect to its material aspect.

Long and Short; Much and Little; Neither Fast nor Slow

The dual aspect of time – discrete and continuous – also accounts for qualities commonly ascribed to time. We say that time is long or short insofar as it is a continuous quantity. And we say that there is much time (or a lot of time), or that there is little of time insofar as it is a discrete quantity. Indeed, 'much' and 'little' seem to imply somehow a reference to the measure of the quantity which they qualify, and a quantity is measured by a number; in other words, 'much' and 'little' imply some reference to the question "how much?" We say that there is much of something (usually a continuous quantity), implying that the measure of it expresses an important quantity. For example, we may say that '3 years' is much time (or a lot of time) to write a dissertation.

Aristotle adds that while these qualities – long, short, much, little – apply to time, 'fast' and 'slow' do not apply to it. Once again, he says that this is explainable by the nature of time. Time is a number, and a number is not said to be fast or slow. 'Fast' and 'slow' apply to motion; they refer to the speed of a motion. The speed of a motion is determined by time (for we say that a motion is fast because it covers a

long-distance in a little time), but time itself does not have a speed. This will become clearer in chapter 3.

Measure of Movement And Measured by Movement

As the number of movement, time has the property to measure movement in respect of succession. This is a property to which Aristotle has alluded when, as a sign that time is a number, he said that we judge the more or less of something by a number, and the more or less movement by time.[223] When commenting on this statement, I mentioned that time measures movement in two related ways: intrinsically and extrinsically. As a number of parts of movement, time measures movement intrinsically. In chapter 3, we will see that time only measures one movement in this mode; it measures other movements extrinsically, by the number of another movement.

Aristotle explains that time is reciprocally measured by movement:

> We not only measure movement by time, but also time by movement because they are determined by each other. Time determines movement, being the number of it, and movement determines time. We say that much or little time has passed, measuring it by movement – as we measure the number by what is numerable, for example the number of horses by one horse. Indeed, we know the quantity of horses by the number of them, and the number itself of horses by one horse.[224]

Because time is a numbered number, Aristotle uses an example involving a numbered number – a number of horses – in order to clarify his claim that time is measured by what it is the number of – movement. A quantity of horses is measured by a number; but this number is itself measured by one horse. A number of horses is thus reciprocally measured by what it numbers. Likewise, time measures movement in being its number, but it is also measured by movement. Aristotle writes: "We say that much or little time has passed, measuring it by movement". He probably refers to our experience of knowing approximately how much time has passed through some familiar motion. Albert gives the following examples[225]: we may judge that much of

[223] *Phys*. IV. 11, 219b2-5.
[224] *Phys*. IV. 12, 220b14-22.
[225] *Phys*. IV. 17-21.

the day has passed by observing that the sun has completed much of its movement around the earth; we may also judge that a long time has passed if we have completed a journey that usually takes us long to make. In addition to these examples, we can add the consideration that all the instruments and methods that we use to measure time consist in measuring time by movement. To take a simple example, a clock uses the movement of the pointers to measure time.[226]

Because time is materially a continuous quantity, Aristotle shows that time is measurable by movement through a second consideration, one pertaining to the continuous aspect of time:

> We measure movement by time, and time by movement, and this happens reasonably. Movement indeed follows magnitude, and time follows movement in being quantities that are continuous and divisible… And we measure magnitude by movement as well as movement by magnitude. Indeed, we say that the road is long if the journey is long, and that the journey is long if the road is long; and that the time <is long>, if the movement is long, and that the movement <is long> if the time is long.[227]

Time follows movement, and movement follows magnitude as continuous quantities. The quantity of time, motion and distance are thus proportional to one another: the more there is of one, the more there is of the others. Therefore, as we can estimate magnitude by motion (in reasoning for example that the road is long because the motion is long), so we can estimate time by motion (in reasoning that the time is long because the motion is long).

Albert explains that time is *per se* the measure of movement since it is its number (and a quantity is measured by a number). Time is measured by movement because in some circumstances, the quantity of movement is better known to us than the quantity of time. It is thus by accident, on account of a reason extrinsical to time (our

[226] Knowing that the movement of one of the pointers on a certain section of the clock corresponds to a time of one minute, we can then measure the quantity of time in minutes by the quantity of movement of the pointer, itself measured by the magnitude (provided that the pointer moves at a regular speed).
[227] *Phys*. IV, 12, 220b23-31.

ignorance) that movement measures time.[228] We find the same remark in the commentaries of Simplicius[229], Philoponus[230] and Aquinas.[231]

These are some of the "properties" of time. They are not exhaustive. Aristotle mentions another important property of time: simultaneity. I reserve the treatment of this one for chapter 3.

Interpretations that Equate 'Number' with 'Measure'

Several commentators have claimed that in defining time as the number of movement (with respect to the before and after), what Aristotle means is that time is the measure of movement, or the measurable aspect of movement; in other words, they affirm that he uses 'number' as a synonym for 'measure'[232]. Similarly, there are commentators who think that if he meant 'number', he should have used instead 'measure'.[233]

There are two main considerations that give support to this interpretation, which are often invoked by its adherents. First, in *Metaphysics* V.13, where Aristotle defines quantity, he says that a plurality [πλῆθος], a discrete quantity, is numerable [ἀριθμητὸν], and that a magnitude [μέγεθος], a continuous quantity, is measurable [μετρητὸν].[234] Since time is continuous, this text suggests that it is measurable, not numerable. Now, the measure of a continuous quantity is a number. Therefore, we may think that 'number' is synonym of 'measure' in the definition.

The second reason that supports this view is the fact that in his treatise of time, Aristotle speaks of time both as the number of movement and as the measure of

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[228] Cf. Albert, *On Physics* IV, Tract.3, Cap.9, 11-21.
[229] Simplicius interestingly explains that all measures are accidently ("contingently") measured by what they are the measure of: "Pre-eminently time measures motion as being its number and determining it by the before and after, but in a contingent way it is measured by it. We see the same thing happening in the case of all other measures. For the measures are measured in their turn by the things measured. For we judge the wooden bushel-measure by the bushel of wheat, whether it is not too small or too big, and we measure the bronze pint-cup in its turn by the pint of wine." Simplicius, *On Physics* IV. 11, Diels. 733, 16-23. Trans. Urmson.
[230] Philoponus, *On Physics* IV. 11, Diels. 741, 25-30.
[231] Aquinas, *On Physics* IV, lect. XIX, no.6.
[232] Harry 2015, 58; Roark 2011, 120; Hussey 1993, xxxviii; Goldschmidt 1982, 144; Moreau 1965, 126; Callahan 1948, 50-53.
[233] Plotinus. *Enn.* III 7, 13, 9-14; Bostock 1980, 154.
[234] *Met.*V. 13, 1020a7-11.

movement without explaining the distinction between these attributes. He thus seems to use these terms interchangeably. Julia Annas remarks that in some passages, "time turns up quite indifferently as number and as measure within the same line of thought."[235]

My reply to this view is that 'number' is not a synonym for 'measure' in the definition of time. To be the measure of movement is a property of time rather than its nature. Time is not number because it is measure; rather, it is measure because it is number. Aristotle indicates that being measure is a property of time as he writes that as the number of movement, it measures movement (*per se)* and is reciprocally measured by it (*per accidens).*[236]

Moreover, 'number' and 'measure' are related but distinct notions for Aristotle. 'Number' is defined as a plurality measurable by a unit, and 'measure' as this by which we know the quantity. As Ursula Coope rightly points out[237], it is unlikely that Aristotle would have used 'number' if he had meant 'measure' in the context of an essential definition. Indeed, in a definition, we can expect Aristotle to use concepts in their strict sense.

Interpreters are right to notice that Aristotle often refers to time as the measure of movement. However, I don't think he uses 'number' and 'measure' interchangeably. The use of one term rather than the other is usually intentional and explainable by the context in his treatise of time. For example, the passage where he refers to time the most as 'measure' is where he treats of the notion of "being in time".[238] He explains that 'being in time' means 'being measured by time'. However, as we will see in chapter 3, if Aristotle holds that all natural things and motions are in time, he does not

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[235] Julia Annas, 'Aristotle, Number and Time', *Philosophical Quarterly* 25 (1975): 98. She points out the passage where Aristotle says, as a sign that time is a number, that we judge the more or less by a number and the more or less movement by time (11, 219b5-7); she also points out a passage where Aristotle, after saying that time is responsible of corruption because it is the number of movement, adds that a sign of the incorruptibility of eternal things is that they are not measured by time (12, 221b2-7).

[236] *Phys*. IV. 12, 220b14-22.

[237] Ursula Coope, *Time for Aristotle: Physics IV.10-14*, Oxford Aristotle Studies (Oxford : Oxford ; New York: Clarendon ; Oxford University Press, 2005), 87.

[238] *Phys.* IV. 12, 221aff.

think that time is the number of all natural things and motions. In this context, he thus uses ‘measure’ intently, and ‘number’ would be inadequate. However, in the passage where he treats of the properties of time (e.g. having a minimum, not slow or fast, different before and after), he speaks of time as the number of movement, not as the measure of movement[239] This is because he wants to explain these properties by the nature of time; he even explains that time has the property of being measure because it is number.

In response to the other argument – the one invoking Aristotle’s statement that plurality is numerable and magnitude measurable – I think it is based upon a mistaken interpretation of this distinction. First, we should observe that it is essential for quantity to be measurable[240]; therefore, ‘measurable’ applies to plurality as well as to magnitude. A number is a finite plurality, and Aristotle defines it as a plurality *measurable* by a unit. As Robert Labrie explains[241], ‘measurable’ is a generic term, and ‘numerable’ is the specific term for ‘measurable’ as it applies to plurality. If Aristotle says that magnitude is measurable, it is because there is no specific term of ‘measurable’ for magnitude; it is thus designated by the generic term. Indeed, sometimes, the same word can refer both to a genus and to a species.[242]

Therefore, we should not think there is an opposition between these terms for they both refer to measurability, the aptitude of quantity to be measured. In fact, if plurality is numerable, it does not preclude that the continuous be also numerable. As we have seen, the continuous is numerable because it is divisible into a number of parts that can be counted; it is measurable because it is numerable. Furthermore, we have seen that as numerable, the continuous can be said to have a number. The continuous is not a number, a plurality, but we can say that there is a number of the

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[239] *Ibid*. 12, 220a27-33.

[240] As mentioned before, quantity refers to the question “how much?” or “how many?”. Cf. *Cat.* 4, 1b27-30. Moreover, we can see that measurability is essential to quantity in the fact that the proper character Aristotle attributes to quantity, equality and inequality, presupposes its measurability. Cf. *Cat*. 6, 6a25-30.

[241] Robert Labrie, ‘Commentaire du traité du temps d’Aristote’ (Doctoral Thesis, Québec, Qc, Université Laval, 1952), 99.

[242] This is the case for example with the word ‘chance’, which can designate both the ‘genus’ and one of its species, whereas there is a specific term, ‘luck’, to designate the species of chance concerned with human affairs.

continuous. Aristotle has shown that time is what is numerable in movement, the before and after as they form a plurality determinable by the mind. Hence, he has shown that time is a number, the number of movement. This number is indeed measurable and measures movement; but these attributes do not define its nature.

This shows that ultimately, commentators who propose to understand 'number' as a synonym for 'measure' in Aristotle's definition do so because they think it is contradictory to define time as a discrete quantity. For example, David Bostock contends that Aristotle's definition is either meaningless, or insensible and inconsistent: it is meaningless if he in fact means to define time as a 'number' since time, being continuous, cannot be a number; it is insensible and inconsistent if he means 'measure', for he should have been aware that the notion of 'measure' is different than the notion of 'number'.[243] Likewise, Moreau, who thinks that Aristotle conceives of time as the measurable aspect of movement[244], asserts that it is because he lacks a diagram for depicting motion (such as the Cartesian system of coordinates) that he has been driven to call time "a number".[245]

A similar observation can be made about Tony Roark's interpretation. To the question: "is time a magnitude or a plurality?", he replies: "the answer seems to be both, though equivocally."[246] He explains that we must distinguish between two notions of time: "time" and "a time". "Time" is motion's susceptibility to division into undetached parts of arbitrary length by percipient minds; and "a time" is a determinate segment of motion.[247] He argues that considered generally as temporal extension, time is a continuous magnitude that is measured, and that, considered as a collection of temporal intervals, of "times" that can be counted, it is a plurality. The two notions are related in this that "time", temporal extension, is measured by "times", a number of temporal units.[248]

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[243] David Bostock, 'Aristotle's Account of Time.', *Phronesis: A Journal of Ancient Philosophy* 25 (1980): 154.
[244] Joseph Moreau, *L'espace et le temps selon Aristote* (Pavoda: Antenore, 1965), 126.
[245] Moreau, 126.
[246] Roark, *Aristotle on Time*, 111.
[247] Roark, 111.
[248] Cf. Roark, 112.

With this distinction between "time that can be measured" and "times that can be counted", Roark's view amounts to considering time as a plurality only in the sense that it measures motion. It is clearly the problem of the dual aspect of time (discrete and continuous) that leads him to propose this conception.

A similar critique can be done against Mark Sentesy's interpretation. We recall that he interprets time as a unit generated by the soul as a result of marking off a stretch of motion, and writes that to use this unit to count is to use it as a number, and use it as time.[249] It follows that according to Sentesy, time is a number in the sense of measure; it is a unit, which, by being counted, measures other motions.

Sentesy does not feel the need to address the problem of the discrete vs. continuous aspects of time because he maintains that time is an abstract number. According to his view, the unit that time is is abstracted from motion, and once that it is separated, it exists as an independent entity generated by the soul.[250] This idea is contradicted by Aristotle's statement that time is a numbered number, not a numbering number. Sentesy holds that Aristotle's distinction between number by which we count (numbering number) and number which is counted (numbered number) does not imply a distinction between concrete and abstract number. He asserts that time is a number which is counted because temporal units are counted by the now.[251] I think he is mistaken. As I have argued, a number by which we count is an abstract number used as measure, and a number which is counted is a number having a subject. Time is the number of motion, and a number of motion is not an abstract number since it has motion for subject. Time is a number in the sense of "what is numbered" since it is the before and after numbered in motion. The before and after numbered by time are not abstract units, but parts of movement.

As a final example, let us turn to Julia Annas[252], whose original interpretation has been influential. After arguing that Aristotle uses 'number' and 'measure' interchangeably in his treatise of time, she thinks that he defines time as the number

[249] Sentesy, 'The Now and the Relation Between Motion and Time in Aristotle', 5.
[250] Sentesy, 5.
[251] Sentesy, 9.
[252] Cf. Annas, 'Aristotle, Number and Time', 97–107.

of movement rather than as the measure of movement because his conception of time bears an important analogy with the conception of number that he develops in *Metaphysics* X. 1-3. In this text, which she considers as the background for Aristotle's definition of time, she maintains that Aristotle's motivation for defining 'number' as a plurality measurable by a unit is to oppose the Platonic view that numbers are abstract entities: the point of defining number as something measurable would be to define it as something that does not exist independently of an act of counting concrete things. Similarly, in *Physics* IV. 11-14, Annas claims that by presenting time as the measure of movement, Aristotle wants to oppose Plato's conception of time as a metaphysical container that would exist independently of natural things: he would want to tie the existence of time to the operation of measuring change. Annas thus argues that defining time as the number of movement rather than the measure of movement is deliberate: Aristotle uses 'number' as an analogy to convey the idea that time has the same kind of existence as numbers.[253]

In the last section of her article though, she claims that this definition poses a difficulty since Aristotle would not succeed in uniting the view of time as number (which has for background *Metaphysics* X. 1-3, and the view that time is a continuum (which has for background *Physics* VI. 3).[254] This criticism reveals that it is Annas' failure to see how time can be defined as a discrete quantity which ultimately accounts for her interpretation. This difficulty has prompted her to look for another reason to explain the use of 'number' in the definition: an analogy between Aristotle's anti-Platonic view of time and his anti-Platonic view of numbers.

Why Define Time as 'Number' rather than 'Measure'?

I have mentioned briefly before the opinion of David Bostock who qualifies Aristotle's definition as "either meaningless, or insensible and inconsistent."[255] He thinks the only meaningful way to interpret Aristotle's definition of time as the number of movement would be to construe it as the measure of movement. To

[253] Annas, 100.
[254] *Ibid.*109.
[255] Bostock, 'Aristotle's Account of Time.', 154.

illustrate his point, he compares the case of time to the case of spatial magnitude: "how would you understand someone who said that space is a number? Or, perhaps a little more comprehensively, spatial distance is a number?"[256] He continues on, answering that the only meaning that such a statement could have is that distance is the measure of space. This is why he claims that Aristotle's definition is, if not meaningless, inconsistent, for he would not define distance as the number of space, and time is continuous like space. He argues: "If we cannot explain in this or any other way what it might mean to call a distance a number, how could it make any better sense to say the same of a time?"[257]

Julia Annas has expressed a similar concern:

> It would be of interest to determine whether Aristotle has philosophical reasons for treating time as a number, because it is the product of measuring procedures, but not magnitude, or whether this merely reflects personal preferences. He certainly seems to find the existence of time more problematic than that of magnitude… but it is hard to see why.[258]

I have already explained how it is possible for time to be defined as a discrete quantity in spite of being continuous. Nonetheless, Bostock and Annas have a point. Time is actually continuous, not discrete. As we noticed before, it is the quantity of movement, and movement is continuous. Invoking the distinction between the formal and material aspect of time explains why defining it as a number does not involve a contradiction. However, it is not sufficient to explain why it is defined as a discrete quantity. Defining time as a number still seems like predicating upon it the wrong species of quantity, the species 'discrete' rather than the species 'continuous'. From this point of view, the definition seems utterly false, asserting that time is something which it is not in reality. Bostock offers a convincing reason in support of this objection: it would not make sense to define distance as the number of space. What makes sense is to define distance as the measure of space. Accordingly, what would be consistent is to define time as the measure of motion.

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[256] Bostock, 154.
[257] Bostock, 155.
[258] Annas, 'Aristotle, Number and Time', 109.

In part one, I have argued that the reason why time is defined as a number follows from the demonstration by which Aristotle manifests its nature. Time is defined as the number of movement (with respect to the before and after) because in order to perceive time, we must number movement. This already explains why time is defined as a discrete quantity. But why is it necessary to number movement in order to perceive time? This question is the key to find out why, fundamentally, time is defined as a number, as opposed to other continuous quantities.

Let us study once again the argument from which Aristotle concludes the definition of time. In the course of this argument, he observed that we don't perceive time unless we perceive the now as before and after:

> When we perceive the now as one, and not as before and after in movement, or when we perceive the same now as belonging to some before and some after in movement, it does not seem that any time has passed because neither does it seem that there has been movement. But when <we perceive> the before and after, then we say time <has passed>.[259]

We perceive time by successive instants. This is because time exists successively. In *Categories* 6, Aristotle says that time is a quantity whose parts don't have position; he explains that they don't have position because they don't subsist.[260] This is a consequence of the fact that time follows motion, and motion is a quantity whose parts don't have position for the same reason. Since the parts of time don't subsist, they neither coexist, so time is a quantity that does not exist all together as a whole. In fact, as Aristotle observed in the dialectical inquiry, there is not even a part of time that exists altogether, at once; what exists of time is the now. This is why we perceive time by the now. By perceiving the now being before and after, we perceive time because we measure its quantity by 2 instants. But measuring time by two instants, it is to number movement. We thus perceive time by numbering movement because time exists successively (like movement that it follows).[261]

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[259] *Phys*. IV. 11, 219a30-b1.
[260] Cf. *Cat*. 6, 5a15-37.
[261] The point that time exists successively will be studied in detail in Chapter 4.

Accordingly, it is the mode of existence of time which fundamentally explains why it is defined as a number, although it is continuous.[262] Distance is not defined as the number of space because space exists simultaneously. Therefore, it is not necessary to number it in order to perceive its quantity. However, I cannot perceive time, the quantity of movement, without numbering movement by counting two successive instants. Time is thus defined as a number because of its successive mode of existence.[263]

Interpretations which Disassociate 'Number' and 'Measure'

There are commentators who, like me, disagree with the interpretation that 'number' is a mere synonym for 'measure' in Aristotle's definition. However, as opposed to me, they think that being measure of movement is not an essential property of time, an attribute that is directly implied by its nature of number of movement. For example, Destrée thinks that the idea that time is the measure of movement is a common conception of time which Aristotle does not reject, but that he does not retain as an essential definition.[264] Sorabji writes that "Aristotle does call time the measure of motion, but he does not offer this as part of the definition of time."[265] He thinks that there might be a relation between the statement that time is number and the one that it is measure, but that Aristotle wants to separate them, and even rejects the viewpoint that time is essentially measure.[266] For her part, Ursula Coope thinks that by defining time as a number, Aristotle does not even mean to define it as a quantity.[267] These commentators put forward two main reasons to defend their point of view.

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[262] Annas has intuited that it is the different mode of existence of time which explains that it is defined as number, but she has not understood what is this difference. She writes: "It would be of interest to determine whether Aristotle has philosophical reasons for treating time as a number… *He certainly seems to find the existence of time more problematic than that of magnitude… but it is hard to see why*." Annas, 109.

[263] This will become clearer in the context of the study of a particular problem which will be examined in chapter 4: whether time can exist without the mind.

[264] Pierre Destrée, 'Le nombre et la perception: Note sur la définition aristotélicienne du temps', *Revue de Philosophie Ancienne* 9, no. 1 (1991): 65.

[265] Richard Sorabji, *Time, Creation, and the Continuum: Theories in Antiquity and the Early Middle Ages* (Ithaca, N.Y: Cornell University Press, 1983), 87.

[266] Sorabji, 86–87.

[267] Coope, *Time for Aristotle*, 99–100.

Sorabji[268] and Destrée[269] maintain that in its nature of number, time is not measure of movement because it would then be a numbering number, something by which we count rather than something which is counted. Now, Aristotle says that time is by nature a numbered number, not a numbering number. They allege that in the passages where Aristotle speaks of time as the measure of movement, he treats it as a numbering number. They provide the example of the passage where Aristotle says that it is by a number that we judge the more or less, and by time that we judge the more and less movement. They also point out the passage in which he says that time is not slow or fast because a number by which we count does not have these qualities.

In addition, Sorabji and Coope argue that Aristotle does not conclude that time is the number of movement in showing that we perceive it by measuring movement. First, he does not use vocabulary such as 'measuring', 'measure' or 'measurement' in the passage leading up to the definition. Second, they contend that measuring movement requires the definition of a unit of measure and the division of movement into parts equal to this unit. Now, in the passage leading up to the definition, there is no mention of these conditions required for an operation of measurement. Coope writes: "Aristotle says nothing in this passage about the need to find some unit for measuring change. When we measure the duration of a change, we have to fix upon some way of marking out equal intervals. We need, that is, to find some regularly repeated change to use as a kind of clock."[270] Likewise, Sorabji writes: "In the definition, there is no sign that the counting will be evenly spaced, so as to provide units of measurement… One needs access to a clock."[271]

For my part, I believe that if defining time as the number of movement is not a synonym of defining it as measure of movement, these concepts are closely and necessarily related: measuring movement is a property of time that follows its nature of number. Aristotle shows it when he writes that in being the number of movement, time measures movement because it determines its quantity. Moreover, if time was

[268] Sorabji, *Time, Creation, and the Continuum*, 88.
[269] Destrée, 'Le nombre et la perception: Note sur la définition aristotélicienne du temps', 68–70.
[270] Coope, *Time for Aristotle*, 97.
[271] Sorabji, *Time, Creation, and the Continuum*, 88.

not a number that measures movement, Aristotle would not have invoked this well-known property of time as a sign that it is a number, just after giving its definition.[272]

I think Sorabji and Destrée are mistaken to think that time must measure movement as a numbering number. They wrongly assume that only a numbering number can be measure. A numbered number is the number of a subject, and it measures the quantity of its subject. For example, in the following passage, Aristotle writes: "it is by the number [of horses] that we know the quantity of horses"[273]. Likewise, time, as a number of parts of movement, measures its quantity in respect of succession. It thus measures movement as a numbered number.

Besides, in the passages that Destrée and Sorabji quote to support their view, Aristotle never says that time is a numbering number; he only compares time to a numbering number in its function of measure. This is because it is manifest that a numbering number measures the quantity that it is used to count with, whereas it is less clear that a numbered number is measure. In chapter 3, we will study a passage in which Aristotle has another reason to compare time to a numbering number: as the same numbering number measures many collections of things, so the same time measures many different movements.

As for the other argument – the one contending that Aristotle does not conclude the definition of time in showing that we perceive time by measuring movement – I think it is based upon a narrow understanding of what measurement is. Coope and Sorabji assume that measuring is an operation that necessarily involves the comparison of a quantity with another one defined as a unit of measure. It is certainly true that we usually proceed that way to measure quantities. However, the recourse to a unit of measure is not essential to measuring. What is essential to measuring is numbering quantity, the determination of quantity by a number. Indeed, the measure makes known the quantity, and a quantity is knowable provided it is determined by a

[272] In 219b4-6, he says that time is like a number because we judge how much movement there is by time, and we judge how of something there is by a number.
[273] *Phys*. IV. 12, 220b21-23.

number.[274] On this account, delimiting a quantity by defining its limits can be reckoned as an act of measuring. Indeed, doing so is to determine the quantity by numbering it; it is to determine that it is *one* quantity. In this sense, we can say that a quantity is measured by its limits. It is of course possible to refine the measure, to determine precisely the quantity by comparing it to another quantity defined as a unit. But defining the limits can already be counted as an act of measuring.

Accordingly, in his demonstration of the definition of time, Aristotle does imply that we perceive time by measuring movement for he shows that we perceive it by numbering movement, determining its quantity through the perception of two instants. To measure movement precisely, we must use a unit of time such as the minute, the second, etc. However, this is not necessary in order to perceive time, and that explains why we don't find any reference to a unit of measure in the demonstration of the definition. Indeed, Aristotle has demonstrated the definition of time by showing in what necessary and sufficient conditions we perceive time.

The commentators who contend that defining time as the number of movement does not imply that it is the measure of movement should propose an alternative interpretation to explain what it means to define it as the number of movement.

Destrée asserts that time is the number of the interval of a moving thing which is always elsewhere, the number which is "produced" by movement.[275] However, this description is more puzzling than Aristotle's definition, and Destrée does not explain what he means by this. Moreover, he finishes his article in asking – what is the exact meaning of this number which time is? – thus admitting implicitly that he has not answered that question.[276]

Sorabji seems to think that time is a number of parts of movement, but he believes it is not essential that the parts be equal so that their number measures movement. He suggests that Aristotle defines time as number, not as measure, because there could

[274] This explains why Aristotle writes, in *Phys.* IV. 12, 220b16-18, that time measures movement because it determines it, being its number.
[275] Destrée, 'Le nombre et la perception: Note sur la définition aristotélicienne du temps', 80.
[276] Destrée, 81.

have been time even if there had not been regularity of movement.[277] Once more, I think it is essential that time be a number that measures the quantity of movement. What would be the point of counting parts of movement if it was not to measure movement? All examples of times we can think of are numbers that are measures of movement: 4 seconds, 3 minutes, 2 hours, etc.

Ursula Coope thinks that time is defined as a number because it is something countable by nows, not because it is measurable.[278] Furthermore, she believes that the quantity of what is continuous is measurable, but not countable; only the quantity of what is discrete is countable. Now, motion is continuous, and Aristotle has defined time as the number of motion, which is not synonymous to saying that it is the measure of motion. Hence, she concludes that time is not a number in the sense of a quantity.[279]

In support of her interpretation, Coope invokes Aristotle's distinction between numbering number and numbered (or numerable) number. She interprets this as a distinction between a number that is a plurality and another kind of number, one that is not a plurality. Saying that time is a numerable number would mean that it is not a number in the sense of a plurality, a quantity:

> When Aristotle denies that time is a number with which we count, he is not merely denying that it is a number we in fact use in counting. His point is that it is not even a number of the same kind as these. It is not, like these, a discrete plurality.[280]

She proposes that this "other kind of number" which is not a quantity is essentially an ordinal number. Time would be a number, a numerable number, because it would be an order of motion countable by counting nows before and after:

> Time is, by definition something that is counted by counting nows [in a certain definite order]. As such, it inherits its order from the order of the nows that are counted. This, I think, is the point Aristotle is making when he defines time as a number that is only countable.[281]

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[277] Sorabji, *Time, Creation, and the Continuum*, 89.
[278] "Time is essentially a kind of number because it is, by definition, something that gets counted when we count the series of now that Aristotle calls the before and after in time." Coope, *Time for Aristotle*, 86.
[279] *Ibid.*99-100.
[280] *Ibid.*90.
[281] Coope, 91.

Hence, Coope proposes that Aristotle uses 'number' in an extended sense in his definition of time:

> On the interpretation I have been presenting, Aristotle recognizes that time is only a number in a somewhat extended sense. The word '*arithmos*' is standardly used to refer to numbers with which we can count: 'numbers *simpliciter*'… The point of calling time a kind of number is that it has something in common with numbers with which we count. Like them, it has a certain kind of before and after order.[282]

As evidence that Aristotle intends 'number' to have really this meaning, she claims that in the passage preceding the definition, as Aristotle argues that we perceive time by counting motion by nows, he puts the emphasis on the order in which we count nows.[283]

I think this is weak evidence. Although Aristotle does say that in order to perceive time, we must perceive a number of two nows distinguished by their order of before and after, I don't see how this shows that time is essentially the order of change. The passage rather shows that time is what is numbered in change by counting nows, that it is a number of change, and thus a quantity.

As I said before, there are clear indications in the text of Aristotle that as a number, time measures motion. These passages thereby show that the number which time is is a quantity – the quantity of motion. Indeed, the measure of something is its quantity. Coope mentions two of these passages and admits that she finds them puzzling in view of her interpretation.[284]

Finally, Coope's interpretation is based upon a misunderstanding of the distinction between numbering number and numerable number. She is mistaken to believe that a numerable number is not a plurality, as opposed to a numbering number. It is true that the number of something continuous is not a discrete quantity, but this is on account of its subject, as I have explained. Considered formally, the number of something

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[282] Coope, 95.
[283] Coope, 87.
[284] Coope, 97. One passage Coope mentions is where Aristotle says that "we judge the greater and less by number, and the more and less change by time." (219b3-5); the other one is the passage where Aristotle says that the now measures time by delimiting the before and after (219b11-12).

continuous is a plurality. The continuous can be said to have a number because it is numerable; this is the sense of Aristotle's remark that 'number' is said not only of that by which we number, but also of that which is numbered or numerable. Hence, the point of Aristotle's distinction between numbering number and numerable number is not to show, as Coope thinks, that time is not a plurality; on the contrary, it is to show that time is indeed a plurality, a number even though it is not an abstract number and it has for subject something continuous.

What the Terms 'Before' and 'After' Designate

Another issue concerns the meaning of the terms 'before' and 'after' in the definition of time. There is indeed a certain ambiguity due to the fact that Aristotle uses these terms sometimes to refer to parts of time or motion, or to limits of time or motion (*momenta* or instants).

Different Meanings of 'Before' and 'After' in Aristotle's Treatise

In certain contexts, 'before' and 'after' refer to *momenta* of motion or instants of time. For example, when Aristotle argues that time is perceived by determining the before and after in motion, 'before' and 'after' designates two *momenta* of motion. Likewise, when he says that time is perceived by two instants, one before and one after, 'before' and 'after' obviously refers to instants.[285]

In other contexts, 'before' and 'after' designate parts of motion or parts of time. Aristotle argues that the before and after in time and motion follow the before and after in magnitude.[286] Time and motion are quantities and divisible through magnitude. Magnitude is divisible in parts before and after, and this is why the before and after exist in motion and time. Therefore, in this context, 'before' and 'after' refer to quantitative parts.

We can immediately discard the possibility that 'before' and 'after' would refer to instants or parts of time for this would render the definition logically circular,

[285] Cf. *Phys.* IV. 11, 219a22-28.
[286] *Ibid.* 219a15-22.

defining time by time, so to speak. Moreover, the definition of time has been obtained by arguing, in the second part of the demonstration, that time follows motion with respect to the before and after because we perceive time by perceiving the before and after *in motion*. Accordingly, 'before' and 'after', in the definition 'the number of movement with respect to the before and after', are "kinetic terms", not temporal terms. The question is thus to know whether they designate parts of movement or *momenta*.

Possible Interpretations

Time is a number of parts of motion distinct by their order of succession. 'Before' and 'after', in the definition, can thus be understood as referring to the parts of movement.

Besides, 'before' and 'after' figure in the definition because, as I have explained, Aristotle has shown that time follows motion with respect to the before and after. This argument assumed the prior conclusion that the before and after is formally distinct from motion; it was established by arguing that the before and after is in movement because it follows the before and after in magnitude. Now, I have explained that in the context of this argument, 'before' and 'after' had the quantitative parts of motion as subject. Accordingly, 'before' and 'after' must be construed in the same way in the conclusion that time follows motion with respect to the before and after. So it is, therefore, for the meaning of these terms in the definition of time that ensues: 'before' and 'after' designate parts of motion.

It is true that when Aristotle says that we perceive time by the before and after, 'before' and 'after' designates *momenta*. However, this does not show that time follows *momenta*. The quantity of motion and its parts are perceived by their limits, *momenta*, which follow the same order. In perceiving two *momenta*, we perceive time because we perceive the quantity of motion which these *momenta* delimit, a quantitative part of motion. Movement is divisible into many parts ordered before and after. Therefore, the fact that we perceive time by one *momentum* before and one *momentum* after shows that time follows motion with respect to its quantitative parts.

In light of these considerations, understanding ‘before’ and ‘after’ in the definition as designating parts of motion is justified.

This being said, I have explained that time is not defined as the number of parts of motion but as the number of motion (because motion is the subject of time and motion does not have actual parts). Time, the number of motion, is a quantity of motion, and a quantity of motion is a continuum defined by two limits, one before and one after. From this point of view, it is also legitimate to understand ‘before’ and ‘after’ as referring to *momenta* that determine a quantity of motion. This interpretation has the advantage of making clear that motion is a continuous quantity.

Whether ‘before’ and ‘after’ designate *momenta* or parts also depends upon how we interpret the preposition “*κατὰ*” *[τὸ πρότερον καὶ ὕστερον]*, which we translate by “with respect to” [the before and after] or “in respect of” [the before and after]. On the one hand, this “*κατὰ*” can be understood as designating the aspect of movement which time is the number of, the before and after, its quantitative parts. On the other hand, “*κατὰ*” can also be read in the sense: “the limits relatively to which time numbers movement.”

In sum, both interpretations seem tenable. Understanding ‘before’ and ‘after’ as parts makes more sense with regard to time’s being a number that follows motion with respect to its quantitative parts. However, understanding ‘before’ and ‘after’ as extremities of an interval makes more sense with regard to motion’s being a continuous quantity. This latter interpretation is justified, provided that we understand that insofar as it is a number, time is a number of successive parts of motion, not a number of *momenta*, or simply a continuous quantity determined by 2 extremities.

Tony Roark understands ‘before’ and ‘after’ as referring to *momenta* defining an interval; he calls them “kinetic cuts”.[287] However, he interprets before and after that way because he thinks, as mentioned before, that a time, a number of motion with respect to the before and after, is not a plurality of parts of motion, but simply a

[287] “The phrase ‘with respect to the before and after’ in the definiens refers to kinetic cuts.” Roark, *Aristotle on Time*, 107.

determinate quantity of motion.[288] In keeping with his interpretation, he thus understands 'before' and 'after' as the limits determining this quantity. Hence, Roark's reason to read 'before' and 'after' as "kinetic cuts" is mistaken, according to what I have argued: considered formally, time is a number of successive parts of motion.

A Circular Definition?

I have explained that 'before' and 'after', in the definition of time, cannot designate parts of time or instants because the definition would be logically circular. I have also argued that it is clear, from the demonstration yielding the definition of time, that the 'before' and 'after' of the definition is the before and after in motion. Some commentators, while they do not really dispute Aristotle's intention to speak of the before and after in motion, have objected that the definition is still circular because the 'before' and 'after' in motion presupposes temporal order.[289] The origin of this objection can be traced back to Galen, in Antiquity, who thought that Aristotle's definition amounts to state that "time is the number of change in time". His reading is reported by Simplicius and Themistius. Here is the excerpt from the commentary of Simplicius:

> Galen objected to some of the things said at this point, saying that time revealed itself, so let us consider this objection also: having enumerated many things that are signified by 'before' and 'after', he says that the rest do not fit with the definition, but only the 'before' and 'after' in time. So time is the number of change in time.[290]

Themistius and Simplicius rightly reply to Galen that Aristotle has shown that the 'before' and 'after' are in movement because they follow the before and after that exist first in magnitude, through position; and that the before and after are in time because they follow the before and after in movement. Thus, the existence and the

[288] Roark,113.
[289] (Corish 1976, 245-51); (Owen 1976, 313); (Sorabji 1983, 86).
[290] Simplicius, *On Physics* IV, Diels. 718, 14-18.

knowledge of the before and after in movement does not presuppose the existence and the knowledge of the before and after in time, but in magnitude only.[291]

Simplicius explains that Galen would have replied that the before and after in magnitude being an order of position, it is not of the same kind as the order of succession in existence that we find in movement. There would be two kinds of order in movement: one deriving from magnitude and one deriving from time. The order of succession in movement would follow the before and after in time:

> The before in time is different, accompanying the before and after in change, but not having its before and after through position, but through the extent of its existence; and this is something other than the before and after in position derived by motion from magnitude.[292]

The fact that the before and after in movement follows the before and after in magnitude does not imply that it be also an order of position. It only means that the before and after exists in motion because a similar order exists in magnitude.[293] The before and after in motion is an order of succession because motion is successive by its very nature. Indeed, motion involves a passage between two states of being that are somehow contrary to one another. Now, something cannot be in contradictory states at once. It must be in one state *before* another, that is successively. Succession exists in time because it exists in motion and time is a quantity of motion. Thus, Galen is wrong to claim that the before and after in motion is a temporal order. The same response can be made to scholars who claim that Aristotle's definition is logically circular.

Part III: The Instant

Having studied the definition of time, we must treat in detail of the instant. Indeed, an account of the nature of time would be incomplete without an account of the instant, which Aristotle calls the 'now' [τὸ νῦν]. As Aristotle wrote just before he concluded

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[291] Similarly, Aquinas comments that Aristotle has specified that the before and after in motion follow the before and after in magnitude precisely to avert the objection that defining time by the before and after in motion would be circular. Cf. Aquinas, *On Physics* IV. Lect. XVII, no.10.
[292] Simplicius, *On Physics* IV, Diels. 718, 29-719, 3.
[293] For example, if a moving body travels from a point A to a point C by passing through a middle point B, the part AB of the motion happens before the part BC because the part AB of the distance is before the part BC (relatively to the starting point of the motion).

the definition of time, time is "what is determined by the now"[294], and we perceive time by perceiving instants. Hence, time is so related to the instant that it is impossible to know clearly its nature without also knowing the nature of the 'now'.

In fact, Aristotle does treat of the now in the scientific part of his inquiry. Shortly after defining time, he contends that time is different before and after because the now "which measures time in so far as it determines the before and after"[295] is different. In order to justify that the now is different before and after, he addresses the problem raised about it in the dialectical part of the inquiry: is the now identical or different in time? We indeed remember Aristotle had presented some reasons suggesting that the now is identical and some reasons suggesting that it is different, thereby creating an aporia.

This puzzle had been presented to cast doubt upon the existence of the 'now' (and of time). But I had made the observation it was also a problem concerning the nature of the 'now'. Indeed, the fact that the now appears both identical and different over time makes its nature fairly mysterious. In this section, I will discuss Aristotle's solution of this problem and show that it reveals the essence of the now, as well as important properties of it.

Nature of the Instant

The 'Now' Follows the Moving Body

Aristotle addresses the problem of whether the now is identical or different by comparing it to a moving body. Here is how he justifies this comparison:

> For motion, as was said, follows [ἀκολουθεῖ] magnitude, and time, as we maintain, motion… But the 'now' follows [ἀκολουθεῖ] the body that is carried along, as time follows motion. For it is by means of the body that is carried along that we come to know the before and after in motion, and that by which the 'before and 'after' are numerable, is the 'now'.[296]

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[294] *Phys*. IV. 11, 219a29.
[295] *Ibid.* 219b9-13.
[296] "ἀκολουθεῖ γάρ, ὡς ἐλέχθη, τῷ μὲν μεγέθει ἡ κίνησις, ταύτῃ δ' ὁ χρόνος, ὥς φαμεν […]· τῷ δὲ φερομένῳ ἀκολουθεῖ τὸ νῦν, ὥσπερ ὁ χρόνος τῇ κινήσει (τῷ γὰρ φερομένῳ γνωρίζομεν τὸ πρότερον καὶ ὕστερον ἐν κινήσει, ᾗ δ' ἀριθμητὸν τὸ πρότερον καὶ ὕστερον, τὸ νῦν ἔστιν)·" *Phys*., IV, 11, 219b15-25.

What motivates the comparison of the now to a moving body is the principle that Aristotle has established before: time follows movement with respect to the before and after, and movement follows magnitude. Aristotle argues that similarly, the now of time follows the moving body because the relation of the now to time is proportional to the relation of the moving body to movement. It is by the moving body that we perceive movement and the before and after in movement: by seeing the moving thing being successively at different positions along the magnitude, we perceive that it is moving and we perceive parts that are before and after in the movement. For example, seeing the moving body being in one position, we perceive that its being in a position before belongs to a prior part of movement, and its being in a position after belongs to a posterior part of movement. Similarly, it is by perceiving the now being before and after in time that we perceive time and parts that are before and after in time. Because the now relates to time in the same way as the moving body to movement, and time follows movement, the now follows the moving body.

Definition of the Instant

Aristotle will argue that the now is both identical and different because it follows the moving body, and the moving body is such. Before coming to that, let us observe that what Aristotle argues in the previous passage implicitly reveals the essence of the now. We remember that time, which follows movement, is something of movement: it is formally distinct from movement (being its number) and identical to it in subject. Proportionally, if the now follows the moving body, it implies that it is something of the moving body, formally different from it but materially identical to it. Thus, we can discover the essence of the now by seeking how it differs formally from the moving body, what aspect of the moving body it is.

Aristotle has written: “It is by means of the body that is carried along that we come to know the before and after in motion, and that by which the ‘before and ‘after’ are numerable is the now.” Time is a number of parts of movement before and after, and such a number is determined by a number of instants. These instants are the now insofar as it is before and after. Thus, the now is what numbers movement in parts

before and after. This is what Aristotle means when he says: “That by which the ‘before and ‘after’ are numerable is the now.” But the now follows the moving body insofar as the moving body, being before and after, divides movement into parts. Therefore, the now is nothing but the moving body insofar as it numbers movement in parts before and after. Such is the definition of the ‘now’.

This definition can be reformulated using the concept of ‘*momentum*’. This concept has been introduced earlier, but let us be more specific about what it is. Motion is divisible through magnitude; this is why it is a quantity. A *momentum* is a potential division of motion corresponding to a potential division of magnitude (on which a certain movement happens). Now, motion happens in a body; it is the actuality of a body (as mobile); motion is a quantity because the moving body moves through magnitude. Hence, the *momentum* corresponds to the moving body insofar as it is in different positions; because magnitude is divisible at one point, motion is also divisible by the moving body as it is found in the position corresponding to that point. The moving body potentially divides motion into parts before and after, but the before and after in motion is an order of succession, not an order of position as in magnitude. The moving body is successively in different positions, and it is as such that it divides motion in parts before and after. Consequently, the *momentum* is the moving body insofar as it is before and after, i.e. successively in different positions over the course of its motion.

The now is the moving body insofar as it numbers movement. Now, the moving body numbers movement insofar as it is before and after, and as such it corresponds to the concept of *momentum*. Hence, the now is the *momentum* insofar as it numbers movement (with respect to succession).

This definition of the now is supported by a passage in which Aristotle argues that time and the now exist together:

> Clearly, too, if there were no time, there would be no now, and if there were no now there would be no time. Just as the moving body and its locomotion are

> simultaneous [ἅμα], *so too are the number of the moving body and the number of its locomotion*.[297]

Aristotle calls the now "the number of the moving body". This expression, enigmatic at first glance, makes sense if we consider that the now corresponds to the moving body insofar as it is before and after. Regarded as such, the moving body forms a number of *momenta* which numbers movement with respect to the before and after, and thereby to a number of instants. The 'now', in its function of numbering movement, can thus be described as the 'number of the moving body'. Indeed, a number of instants corresponds to a number of *momenta,* and this number corresponds to the moving body as formally distinct, being before and after.

An exegetical Issue

In the phrase that I take as indicative of the definition of the now, "ᾗ δ' ἀριθμητὸν τὸ πρότερον καὶ ὕστερον, τὸ νῦν ἔστιν"[298], the relative adverb of manner or place "ᾗ" can have, linguistically speaking, two senses which give a different meaning to the sentence. It can have the sense "that by which". The meaning of the sentence is then: "The now is that by which the before and after is numerable". This is how I have interpreted it. The adverb "ᾗ" can also have the sense of "as" or "in so far as", sometimes rendered by the Latin *qua*. The sense of the phrase then becomes: "The now is the before and after as numerable."

Roark, in keeping with his interpretation that time is a unit of motion determined by one *momentum* before and one *momentum* after, accordingly interprets Aristotle's phrase as: "the now is the before and after as numerable". In other words, the 'now' is, according to Roark[299], the moving body insofar as numerable before and after, or the *momentum*[300] as numerable.[301]

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[297] "φανερὸν δὲ καὶ ὅτι εἴτε χρόνος μὴ εἴη, τὸ νῦν οὐκ ἂν εἴη, εἴτε τὸ νῦν μὴ εἴη, χρόνος οὐκ ἂν εἴη· ἅμα γὰρ ὥσπερ τὸ φερόμενον καὶ ἡ φορά, οὕτως καὶ ὁ ἀριθμὸς ὁ τοῦ φερομένου καὶ ὁ τῆς φορᾶς." *Phys*., IV, 11, 219b33-220a4.
[298] *Phys*., IV, 11, 219b23-25.
[299] Roark, *Aristotle on Time*, 115.
[300] Roark calls the *momentum* "a kinetic cut".
[301] In his translation, Pellegrin mentions that Goldschmidt also understands the phrase this way. Cf. Aristote, *Physique,* 254. Trans. Pellegrin.

It is true that the now corresponds to the *momentum*, the moving body as before and after, and that as such, the moving body is numerable. This is why Aristotle can call the now, by analogy with time, "the number of the moving body", as I have just explained. However, the now follows the moving body insofar as it is this by which parts before and after are distinguished in movement; furthermore, it must be defined in correlation with time, which is a number of parts of movement. Accordingly, the now must be defined as the moving body as that by which the before and after are numerable.

Defining the now as the before and after as numerable would imply that time is a number of *momenta*, which is absurd. In fact, Roark realizes it does not make sense to understand Aristotle's phrase as "the now is the before and after as numerable" if 'numerable' is taken in the strict sense of 'countable'. Accordingly, to make the text fit his interpretation, he claims that 'numerable' must be construed in an analogical sense, in the sense of 'individuable', or 'determinable', or 'perceptible'.[302]

It follows that even though both readings of the sentence are linguistically tenable, understanding the phrase as 'the now is that by which the before and after are numerable" is more consistent with the comparison of the now to the moving body in Aristotle's argument and with time's definition as the number of motion (with respect to the before and after).

The 'now' is Formally Distinct, Materially Identical to the Moving Body

The expression "the number of the moving body"[303] has the advantage of implying that there is a proportionality of relation between the now and the moving body, on the one hand, and time and motion, on the other hand: as time follows movement, being the number of it, so the now follows the moving body, being "its number". It can be considered as a way to define the now by analogy with the definition of time.

[302] Roark,115.
[303] "ὁ ἀριθμὸς ὁ τοῦ φερομένου καὶ ὁ τῆς φορᾶς." *Phys.* IV. 11, 220a1-3.

The definition of the now reveals the moving body as subject of the now. The now is thus identical with the moving body in subject. Aristotle expresses this material identity of the now with the moving body as he writes: "The now is the before and after in movement."[304]

The now is the moving body regarded under a certain aspect – insofar as it numbers movement. It is thus distinct from the moving body formally. From this point of view, the relation of the now to the moving body is parallel to the one of time to motion: as time is materially identical but formally distinct from its subject, movement, so the now is materially identical, but formally distinct from its subject, the moving body. Calling the 'now' the "number of the moving body', by analogy with time which is the "number of movement" reflects this material vs. formal parallelism.

"Properties" of the Instant

In part two, we have seen some characteristics of time which Aristotle accounts for by its nature. Likewise, Aristotle accounts for some characteristics of the now, inferring them from the moving body which the now follows. As is the case for the characteristics of time, we can call these characteristics of the now "properties" (by analogy)[305] insofar as they follow from the nature of the now.

Materially Identical; Formally Different

Aristotle asserts the now is both the same and different over time, in different respects:

> The 'now' in one sense is the same, in another it is not the same. In so far as it is in what is other and other, it is different (it is this which was the being [εἶναι] of the now), but as subject [ὃ δέ ποτε ὄν ἐστι τὸ νῦν][306] it is the same.[307]

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[304] "νῦν ἐστι, τὸ αὐτό (τὸ πρότερον γὰρ καὶ ὕστερόν ἐστι τὸ ἐν κινήσει)". *Phys.* IV.11, 219b26-27.

[305] I call these characteristics of the now "properties by analogy" because the now, like time, is not a substance (strictly speaking, properties belong to substances).

[306] The formula *ὃ δέ ποτε ὄν ἐστι τὸ νῦν* is grammatically odd, difficult to translate and interpret, and its meaning will be discussed shortly below. Most translators have rendered it by an expression synonym of "the now as subject", which is how I choose to translate it as well. I explain why in the discussion below.

[307] "τὸ δὲ νῦν ἔστι μὲν ὡς τὸ αὐτό, ἔστι δ' ὡς οὐ τὸ αὐτό· ᾗ μὲν γὰρ ἐν ἄλλῳ καὶ ἄλλῳ, ἕτερον (τοῦτο δ' ἦν αὐτῷ τὸ νῦν <εἶναι>), ὃ δέ ποτε ὄν ἐστι τὸ νῦν, τὸ αὐτό." *Phys.* IV.11, 219b12-15.

Aristotle infers these characteristics from the moving body:

> It is the same for the point and the body which is carried along, and by which we are aware of the motion and of the before and after involved in it. In subject, [τοῦτο δὲ ὃ μέν ποτε ὂν] it is identical (whether a point or a stone or something else of the kind), but in definition [τῷ λόγῳ] it is different—as the sophists assume that Coriscus' being in the Lyceum is a different thing from Coriscus' being in the market-place. And the body which is carried along is different, in so far as it is at one time here and at another there.[308]

In this passage, Aristotle argues that the moving body is different and identical in different respects. These aspects are expressed by a contrast between two expressions: "τοῦτο δὲ ὃ μέν ποτε ὂν" and "τῷ λόγῳ".

The moving body is different "τῷ λόγῳ". This expression, 'τῷ λόγῳ', has the following general senses: "in definition", or "in essence", or "in being".[309] The moving body is different "in so far as it is at one time here and at another there"; in other words, it is different because it differs in position as it moves along a magnitude. The position of a moving body defines it insofar as it qualifies its being. Indeed, the moving body is a substance, position is an accident of substance and it is one of the categories of being (one of the senses according to which 'being' is said). Therefore, in so far as the moving body is at different positions over its movement, it is different in being, and thereby different in definition ("τῷ λόγῳ"). As a sign, Aristotle mentions that the sophists exploited this difference in definition, in being, of a moving subject in order to argue that someone who changes of place is not the same person: "Coriscus' being in the Lyceum is a different thing from Coriscus' being in the market-place".

In another respect, Aristotle writes that the moving body is identical over motion. This aspect is expressed by the formula "τοῦτο δὲ ὃ μέν ποτε ὂν < ἐστι τὸ φερόμενον >". This formula is grammatically odd; a possible literal translation would be: "that which, being at a certain time, the moving body is". We find variants of the general

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[308] "ὁμοίως δὴ τῇ στιγμῇ τὸ φερόμενον, ᾧ τὴν κίνησιν γνωρίζομεν καὶ τὸ πρότερον ἐν αὐτῇ καὶ τὸ ὕστερον. τοῦτο δὲ ὃ μέν ποτε ὂν τὸ αὐτό (ἡ στιγμὴ γὰρ ἡ λίθος ἤ τι ἄλλο τοιοῦτόν ἐστι), τῷ λόγῳ δὲ ἄλλο, ὥσπερ οἱ σοφισταὶ λαμβάνουσιν ἕτερον τὸ Κορίσκον ἐν Λυκείῳ εἶναι καὶ τὸ Κορίσκον ἐν ἀγορᾷ. καὶ τοῦτο δὴ τῷ ἄλλοθι καὶ ἄλλοθι εἶναι ἕτερον·" *Ibid*. 219b16-22.

[309] We will see that Aristotle will use 'being' or 'essence' ("εἶναι"), rather than definition ("τῷ λόγῳ") when applying the same reasoning to the 'now'. The now is different in 'being'.

formula "ὃ δέ ποτε ὄν 'X' ἐστι" in *PA* II, 2, 649a15 – "ὃ μὲν γάρ ποτε τυγχάνει ὂν τὸ ὑποκείμενον" – and in *Gen. et Corr*. I, 3. 319b3 – "*ὃ μὲν γάρ ποτε ὂν ὑπόκειται* τὸ αὐτό, τὸ δ' εἶναι οὐ τὸ αὐτό." In these passages, the formula is used by Aristotle to refer to the subject (τὸ ὑποκείμενον), the substrate of something, as opposed to its essence or being (τὸ εἶναι).

In the passage that we are studying, the formula has a similar signification: it is used by Aristotle to refer to the moving body as subject of motion (the material aspect of the moving body), as opposed to its being in different positions (the formal aspect of it). Aristotle argues that although the moving body changes its position over the movement, it remains identical as "a point, a stone or something of this kind". In *Physics* I, Aristotle argues that every change presupposes a subject, a substrate which is not destroyed by the change.[310] In the case of locomotion, such a subject is "a point, a stone or something of this kind", and it remains identical, as subject, over the movement. The sophists falsely argued that Coriscus was not the same person because he had changed place: even though Coriscus changes place, he remains essentially the same person throughout such a movement. Thus, when Aristotle says that the moving body is identical as "a point, a stone or something of this kind", he means that it is identical as subject.[311]

The moving body is identical as subject of motion, but different in being. Aristotle then argues that the now also has these properties:

> But the 'now' follows the body that is carried along, as time follows the motion… Hence the same is true regarding the nows: the 'now' remains the same as subject [ὃ μέν ποτε ὂν νῦν ἐστι] (for it is the before and after in movement), but its being [τὸ δ' εἶναι] is different, for that by which the before and after is numerable is the 'now'.[312]

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[310] Cf. *Phys*., I, 7, 190a13 ff. Cf. also Chap 1 of this thesis. Section "Principles of Change".

[311] Such is thus what I take to be, in the present context, the meaning of the expression "τοῦτο δὲ ὃ μέν ποτε ὂν < ἐστι τὸ φερόμενον>": it refers to the moving body as subject. For more discussion of this formula, see Rémi Brague, *Du temps chez Platon et Aristote : quatre études* (Paris: Quadrige / Presses universitaires de France, 2003). And Coope, *Time for Aristotle*, 173-177.

[312] "τῷ δὲ φερομένῳ ἀκολουθεῖ τὸ νῦν, ὥσπερ ὁ χρόνος τῇ κινήσει…ὥστε καὶ ἐν τούτοις ὃ μέν ποτε ὂν νῦν ἐστι, τὸ αὐτό (τὸ πρότερον γὰρ καὶ ὕστερόν ἐστι τὸ ἐν κινήσει), τὸ δ' εἶναι ἕτερον (ᾗ ἀριθμητὸν γὰρ τὸ πρότερον καὶ ὕστερον, τὸ νῦν ἔστιν)." *Phys*., IV, 11, 219b23-28.

Because the now follows the moving body, and the moving body is formally different and materially identical, so it is for the now. Aristotle expresses this twofold aspect of the now by formulas similar to the ones used for the moving body: "ὃ μέν ποτε ὂν νῦν ἐστι" vs. "τὸ δ' εἶναι".

The now is "the before and after in movement": it is the moving body insofar as it is before and after. Because the moving body is materially identical over movement, the now is also materially identical over time (ὃ μέν ποτε ὂν νῦν ἐστι). Yet, the moving body is also formally different over the movement. Hence, so it is for the now: it is formally different over time. The now numbers movement with respect to the before and after. Therefore, the now differs formally by the before and after, that is by succession. For example, two instants of time differ from one another as one is before and the other after.

Thus, from the principle that the now follows the moving body, which is identical in subject and different in being, Aristotle has shown that the now also has this double property, proportionally. This solves the paradox presented at the beginning of the inquiry: the now can be both identical and different over time because it is so in different respects.

Limit, Continuity and Potential Division

Insofar as the now is materially identical, it makes time continuous; and insofar as it is formally different, it divides time. Aristotle shows that these properties follow from the moving body. Insofar as the moving body is different in being, it divides motion into parts before and after: "the moving body divides [ὁρίζει] the movement before and after".[313] And insofar as it is identical in subject, the moving body makes movement continuous. Aristotle explains it as he says: "the locomotion is one by the moving body, because it is one".[314] Because the moving body is the subject of motion, motion is individualized by the moving body and its unity depends upon the unity of the moving body; for example, there are as many individual motions as there

[313] *Ibid.* 220a9.
[314] *Phys*, IV, 11, 220a7.

are individual moving subjects. A continuous motion is numerically one. Accordingly, the continuity of motion depends upon the unity of the subject of motion.[315] For instance, the motions of different subjects cannot form one continuous motion even if they are contiguous and consecutive – e.g. in a relay course, the run of one individual immediately followed by the run of his or her teammate do not form one continuous motion.[316] Thus, motion is continuous because the moving body is one[317], i.e. because it is identical in subject.

Because motion is divisible and continuous by the moving body, in an analogous way time is also divisible and continuous by the now. However, the now is, like the moving body which it follows, a flowing entity. Therefore, it is not obvious that it has the properties of dividing and uniting time (neither is it obvious that the moving body has them). For this reason, Aristotle shows that these properties also follow from the point which is the limit of magnitude:

> But it also follows in a certain way from the point. Indeed, the point too continues [συνέχει] and divides [ὁρίζει] magnitude. It is indeed the beginning of one part and the end of another.[318]

As opposed to the now, the point is stable, so it is manifest that it divides and unites magnitude. The point is the limit of magnitude. It is the beginning of one part and the end of another. As such, it divides magnitude (potentially). By the same token, it is the continuity of magnitude for it is the same point that is beginning and end. Indeed, the parts of a continuous quantity are united by a common limit.

As time follows motion, which follows magnitude, so the now follows the *momentum*, which follows the point. Hence, there is a proportionality between, on the one hand, the now and time, and on the other hand, the point and magnitude: the now is to time what the point is to magnitude. Hence, as the point divides and unites magnitude, so the now divides and unites time. Aristotle writes:

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[315] *Phys*. V. 4, 228a20-b12.
[316] *Ibid.* 228a28-30.
[317] This presupposes that the other conditions for the continuity of motion are met, namely, that the subject does not pause its motion, and undergoes the same kind of motion. Cf. *Phys*. V. 4, 228b2-b12.
[318] "καὶ συνεχής τε δὴ ὁ χρόνος τῷ νῦν, καὶ διήρηται κατὰ τὸ νῦν· ἀκολουθεῖ γὰρ καὶ τοῦτο τῇ φορᾷ καὶ τῷ φερομένῳ… ἀκολουθεῖ δὲ καὶ τοῦτό πως τῇ στιγμῇ· καὶ γὰρ ἡ στιγμὴ καὶ συνέχει τὸ μῆκος καὶ ὁρίζει· ἔστι γὰρ τοῦ μὲν ἀρχὴ τοῦ δὲ τελευτή." 11, 220a4-11.

> The 'now' is the continuity [συνέχεια] of time… It joins [συνέχει] the time past with the time future, and it is the limit [πέρας] of time. It is indeed the beginning of the future, and the end of the past.[319]

Like the point for the line, the now is the limit of time. It is the end of one part before that we call "past", and the beginning of one part after that we call "future". As such, the now divides time. It is also a common limit for the past and the future; it is the same now that is beginning and end. As such, the now is the continuity of time.

Because the relation of the now to time is proportional to the relation of the point to magnitude, it is possible to conceive of the now by analogy with the point: we can think of the now as limit of time by imagining it like a point on a line representing time. Such a representation is helpful because, as mentioned before, the point is a stable entity, which the now is not.[320] By the same token, it has a limitation and must be qualified. Aristotle explains it in a passage that is quite difficult:

> But when you take a point in this way, using the one point as two, a pause is necessary, if the same point is to be the beginning and the end. The 'now' on the other hand, since the body carried is moving, is always different. Hence time is not number in the sense in which there is number of the same point because it is beginning and end, but rather as the extremities of a line.[321]

Aristotle here refers to a principle that he argues for in *Physics* VIII. 8, namely that if a point on the path of a movement is principle and end in actuality, movement must be discontinued at this point and the body must pause its motion.[322] To understand Aristotle's point in the present context, it will be sufficient to observe the following. A limit cannot be perceived as beginning and end simultaneously. Consequently, in order to perceive the now as limit of consecutive parts of time, the now would have to

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[319] "Τὸ δὲ νῦν ἐστιν συνέχεια χρόνου, ὥσπερ ἐλέχθη· συνέχει γὰρ τὸν χρόνον τὸν παρεληλυθότα καὶ ἐσόμενον, καὶ πέρας χρόνου ἐστίν· ἔστι γὰρ τοῦ μὲν ἀρχή, τοῦ δὲ τελευτή." *Phys*. IV.13, 222a10-12. My trans.

[320] Aristotle writes: "[The 'now' is] the beginning of a time and the end of another. But this is not obvious as it is for the point which remains." *Ibid*. 222a10-14.

[321] "ἀλλ' ὅταν μὲν οὕτω λαμβάνῃ τις ὡς δυσὶ χρώμενος τῇ μιᾷ, ἀνάγκη ἴστασθαι, εἰ ἔσται ἀρχὴ καὶ τελευτὴ ἡ αὐτὴ στιγμή· τὸ δὲ νῦν διὰ τὸ κινεῖσθαι τὸ φερόμενον αἰεὶ ἕτερον. ὥσθ' ὁ χρόνος ἀριθμὸς οὐχ ὡς τῆς αὐτῆς στιγμῆς, ὅτι ἀρχὴ καὶ τελευτή, ἀλλ' ὡς τὰ ἔσχατα τῆς γραμμῆς μᾶλλον." 11, 220a12-16.

[322] "So in the straight line any one of the points lying between the two extremes is potentially a middle-point; but it is not actually so unless that which is in motion divides the line by coming to a stand at that point and beginning its motion again: thus the middle-point becomes both a beginning and an end, a beginning of the latter part and an end of the first part." *Phys*., VIII, 8, 262a21-28. Trans. Hardie and Gaye.

be at rest. Yet, the now flows: it is "always different" for it follows the moving body. When we represent time as a line, we must conceive such a line as generated by the motion of the now represented by a moving point. Consequently, we cannot perceive divisions in time in the manner that we perceive divisions in a line, by taking one instant as beginning and end; to do so, the flow of time would have to stop. Rather, in order to divide time, we must take two instants delimiting an interval. This is the sense of Aristotle's remark: "Time is not number in the sense in which there is number of the same point because it is beginning and end, but rather as the extremities of a line." This statement certainly does not mean that time is a number of nows. Rather, the context suggests the following meaning: we perceive time, the number of motion, in numbering movement by perceiving two instants that delimit an interval, not by perceiving one instant as beginning and end, as we could number a line in dividing it by taking the same point as beginning and end.

Measure of time

Insofar as the now is formally different, being before and after, it measures time. Aristotle writes: "The 'now' measures time insofar as it delimits the before and after".[323] The measure is that which makes known the quantity[324]. Time can be regarded as a discrete quantity or as a continuous quantity. We measure time as a continuum by counting a number of its parts. We do so by counting the now which, as being before and after, delimits successive parts of time. In other words, we measure time by successive instants (corresponding to the now as before and after). For example, a time of 60 seconds can be measured by 60 successive instants delimiting 60 successive parts of time. Thus, the now is the measure of time: it is this by which we know the quantity of time.

We can also see that the now is the measure of time if we regard time as a discrete quantity. Time is the number of movement with respect to the before and after, and the now is by definition this which numbers movement with respect to the before and

[323] *Phys*., IV, 11, 219b11-12. This is how Pellegrin proposes this passage. See Aristote, *Physique*. Trans. Pellegrin, 2002.
[324] *Met*. X. 1, 1052b20.

after. Time, the number of movement, is thus measured by the now. We indeed measure time, a number of parts of movement, by counting a number of instants numbering movement.

Aristotle shows that the now is the measure of time as he compares the now to "the unit of a number" in the following passage: "The number of the locomotion is time, while the 'now' is like the moving body, like the unit of a number [οἷον μονὰς ἀριθμοῦ]."[325] The unit is the measure of a number. Time, the number of movement, is measured by the now, which corresponds to the moving body as before and after. In its function of measuring time, the now is thus similar to the unit of a number.

Fundamentally, the reason why the now is measure is because this is what is most knowable in time. Aristotle again explains this by the fact that the moving body, which the now follows, is what is most knowable in motion:

> This is what is most knowable [the 'now']; for motion is known because of that which is moved, locomotion because of that which is carried. For what is carried is a 'this' [τόδε τι], which movement is not.[326]

Movement does not exist simultaneously as a whole.[327] Consequently, it is not "a this (τόδε τι)", something that can be pointed out and known immediately. However, the moving body is "a this (τόδε τι)", so it is knowable. As explained before, we perceive movement by perceiving the moving body being before and after. Thus, movement is known by what is most knowable in it, the moving body.

Like movement which it follows, time is not directly perceivable because it does not exist simultaneously. But the now is perceivable because it corresponds to the moving body. We perceive time by perceiving the now as before and after. Thus, we know time by the 'now', which is what is most knowable of time.

As what is most knowable in time, the now is the measure of time. In *Metaphysics* X. 1, Aristotle explains that because the measure is that which makes known quantity,

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[325] "χρόνος μὲν γὰρ ὁ τῆς φορᾶς ἀριθμός, τὸ νῦν δὲ ὡς τὸ φερόμενον, οἷον μονὰς ἀριθμοῦ." *Ibid.* 220a3-4.
[326] "καὶ γνώριμον δὲ μάλιστα τοῦτ' ἔστιν· καὶ γὰρ ἡ κίνησις διὰ τὸ κινούμενον καὶ ἡ φορὰ διὰ τὸ φερόμενον· τόδε γάρ τι τὸ φερόμενον, ἡ δὲ κίνησις οὔ." *Phys.*, IV, 11, 219b28-33.
[327] This will be explained in full details in chapter 4.

the measure in each genus of quantity is what is best known in that genus.[328] We perceive time by the now because it is what is most knowable of time. We also measure time by the now for this reason.

The 'Now': Summary

The aim of this section was to study the 'now', because a full understanding of what time is depends upon a clear conception of the now. By studying Aristotle's solution to the problem of whether the now is identical or different over time, I have maintained that the now, which follows the moving body, can be defined as the *momentum* insofar as it numbers movement with respect to the before and after. Moreover, we have seen that on account of its nature, the now has the following properties. It is, like the moving body which it follows, identical in subject and different in being. Insofar as it is identical, it is the continuity of time; insofar as it is different, it is its potential division; the now is therefore the limit of time, as the point is the limit of the line. Furthermore, because it is formally different, the now has the property of measuring time.

Conclusion of the Chapter

The aim of this chapter has been to understand what time is according to Aristotle. In the first part of the chapter, I have argued that Aristotle defines time as the number of movement with respect to the before and after because it is necessary and sufficient to number movement in this respect in order to perceive time. I have maintained that this definition means that time is a number of successive parts of motion that measures its quantity. This interpretation agrees with the view of a few ancient and medieval commentators. However, it disagrees, by and large, with the view of modern commentators, whose interpretation generally amounts to claim that time is a number in an extended sense (measure, determination, order, etc). Scholars have developed this view on account of several ambiguities, difficulties and objections to which Aristotle's definition of time is subject. Therefore, in the second part of the chapter, I have clarified and defended my interpretation by engaging with them on these issues.

[328] Cf. Chap. 3. *Met.* X, 1, 1052b20-35.

I have addressed, among other things, the main difficulty posed by Aristotle's definition – how time, in spite of being continuous, can be defined as something discrete – arguing that its solution lies in Aristotle's distinction between 'numbered number' and 'numbering number'; I have maintained that time, a numbered number, is formally discrete but materially continuous on account of its subject, motion. In the third part of the chapter, I have continued to expound and consolidate my interpretation of the nature of time by providing an account of the 'now', by which time is determined and perceived. I have maintained that the now can be defined, in correlation with time, as "the *momentum* insofar as it numbers movement with respect to the before and after". I have also treated of properties of the now which Aristotle infers from its nature: materially identical and formally different; limit that divides and unites time; measure of time.

Chapter III: The Universal Unity of Time

The last chapter has discussed the nature of time. We have also seen a few properties that follow from the nature of time, in particular, its property of measuring movement. We have not yet considered another important property which is commonly reckoned as belonging to time: its universality. It is a matter of common experience that time is everywhere in the universe: there is not a point of space where there is no time. We also have the intuition that it is the same time everywhere. In other words, we think that things and events which exist and happen simultaneously are in a unique time, wherever they are and however distant they are from each other. A comprehensive theory of time must account for this primordial and mysterious feature of time, so it is worth asking how Aristotle explains it.

Aristotle, as it is his custom not to distrust what is strongly testified by common experience, reckons as a matter of fact that time is simultaneously the same everywhere. In the dialectical part of his inquiry, it is on account of this feature of time that he rejects the opinion that time is the same thing as movement:

> But the change and the movement of each thing resides only in what changes or wherever happens to be found what moves or change; but time is the same everywhere and concerning all things.[329]

It is also by invoking this feature he refutes the opinion that time would be the movement of the heavenly sphere of the universe. He argues that this opinion cannot be true for if there were many universes coexisting, there would be many simultaneous times.[330]

Yet, accounting for the unicity of time poses a significant challenge given how Aristotle conceives of the nature of time. He has indeed defined time as something of motion, something that follows motion; now, there are many movements happening simultaneously in nature. How then, can there be a unique time?

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[329] *Phys*. IV. 10, 218b10-13.
[330] Cf. *Phys*. IV. 10, 218b4-6.

Furthermore, since time is something of motion, it must exist because there is motion and where there is motion. But it doesn't seem that motion is happening always and everywhere in nature. Therefore, how can one explain the universality of time, the fact that there is always time everywhere?

The subject of this chapter is to study how Aristotle explains the universal unity of time by addressing these questions and related ones. The first part of the chapter will discuss how Aristotle accounts for the unity of time and the related property of simultaneity. The second part of the chapter will investigate why time is universal in nature, and what ultimately explains temporality.

Part I: Time's Unity

To discuss the topic of time's unity, I will proceed in the following order. First, I will present the precise shape that this problem takes in Aristotle's treatise of time. Second, I will explain how I think its solution can be inferred from a number of considerations and passages. Third, I will consider a few difficulties and objections against the interpretation I propose.

The Problem

Aristotle thinks that time is universal in nature, in other words that there is time everywhere. For example, he writes: "Time is in everything, in the earth, in the sea as well as in the sky."[331] Besides, he affirms that time is one, i.e. that it is the same time everywhere in the universe:

> [Time] is also the same everywhere simultaneously [ἅμα]. But before and after it is not the same… The nows, indeed, are different.[332]

In order to better understand this claim, it will be beneficial to raise a few considerations as well as to introduce important notions: the notion of 'being in time' and the notion of 'simultaneity'.

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[331] *Phys.* IV. 14, 223a16-18.
[332] *Phys*. IV. 12, 220b5-12.

There is Time Wherever there is Movement

Since time follows movement, it is reasonable to assume that there is time somewhere because there is movement there, and then that if time is everywhere, it is because there is somehow movement everywhere. This is indeed how Aristotle explains the universality of time in the following passage:

> It is worth examining why it is thought that time is in everything, in the earth, in the sea as well as in the sky. Is it not because it is a certain affection [πάθος] or certain state [ἕξις] of movement given that it is the number of it, and that all these things are mobile (because all are in a place), and that time and movement go together in actuality as well as in potentiality?[333]

This passage will be discussed in detail in the second part of this chapter. For the moment, it is sufficient to observe that Aristotle is essentially arguing that there is time everywhere in nature because all natural things being mobile, there is movement everywhere, in potentiality or in actuality.

Motion is in Time

Insofar as time is something of movement, time is in movement. Yet, in another sense, it is the opposite: movement is in time. Aristotle shows that movements are in time by the following argument. Any movement is faster or slower than another movement to which it can be compared. What moves more rapidly finishes to move before, on the same distance, than another moving object, and what moves more slowly finishes to move after. In this context, 'before' and 'after' are temporal terms. What moves more rapidly is said to finish its movement *before* because it completes its movement in an interval of time shorter than the other mobile, measured relatively to the instant at which both objects begin to move. Since an instant of time is in time, so it is for the interval and the before and after. Hence, the fact that every moving object moves more rapidly or more slowly than another one shows that every movement is in time.

Besides showing that every movement is in time, this argument lets us grasp what it means for a movement to be in time. A movement is in time because it is delimited,

[333] *Phys.* IV. 14, 223a16-21.

contained by two instants of time that measure it. Thus, a movement is in time in the sense that it is measured by time. And this is what Aristotle says: he writes that for a movement, to be in time means to be measured by time.[334]

‘Before’, ‘After’ and ‘Simultaneous’ in Time

Insofar as movements are in time, they are, in comparison to one another, before, after or simultaneous in time. Let us say more about these temporal relations.

‘Before’, ‘After’

In chapter 2, we have seen that Aristotle explains that the ‘before’ and ‘after’ are in time because they follow the ‘before’ and ‘after’ in movement, which in turn follow the ‘before’ and ‘after’ in magnitude. Accordingly, the ‘before’ and ‘after’ in time is not the same as the ‘before’ and ‘after’ in movement and the ‘before’ and ‘after’ in magnitude. Aristotle makes this clear in *Metaphysics* V.11, where these are presented as different modalities of ‘before’ and ‘after’. In *Physics* IV.14, he explained that the ‘before’ and ‘after’ in time are defined relatively to the present instant:

> We say ‘before’ and ‘after’ with reference to the distance from the now, and the now is the boundary of the past and the future… ‘Before’ is said contrariwise with reference to past and future time; for in the past we call ‘before’ what is farther from the now, and ‘after’ what is nearer, but in the future we call the nearer ‘before’ and the farther ‘after’.[335]

Simultaneity

The notions of temporal priority and posteriority define another temporal relation: simultaneity. To be simultaneous literally means to be together, to coexist. The Greek word *ἅμα*, which we translate by ‘simultaneous’ indeed means ‘together’. The etymology of ‘simultaneous’ also reveals this meaning; it comes from the latin *simul*, which like the Greek *ἅμα*, literally means ‘together’. There is a sense of simultaneity associated with space. Things are simultaneous in space if they exist together in the same primary location, as Aristotle explains in *Physics* V. 3 and in *Metaphysics*

[334] *Phys.* IV. 12, 221a4-5.
[335] *Phys*. IV. 14, 223a4-13. Trans. Hardie and Gaye.

XI.12.[336] In another sense, the concept of simultaneity means to be together in time. Aristotle speaks of this sense of 'simultaneous' in *Categories* 13 as being the primary sense of the term:

> Those things are called simultaneous without qualification and most strictly which come into being at the same time; for neither is prior or posterior. These are called simultaneous in respect of time.[337]

Things that are simultaneous in time are neither before nor after in time, but coexist in time. Time differs with respect to the before and after, so to be simultaneous in time is to be in the same time. Moreover, because time differs in respect of the before and after by the now, temporal simultaneity is defined by the now:

> To be simultaneous [ἅμα] with respect to time, that is to be neither anterior nor posterior, is to be in the same and unique 'now'."[338]

Time is Simultaneously the Same Everywhere

By the means of these notions, we can articulate the meaning of Aristotle's claim that time is "the same everywhere simultaneously", and different before and after because "the nows are different".

Motion may happen anywhere in the universe, and all movements are in time, wherever they happen. Time differs only by the instant, insofar as it is before and after. Movements that are happening simultaneously happen at the same instant, so they happen at the same time. Hence, time is simultaneously the same everywhere insofar as simultaneous movements happen in the same time, wherever they happen in the universe.

A Contradiction?

The previous argument makes sense. However, it raises a difficulty on account of Aristotle's definition of time. Let us consider the following.

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[336] *Phys.* V, 3, 226b21; *Met.* XI. 12, 1068b26.
[337] *Cat.* 13, 14b24-27.
[338] "Τὸ ἅμα εἶναι κατὰ χρόνον καὶ μήτε πρότερον μήτε ὕστερον τὸ ἐν τῷ αὐτῷ εἶναι καὶ ἑνὶ [τῷ] νῦν ἐστιν." *Phys.* IV. 10, 218a25-27.

Motion is the actuality of a moving object, so it is individualized by a moving object, in which it is as in a subject. Therefore, there are as many different movements as there are different moving things. Many moving things may be moving simultaneously in different regions of space, so many movements may happen simultaneously. Since time follows motion, it seems to entail that each of these movements will be followed by a different time, so that different times will coexist, be simultaneous. This is in contradiction with Aristotle's statement "that time is simultaneously the same everywhere", for the latter implies that simultaneous movements happen at the same time.

This simple consideration shows that the statement that time is universally the same everywhere seems inconsistent with the essence of time, as it has been defined by Aristotle. Aristotle himself raises this difficulty, although in an indirect and different form, toward the end of his inquiry into time:

> But we could be perplexed as to what kind of movement time is the number of. Is it not of any kind of movement? For in time things both come into being and pass away, and grow, and are altered, and are moved locally; thus in so far as there is movement, there is a number of each movement. That is why [time] is the number of continuous movement absolutely, not of some movement. But something else could have been moved now; and there would be a number for each of the two movements. There would then be another time, and there would be two times that are simultaneous and equal.[339]

As we have seen, it is because time has been defined as something of movement, the number of movement, and that many movements may be simultaneous, that the problem of time's unity arises. Therefore, Aristotle addresses this problem by posing the question: "what movement is time the number of?" He first offers two reasons to think that it is the number of every movement.

One of them is that time has been defined as the number of movement in general, not as the number of a particular movement – not even as the number of a specific kind of movement: "[Time] is the number of continuous movement absolutely, not of some movement."

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[339] *Phys.* IV. 14, 223a21-b2.

The second reason is the following. Every movement happens in time, whatever kind of movement it is. Now, for a movement, to be in time is to be measured by time, a number, so being in time is being numbered by time. Hence, every movement is numbered by time. This consideration suggests that time is a number that follows movement as movement, and thus that it is the number of any movement: "In so far as there is movement, there is a number of each movement."

But Aristotle shows that this is impossible since it entails an absurd consequence: "But something else could have been moved now; and there would be a number for each of the two movements. There would then be another time, and there would be two times that are simultaneous and equal." We recognize the difficulty sketched before: if we suppose that time is something of each movement, this contradicts the statement that time is simultaneously the same everywhere.

Aristotle's Puzzling Explanation

In the face of this absurdity, Aristotle reaffirms the unity of time. He shows that simultaneous and equal movements are in the same time, using the following analogy:

> If there are dogs and horses, each [numbering] seven, it is the same number. Likewise, the time is also the same of movements that are delimited simultaneously [ἅμα], although one movement may be fast and the other not, and one can be a spatial movement while the other an alteration. Nonetheless the time of the alteration and of the spatial movement is the same, if the number is equal and simultaneous [ἅμα]. And that is why movements are different and separate, but time is everywhere the same, because the number is one and the same everywhere of [movements] that are equal and simultaneous [ἅμα].[340]

Simultaneous movements having an equal time, that is, movements that begin and end at the same instants, are in the same time, wherever they happen, whether they are slow or fast, and whatever kind of motion they are. The reason which is supposed to explain this is that "the number is one and the same everywhere of things that are equal and simultaneous." As the number of seven horses and seven dogs is the same number, 7, so the time which is the number of equal and simultaneous movements is the same time.

[340] *Phys.* IV. 14, 223b4-12.

There is a problem with this explanation. We recall, from chapter 1, that the notion of "same number" is equivocal: numbers may be said the same because they are equal or because they are identical, identity and equality being distinct relations. Concrete numbers are identical if they differ neither by a specific difference of the genus 'number' nor by a specific difference of their subject. For example, two collections of seven horses are the same number '7'. But numbers may also be said the same if they are equal numbers. This is a different sense of 'same number', which does not mean 'identical'. This is the case with the example given by Aristotle: '7 horses' and '7 dogs' are the same number in the sense they are equal numbers. They are said to be the same number insofar as they don't differ by a specific difference of the remote genus 'number'; they are the same species of number: '7'. However, they are not identical numbers: they are not the same '7' for they differ by a specific difference of '7', their subjects being different: horses and dogs.

The number which is the same for equal numbers is an abstract, numbering, number. For instance, the number which is the same for a collection of '7 dogs' and a collection of '7 horses' is the number '7'. This is a numbering number: by the number '7', we may count a quantity of dogs, horses and many other things.

We thus see the difficulty raised by Aristotle's use of this analogy to exhibit the unity of time across different movements. He has written that the time of movements that are simultaneous and equal is the same because their number is the same, as the number of 7 horses and 7 dogs. But the number which is the same in 7 horses and 7 dogs is the abstract number '7', a numbering number. Now, time is a numbered number. As numbered numbers, '7 dogs' and '7 horses' are not identical numbers because they don't have the same subject. Likewise, equal numbers of different movements are not identical because the movements are distinct. Thus, this analogy is troubling because it purports to show that time is one by comparing it to a numbering number.

The difficulty is aggravated by the fact that this passage seems to contradict the use which Aristotle makes of the same analogy elsewhere:

> [Time] is also the same everywhere simultaneously. But before and after it is not the same, because change too is one as it is present, but other as it is passed and to come. Now time is not a number by which we number but a numbered number, and it finds itself before and after, always different. The nows, indeed, are different. The number of 10 horses and of 10 men is one and the same; the things, though, which it is the number of are different: horses <are different> from men.[341]

In this passage, Aristotle explains that time is different before and after by the fact that it is a numbered number. Numbered numbers are not identical unless both their number and their subject are the same: although the number of '10 horses' and '10 men' is the same – the number '10' – '10 horses' and '10 men' are not identical numbers: they are not the same number '10' because their subject is different: horses and men. Likewise, as a numbered number, time is not the same before and after because movement, the subject of which it is the number, is different before and after. For example, '10 minutes' before is not the same time as '10 minutes' after because the parts of movement numbered are different: one part is before the other.[342]

In sum, in the 2 passages, Aristotle uses the same analogy in different ways to reach opposite conclusions: in one passage, he argues that the time of simultaneous and equal movements is the same as the number of equal pluralities is the same, comparing time to a numbering number; in another passage, he argues that time is different before and after as numbers of different subjects are not identical, comparing time to a numbered number.

This whole difficulty has, of course, been noticed by commentators. Some have deemed Aristotle inconsistent both because he uses the same analogy in inconsistent ways, and because he attempts to explain the unity of time by treating it as a numbering number.[343] Others have attempted to resolve this problem by proposing

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[341] *Phys*. IV. 12, 220b5-12.

[342] In *Phys*. IV. 12, 220b12-15, Aristotle explains that periods of time before and after may be specifically identical, like the seasons, but not absolutely identical. For example, one summer is a time specifically identical to another summer, but they are not absolutely the same summer because one is before the other.

[343] Hussey thinks that in these passages, Aristotle is wavering between the view that time is an abstract number and the view that it is a number of change, so there is a "big confusion at the heart of Aristotle's account". Aristotle, *Physics, Books III and IV*, trans. Edward Hussey, Clarendon Aristotle Series (Oxford [Oxfordshire] : New York: Clarendon Press ; Oxford University Press, 1983), xli–xlii; 161.

that time is one in the sense that it is one in kind: the time which is the number of simultaneous and equal movements would be the same in the manner of a universal genus.[344] I will explain further why I think this solution is inappropriate.

Summary of the Problem

To summarize the whole problem, Aristotle's affirmation of the unity of time, laid out in the formula, "time is simultaneously the same everywhere", seems inconsistent with his definition of time. If time is simultaneously the same everywhere, then equal and simultaneous movements are in the same time because they are delimited by the same nows. But if time is the number of movement with respect to the before and after, it seems to imply that on the contrary, simultaneous movements will be followed by different times, even though these times are equal. Therefore, several times will coexist, contradicting the statement that there is one time. Aristotle denies this apparent contradiction. He maintains that equal and simultaneous movements are in the same time as equal numbers of different things have the same number. But this just seems to reproduce, or move the problem. Time is a numbered number, and equal numbers of different things are not the same numbered number. Thus, unless Aristotle contradicts himself by now asserting that time is a numbering number, this analogy, instead of explaining how time is universally one, rather suggests once more that a multiplicity of simultaneous times will follow a multiplicity of simultaneous movements.

The Cause of Time's Unity

Is there a way to resolve the inconsistency described above? How to explain that equal and simultaneous movements are in the same time while maintaining that the definition of time is correct? Is there a way that Aristotle's analogy may suggest a solution to this problem, instead of adding to the contradiction and confusion? In the present section, I will propose a solution to this problem, explaining why, according

[344] Sentesy 2017; Stein 2016; Coope 2005; Loughlin 2011. See the discussion of these interpretations further down for reference to specific sections of these works.

to Aristotle, time is one. I will then discuss alternative interpretations. Finally, I will consider two difficulties posed by my interpretation.

General Form of the Solution

We have seen that all movements are in time, and that this means they are measured by time. Now, the measure of a kind is one, whereas the things measured by it are many. For example, we can measure length by a meter, and many lengths can be measured by the same meter. This suggests that time is universally the same as the one measure of many movements; in other words, it suggests that equal and simultaneous movements are in the same time because they are measured by a unique time.

Moreover, a quantity is measured by a quantity of the same kind: length by a length, volume by a volume, weight by a weight, etc. Therefore, if time is the measure of movement, it must measure movement by the quantity of some movement. This is corroborated by the following passage. Aristotle writes: "[Time] measures movement by determining some movement which will measure the whole (as the cubit measures the length by determining some magnitude which will measure the whole)."[345] Now, time determines movement by being its number, and it measures movement as its number. Together, these elements suggest that time measures all movement by the quantity of one movement which it determines and measures in being its number. To take a comparison, a rule measures many lengths by measuring and determining the quantity of one length.

The Movement Time Follows

We get a confirmation that this is correct in Aristotle's text. Following the passage in which he maintains that time is not the number of any movement, Aristotle argues that movement and time are measured by one movement whose identity he specifies. Here is the first part of this passage:

[345] *Phys*. IV, 12, 221a1-4.

> Since locomotion exists, and particularly the kind of locomotion that is circular, that everything is numbered by a unit of the same genus, units by units, horses by horse, similarly time too is measured by a determined time. Now, time, as we have said, is measured by movement and movement is measured by time (this is because both the quantity of movement and the quantity of time is measured by a movement determined by time).[346]

Let us reformulate and explain what Aristotle says here. Time is a quantity. Now, all quantity is measured, numbered by a quantitative unit of the same kind. Therefore, time is measured by "a determined time", i.e. a certain time-unit. Since time is a quantity of movement, this "determined time" must be a certain quantity of movement determined as a time-unit. As a matter of fact, Aristotle writes that "the quantity of time is measured by a movement determined by time". Hence, the "determined time", the time-unit by which time is measured is the quantity of a certain movement. Now, time is the measure of all movement, and Aristotle writes that the movement which measures the quantity of time also "measures the quantity of movement". We can thus conclude that time measures movement by the quantity of one movement which it determines.

This is congruent with the way Aristotle said time measures movement. We recall that he wrote: "[Time] measures movement by determining some movement which will measure the whole (as the cubit measures the length by determining some magnitude which will measure the whole)."[347] Time first measures the movement which it determines: it determines as a time-unit a part of this movement that measures a larger quantity of it. In doing so, it measures other movements which are equal and simultaneous because equal quantities have the same measure. The way time measures movement is thus comparable to the way a cubit, or a metre (to take a modern example) measures length. The metre determines some part of a length that measures the whole length. By measuring that length, it may measure others lengths whose quantity is equal.

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[346] "Επεὶ δ' ἔστι φορὰ καὶ ταύτης ἡ κύκλῳ, ἀριθμεῖται δ' ἕκαστον ἑνί τινι συγγενεῖ, μονάδες μονάδι, ἵπποι δ' ἵππῳ, οὕτω <δὲ> καὶ ὁ χρόνος χρόνῳ τινὶ ὡρισμένῳ, μετρεῖται δ', ὥσπερ εἴπομεν, ὅ τε χρόνος κινήσει καὶ ἡ κινήσις χρόνῳ (τοῦτο δ' ἐστίν, ὅτι ὑπὸ τῆς ὡρισμένης κινήσεως χρόνῳ μετρεῖται τῆς τε κινήσεως τὸ ποσὸν καὶ τοῦ χρόνου)." *Phys.* IV, 14, 223b12-18.
[347] *Phys*., IV, 12, 221a1-4.

It follows that time is reciprocally measured by the movement which it determines. As a number of parts of that movement, it is measured by the part of that movement which it defines as a time-unit. Let us indeed recall the comparison taken by Aristotle: "We measure the number by what is numerable, for example the number of horses by one horse. Indeed, we know the quantity of horses by the number of them, and the number itself of horses by one horse."[348]

Thus, time measures all movement by measuring one movement which measures it reciprocally. This is why Aristotle writes that "both the quantity of movement and the quantity of time is measured by a movement determined by time". The quantity of movement is measured "by a movement determined by time": time indeed measures movement by the quantity of the movement which it determines. And the quantity of time is measured "by the movement determined by time": as the number of movement, time is indeed measured by a part of the movement which it determines.

The Absolute Measure of Time

Having argued that there is one movement that is the measure of all movement and time, Aristotle specifies what movement it is. We recall that the first part of the passage (quoted above) began in this way: "Since locomotion exists, and particularly the kind of locomotion that is circular…" In the second part of the passage, Aristotle writes:

> If then, what is first [τὸ πρῶτον] is the measure of the things in the same genus, regular circular locomotion is the measure *par excellence* [μέτρον μάλιστα] because the number of it is best known. Neither alteration, nor augmentation, nor generation are regular movements, but locomotion is so. [349]

In this short passage, Aristotle designates what he calls "regular circular motion" as the motion which is measure par excellence on two accounts: regularity and primacy.

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[348] *Phys*. IV. 12, 220b14-22.

[349] "εἰ οὖν τὸ πρῶτον μέτρον πάντων τῶν συγγενῶν, ἡ κυκλοφορία ἡ ὁμαλὴς μέτρον μάλιστα, ὅτι ὁ ἀριθμὸς ὁ ταύτης γνωριμώτατος. ἀλλοίωσις μὲν οὖν οὐδὲ αὔξησις οὐδὲ γένεσις οὐκ εἰσὶν ὁμαλεῖς, φορὰ δ' ἔστιν." *Phys.* IV, 14, 223b18-21.

Regularity

The measure of time and movement must be a regular movement, which means that it must be uniform and have a constant speed.[350] For example, in order to measure time and movement accurately with a clock, the movement of the hand of the clock must move at a constant speed. It is necessary that the motion be regular for a measure must remain identical to itself.

Aristotle thus argues that the measure of time and motion must be a circular movement because such a movement is most regular. He implies this idea as he writes: "Regular circular locomotion is the measure *par excellence* because the number of it is best known." The function of a measure is to make known other quantities[351], so the measure *par excellence* must be a quantity best-known. The quantity of circular movement is best known as it is easily divisible, and thus measurable by a number; this is why Aristotle writes that its number is best-known. Now, as the rest of the passage suggests, it is mostly on account of its regularity that the number of circular motion is best-known, and thus a perfect measure: "Neither alteration, nor augmentation nor generation are regular movements, but locomotion is so."

Circular motion is a type of locomotion, the only species of change that may be regular. Growth concerns plants and animals, and it is quite obvious that the growth of a plant, and even more so the growth of an animal varies in speed according to the stages of its development. Alteration too can be irregular with respect to speed. In *Physics* I, Aristotle writes that there are some movements of alteration that happen all at once[352], and in *Physics* VIII, he mentions "freezing" as an example of that.[353] Now, if alteration is not regular, neither can generation and corruption be so for they involve alteration.

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[350] On the regularity of motion, see *Phys.* V. 4, 228b15ff.
[351] Cf. *Met*. X. 1, 1052b20.
[352] *Phys.* I. 3, 186a15-16.
[353] "In the case of any alteration whatever, if that which suffers alteration is infinitely divisible it does not follow from this that the same is true of the alteration itself, which often alters all at once, as in freezing." *Phys*. VIII. 3, 253b23-25. Trans. Hardie and Gaye.

In *Physics* VIII, Aristotle argues that it not even any kind of locomotion which is regular. Rectilinear motion is not regular for an object moves faster as it gets closer to the term of its motion, the final cause of the motion:

> In rectilinear locomotion the motion of things in leaving the beginning is not uniform with their motion in approaching the end, since the velocity of a thing always proportionally increases as it removes itself farther from its position of rest.[354]

Now, if rectilinear motion is not regular, neither can a mixed motion be so, for it is composed of a rectilinear motion.

Circular movement though, Aristotle thinks, is perfectly regular. In *Physics* VIII.9, he argues that in virtue of its simplicity and uniformity, there is no determinate principle and term of a circular movement in actuality. If there is a principle and term of a circular movement, it is located outside of it, at the very center of its trajectory.[355] Now, since every point on a circular path is equally distant from the center, the object which undergoes a circular movement is always at the same distance of the principle and term of the movement, and must therefore maintain the same speed.[356] Therefore, circular motion is perfectly regular. As such, it is a perfect fitting measure of time and other motions.

Primacy

Furthermore, Aristotle has written that "what is first [τὸ πρῶτον] is the measure of the things in the same genus". In chapter 1, we have seen that in *Physics* VIII, Aristotle argues that locomotion is prior to other kinds of change, and circular motion is prior to other types of locomotion. Circular movement is prior because in virtue of being eternal, most simple and uniform[357], it is more perfect.[358] Thus, in virtue of the principle that "what is first is the measure of the things in the same genus", the fact

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[354] *Phys.* VIII. 9, 265b12-15. Trans. Hardie and Gaye. The reason why the speed of the motion increases seems to be that the term of the movement is the natural place of the body, which is the final cause of its natural movement toward this space. For example, the natural place of a heavy body is the earth, so the speed of a heavy body that moves towards the earth increases as it gets closer to this natural end.
[355] *Phys.* VIII. 9, 265b3-5.
[356] *Ibid*. 265b15-17.
[357] *Ibid.* 265a12-24.
[358] *Ibid.* 265a12-24.

that circular motion is prior to other motions provides another reason to infer that the measure of time and motion is a circular movement. Aristotle reiterates this idea in *Physics* VIII. 9:

> There is also the following convertible result: on the one hand, because rotation is the measure of motion it must be the primary motion (for all things are measured by what is primary); on the other hand, because rotation is the primary motion it is the measure of all other motions.[359]

According to Aristotle's cosmology, there are many circular movements and there is an order among them. Accordingly, the measure of time and movement must be the first circular movement. This movement is the first movement in nature, the motion immediately caused by the prime mover.[360] In Chapter 1, we have seen that according to Aristotle's cosmology, this is the movement of the sphere of the fixed stars. Therefore, this is such a movement which Aristotle reckons as the measure of time and motion. As a matter of fact, in the *De Caelo*, he argues that this particular movement is perfectly regular.[361] Moreover, Aristotle likely refers to this particular movement as he writes that the number of the regular circular movement is best-known, as Simplicius explains:

> It is possible to say that the number of cyclic motion is well-known…with regard to how this cyclic motion is numbered, as that the universe has revolved twice or three times…The time [number] which determines this motion is best-known and primary; for we measure a month by days, and a year by months and the whole of time by years. It will be shown in the last book of this work [the *Physics*] that cyclic motion is the only uniform motion.[362]

In sum, Aristotle designates circular motion as the measure of time and motion on account of its regularity and because he thinks the first movement in nature is a circular motion. Aristotle thinks that this movement is "measure *par excellence* [μέτρον μάλιστα]". By this, he implies that it is not for reasons of convention and convenience that this movement is measure. The first circular motion is not a relative,

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[359] *Phys*. VIII. 9, 265b8-12. Note that although the proposition is convertible, the passage suggests that being prior is the cause of being measure.
[360] Cf. Chapter 1.
[361] Cf. *DC.* II. 6, 288a14-b10. One of the reasons he gives is the following. The irregularity of a movement can be caused by the motor, the body that is moved or both. The movement of the first celestial sphere cannot be irregular because it is made of an element that is incorruptible, and because it is moved by a motor that is immobile and must consequently move always in the same way.
[362] Simplicius, *On Physics* IV. 14. Diels. 768, 35-769, 6. Trans. Urmson.

but an absolute measure of time and motion in virtue of objective qualities: primacy and regularity.

Further Characteristics

There are further characteristics, not mentioned in the passage of *Physics* IV above, which make the first circular locomotion a perfect fitting measure of time and movement. Aristotle alludes to these characteristics elsewhere.

Periodicity

Circular motion is periodic, which is part of its simplicity. Therefore, we can easily measure movement and time by the number of its revolutions (being assumed that it is regular and uniform). The passage previously quoted from the commentary of Simplicius alludes to this characteristic of circular motion as an extra reason, besides regularity, why its number is said to be best-known by Aristotle:

> It is possible to say that the number of cyclic motion is well-known…with regard to how this cyclic motion is numbered, as that the universe has revolved twice or three times… We measure a month by days, and a year by months and the whole of time by years.[363]

Eternity

In chapter 1, we have seen that circular movement is the only type of movement that may be, according to Aristotle, infinitely continuous, that is eternal. Now, movement in nature, and time, are both eternal, as Aristotle maintains in *Physics* VIII.1.[364] Hence, the eternity of circular locomotion is another characteristic that makes it an ideal measure of movement and time. In this sense, Aristotle writes in his treatise *On Generation and Corruption* that the movement of which time is the number – and thus the movement which measures both movement and time – must be a circular movement, since only such a movement can be always continuous:

> Since time is continuous, movement must be continuous, inasmuch as there can be no time without movement. Time, therefore, is the number of some continuous movement – a number, therefore, of circular movement.[365]

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[363] Simplicius, *On Physics* IV. 14. Diels. 768, 35-769, 6.
[364] Aristotle writes: "If time is the number of movement or a certain movement, since time always exist, it is necessary that movement too be eternal." *Phys*. VIII. 1, 251b12-14. Trans. Hardie and Gaye.
[365] *Gen. and Corr*. II. 10, 337a22-24. My translation.

Quickness

In chapter 1, we have seen that the measure of each genus is something that is one, indivisible.[366] In the case of continuous quantities, the measure is indivisible "by perception", that is, as small as possible so as to allow for precise measurement.[367] Accordingly, the measure of time must be the smallest possible quantity of time in order to be precise. Now, time is measured by movement, and the movement that takes the least time to move over a certain magnitude is the quickest movement. Therefore, the movement that measures time (and movement by time) must be the quickest movement. As a matter of fact, Aristotle says just this in *Metaphysics* X. 1: "We know movement too by the simple movement and the quickest; for this occupies least time."[368]

The first circular movement, the movement of the outermost sphere, is, according to Aristotle's cosmology, the fastest movement in nature. This can be deduced from geometrical considerations.[369] The celestial spheres of the universe are concentric in Aristotle's system, and take the same time to complete their rotation. Taken as a whole, they thus form a system which is equivalent to a sphere in rotation. Now, in a sphere in rotation, the points which are located on the circumference of the sphere move with the greatest speed. Thus, the first celestial sphere must have the greatest speed because it is the furthest removed from the center of the cosmos; the movement of this sphere, which has been designated as the first movement, is therefore the quickest. On this account too then, the first circular movement is measure par excellence.

Confirmation by the Opinions

Having argued that the rotation of the sphere of the fixed stars is the measure of movement and time, Aristotle provides a sign that this conclusion is correct: it accounts for two common opinions:

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[366] *Met*. X. 1, 1052b20-35.
[367] *Ibid*. 1053a20-25.
[368] *Ibid.* 1053a8-9. And in *De Caelo* he writes: "The quickest movement is the minimum movement". *DC*. II. 4, 287a287a25-26
[369] Cf. *DC.* II. 8, 289b34-290a5.

> That is why time seems to be the movement of the <celestial> sphere, because the other movements are measured by this movement and time is measured by it. This also explains the common saying that human affairs form a circle, and that there is a circle in all other things that have a natural movement and coming into being and passing away. This is because all these things are judged by time, and find their beginning and end as though they were subjected to a sort of periodicity. It indeed seems that time itself is a certain circle. This again seems so because it is the measure of a transport of this kind, and it is itself measured by this kind of transport. So that to say that there is a circle of the things that are generated is to say that there is a certain circle of time, and that because it is measured by a circular locomotion. Indeed, the thing measured seems to be nothing more than the measure, with the difference that the whole is several times the measure. [370]

That time is "the movement of the celestial sphere" is one of the opinions that had been examined in the dialectical inquiry. There, Aristotle had referred to the movement of the celestial sphere as the "movement of the whole" (τοῦ ὅλου κίνησιν)[371], an expression that designates the movement of the first heavenly sphere.[372] The opinion in question is therefore that time is the movement of the first heavenly sphere. This opinion appears to be true because time measures movement by the movement of the first heavenly sphere. This movement thus appears to be what time is. The movement of the first heavenly sphere even measures time. Now, as Aristotle writes at the end of the passage, "the thing measured seems to be nothing more than the measure".

The explanation for the other opinion is similar. Human affairs, and the generation and corruption of natural beings, are phenomena that appear to be a circle because they happen in time and are thereby measured by time, and time seems to be a circle. Now, time appears to be a circle because it measures and is measured by a circular, cyclical movement.

These opinions thus manifest that the first heavenly movement is the measure of time, which measures all movement by this movement.

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[370] *Phys.* IV. 14, 223b21-224a2.
[371] *Phys.* IV. 10, 218a33-b1.
[372] See the 3 senses of the word 'heaven' given by Aristotle in *De Caelo* II. 9, 278b10-24.

Time is the Number of the First Heavenly Movement

This being said, time is not, as these opinions have it, the circular movement of the first celestial sphere – even less the circular path of this movement. It is rather the quantity of this movement, its number with respect to the before and after. This conclusion is implicit in Aristotle's assertion that "the quantity of movement and the quantity of time is measured by a movement determined by time."[373] Time determines movement as its number. Thus, the movement determined by time is the movement of which time is the number. Time measures all movement by determining, numbering, measuring the quantity of this movement. Philoponus writes:

> Time is not the number of every movement (for it is not the number of alteration or growth); instead, it is the number of <movement> with respect to place, and not of all <such> but of regular <movement with respect to place>. For time measures all movement, but primarily <it measures> the regular kind, and through that it measures the others too. For day and hour and month and year are measured by the period of the sphere of the fixed stars, and thereby time measures all movement. Hence it is of that sort of movement that time is number.[374]

Since Aristotle does not explicitly draw this conclusion, it has left room for commentators to deny Aristotle means time is the number of a first, unique, circular movement.[375]

As a general reply to these views, I would say that the context of the argument strongly indicates that it is Aristotle's intention to show that time is the number of a first movement. This argument follows the passage in which Aristotle has raised the problem: what movement is time the number of? In that passage, after providing reasons suggesting that time is the number of any movement, he showed that this is impossible for there is a unique time everywhere. This passage thus concluded implicitly that time is the number of one movement. By seeking, just after, the identity of the movement that is the measure of time and of all movement, it is reasonable to think that Aristotle's intention was to indicate what movement time

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[373] "Επεὶ δ' ἔστι φορὰ καὶ ταύτης ἡ κύκλῳ, ἀριθμεῖται δ' ἕκαστον ἑνί τινι συγγενεῖ, μονάδες μονάδι, ἵπποι δ' ἵππῳ, οὕτω <δὲ> καὶ ὁ χρόνος χρόνῳ τινὶ ὡρισμένῳ, μετρεῖται δ', ὥσπερ εἴπομεν, ὅ τε χρόνος κινήσει καὶ ἡ κινήσις χρόνῳ (τοῦτο δ' ἐστίν, ὅτι ὑπὸ τῆς ὡρισμένης κινήσεως χρόνῳ μετρεῖται τῆς τε κινήσεως τὸ ποσὸν καὶ τοῦ χρόνου)." *Phys.* IV. 14, 223b12-18.
[374] Philoponus, *On Physics* IV. 14, Diels. 718, 14-20. Trans. Broadie.
[375] (Coope 2005, 105); (Roark 2011, 188-190); (Stein 2016, 510); (Sentesy 2017, 39).

follows. In other words, the context strongly indicates that the designation of this movement is the response to the question posed before: what movement is time the number of?

Besides, if Aristotle does not write explicitly, in the passage under consideration, that time is the number of the first heavenly sphere, he is more explicit elsewhere. In a passage from *On Generation and Corruption* II.10 (partly quoted before), he writes*:*

> If there is to be movement, (as we have explained elsewhere, in an earlier work) there must be something which initiates it; if there is to be movement always, there must always be something which initiates it; if the movement is to be continuous, what initiates it must be single, unmoved, and generated, and incapable of alteration; and if the circular movements are more than one, they must all of them, in spite of their plurality, be in some way subordinated to a single principle. Further, since time is continuous, movement must be continuous, inasmuch as there can be no time without movement. *Time, therefore, is the number of some continuous movement – a number, therefore, of circular movement… This is, therefore, what produces continuous movement, viz. the body moved in a circle; and the movement [of this body is what produces] time***.**[376]

In this passage, it is explicitly said that time is the number of one movement, which is a circular movement. Time is "produced" by such a movement, which means that it follows such a movement. The continuity and eternity of time is explained by the fact that it follows such a movement, which is continuous and eternal.

Furthermore, read as a whole, the passage, which assumes the background of *Physics* VIII, suggests that this continuous, circular movement which time follows is the one caused by the prime mover. Indeed, Aristotle reasons that the movement which time follows is continuous and eternal because it is immediately caused by the prime mover.[377] Now, the movement caused by the prime mover is the first movement in nature, which, according to Aristotle's cosmology, is the motion of the first heavenly sphere. Thus, this text is evidence in favor of the interpretation which I have proposed.

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[376] *Gen. and Corr.* II. 10, 337a17-33. Trans. H. Joachim (slightly modified).

[377] In the same sense, we read in *Phys*., VIII, 7, 260a22-26: "It is plain that if there must always be motion, and a particular motion is primary and continuous, then it is this motion that is imparted by the first mover, and so it is necessarily one and the same and continuous and primary." Trans. Hardie and Gaye.

Ursula Coope contends this interpretation "is a consequence of confusing the claim that time is a number with the claim that it is a measure."[378] The reason why Coope has this opinion is because she thinks that 'number' has an extended, analogical sense in Aristotle's definition of time; she thinks, as I have explained in Chapter 2, that defining time as the number of movement with respect to the before and after does not mean that it is a quantity of motion, but an order of motion. She is right to maintain that if time is not a number that has the property of measuring motion, Aristotle's view that time is measured by a circular movement does not imply it is the number of this particular movement. But this is precisely where I disagree with her in the first place: I have argued in chapter 2 that time is essentially a number that measures the quantity of motion with respect to succession. In writing that the interpretation I propose is the result of confusing time as number and time as measure, she implicitly acknowledges that supposing that her interpretation of Aristotle's definition of time as number was mistaken, the interpretation would make sense.

Mark Sentesy also rejects the proposal that time is unique because it follows a particular motion. He thinks that in the passage which grounds this interpretation – the passage in which Aristotle maintains that time measures motion by the first heavenly movement – Aristotle's language is "tentative"; his intention in that passage would be to attempt to "explain why people think of time as a cycle"[379].

Contrary to what Sentesy thinks, Aristotle does not argue that time is measured by the first heavenly motion in order to explain why people think of time as a cycle. Rather, it is the opposite: he invokes this opinion as a sign of the correctness of what he has argued before; his point is that since this opinion is explained by the fact that time is measured by the heavenly motion, it shows that the latter is true. Now, as I have argued, it is in order to designate the movement which time follows that Aristotle has sought by which movement it is measured.

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[378] Coope, *Time for Aristotle*, 105.
[379] Sentesy, 'The Now and the Relation Between Motion and Time in Aristotle', 38–39.

Why time is Universally One

If my interpretation is correct, then, Aristotle, by designating the movement which time follows, has pointed out the cause of the unity of time. Indeed, time is a numbered number, and a numbered number is individualized by its subject. Therefore, if there is one time, it is because it is the number of one movement. Thus, by arguing that time measures all motion by the number of the first heavenly motion, Aristotle has implicitly shown that there is one time because it is the number of that unique motion. Aquinas writes:

> It is manifest that time primarily measures and numbers the prime circular movement, and by it measures all other movements. Therefore, there is only one time because of the unity of the prime movement.[380]

Moreover, Aristotle's point that time measures movement by the movement which it determines explains how time is universally the same. Equal and simultaneous movements are in the same time because their quantity is measured by the same number, the number of the first celestial motion. Simplicius explains this:

> Time is not the number of every change, as of both my walking and your becoming white. If it were, it would not be undifferentiated and simultaneous as distinguished at a single now. But time is the numbered in the first and simple motion of the heavens, and numbers the befores and afters in different changes according to one now of its own, that is according to the before and after of that motion. That is why there is the same time everywhere.[381]

The solution to our problem can be summarized using the distinction between the notions of 'intrinsic measure' and 'extrinsic measure', introduced in Chapter 1.[382] Let us recall that as their names suggest, an intrinsic measure is in the subject that it measures, whereas an extrinsic measure is exterior to it. The same quantity can be both an intrinsic measure and an extrinsic measure with respect to different subjects. For example, the magnitude of a body measures that body intrinsically and can measure other bodies extrinsically. So it is for time. As the number of a first movement, time measures intrinsically that movement. By the quantity of that movement, it measures other movements extrinsically.

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[380] Aquinas, *On Physics* IV, lect. XXIII, no. 12. My trans.
[381] Simplicius, *On Physics* IV. 14, Diels. 721, 7-12. Trans. Urmson.
[382] See the section 'Measure', P.61.

Intrinsic measure is multiplied by the number of subjects measured. For example, it is a different magnitude that measures intrinsically different bodies; each body is measured intrinsically by its own magnitude. But extrinsic measure is not multiplied by the number of subjects measured. For example, the same magnitude can be an extrinsic measure of many bodies. An extrinsic measure can have many subjects because it is simply related to its subject.[383] Now, the same thing can have many relations and be related to many different things. For example, the same person can be the teacher of different people, the father or mother of different children, etc.

As an intrinsic measure, time has one subject, the first movement, so there is one time. As an extrinsic measure, it has a multiplicity of movements as subjects. Yet, it is not multiplied by these movements because it only relates to them as their measure, remaining in the movement of which it is the number. This is why there is one time. Albert summarizes this solution, explaining that time relates differently to movement as intrinsic and extrinsic measure:

> The same one thing relates in different ways to many things. Time relates to the prime mobile [being] and the movement of it as to both a subject and something numbered. It relates to other movements as an extrinsic number to something numbered only, and it is not in them as in a subject; for this reason it is not multiplied by the multiplicity of them [these movements].[384]

This explains why time is universally the same. Being in time is being measured by time. Simultaneous movements are measured extrinsically by the same time, so they are in the same time.

Aristotle's Analogies Explained

We recall that in order to explain the unity of time, Aristotle had put forward the following analogy:

> If there are dogs and horses, each [numbering] seven, it is the same number. Likewise, the time is also the same of movements that are delimited

[383] Aristotle writes: "Things are relative (1) as double to half and treble to a third… (2) as that which can heat to that which can be heated… and in general the active to the passive; (3) as the measurable to the measure, and the knowable to knowledge and the perceptible to perception… That which is measurable or knowable or thinkable is called relative because something else is related to it. For the thinkable implies that there is thought of it… Similarly sight is the sight of something." *Met.* V.15, 1020b26-1021b. Trans. Ross.

[384] Albert, *On Physics* IV, Tract. 3, Ch. 17, 5-15. My Trans.

> simultaneously [ἅμα]... And that is why movements are different and separate, but time is everywhere the same, because the number is one and the same everywhere of [movements] that are equal and simultaneous [ἅμα].[385]

We are now in a position to understand how this analogy, which appeared problematic before, is relevant to illustrate the unity of time. Time relates to different movements in nature as a number that measures them extrinsically. In this regard, its relation to different movements is comparable to the relation of a numbering number to different collections of things. The same numbering number measures equal collections of things because their quantity is countable by that number, although the things counted are different. For example, collections of 7 dogs and 7 horses are countable by the same number: '7'. Likewise, simultaneous and equal movements are countable by the same time, although the movements differ individually and may also differ in kind, in speed, etc. Thus, Aristotle can manifest that the time of simultaneous and equal movements is the same by analogy with the way that the number of equal collection of different things is the same. Philoponus comments:

> Just as the number in the soul, which is one and the same, e.g. ten, measures the external ten such as the 10 of horses and of human beings and of stones, etc, and just as the pint which is one and the same measures wine and water and all liquids… so too, time, which is one and the same, functions as measure of several movements that are equal and occur together.[386]

I mentioned before that some scholars have been troubled by this analogy because Aristotle seems to treat time as a numbering number. But in fact, Aristotle does not identify time with a numbering number; he only compares it to a numbering number insofar as, like a numbering number measures different pluralities, it measures different movements. It is as the number of a first movement that time measures movement. Therefore, time measures movement as a numbered number.

Moreover, this analogy is not inconsistent with its use in the other passage we have encountered. Let us read once again:

> [Time] is also the same everywhere simultaneously. But before and after it is not the same, because change too is one as it is present, but other as it is passed and to come. Now time is not a number by which we number but a numbered number, and it finds itself before and after, always different. The nows, indeed,

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[385] *Phys.* IV. 14, 223b4-12.
[386] Philoponus, *On Physics* IV.14, Diels. 776, 22-28. Trans. Broadie.

> are different. The number of 10 horses and of 10 men is one and the same; the things, though, which it is the number of are different: horses <are different> from men.[387]

The point of this passage is to show that time is different before and after. Time is the number of movement. It is thus a numbered number, and a numbered number differs according to its subject. Now, movement, the subject of time, differs with respect to the before and after. Therefore, time too differs with respect to the before and after.

Time is here considered in its relation to the movement which it follows. It is the numbered number of that movement, so its relation to this movement is the relation of a numbered number to its subject. This explains why, in order to show that time is different before and after because of its subject, Aristotle invokes the example of numbered numbers which differ on account of their subject: '10 dogs' and '10 men' are not the same '10', even though they are equal numbers, because their subject is different. Likewise, we could say that '10 minutes' before and '10 minutes' after are not the same time, even though these are equal times, because they are not the number of the same part of movement.

Thus, the use of the analogy with numbers is not inconsistent in the two passages because time is not considered in its relation to the same movements. In one passage, it is considered in its relation to movements exterior to it, which it measures as a numbering number measures equal collections of things. In the other passage, it is considered in its relation to the movement which it follows, according to which it differs as a numbered number differs according to its subject.

Instead of conflicting, these passages work together to account for the unity of time. In the passage where Aristotle explains that equal and simultaneous movements are in the same time, he also writes that "time is the same of movements that are delimited simultaneously."[388] Let us first observe that these properties of movements – equality and simultaneity – don't imply each other: movements are simultaneous if they coexist at a certain instant of time, which does not imply that they be equal;

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[387] *Phys*. IV. 12, 220b5-12.
[388] *Phys.* IV. 14, 223b6-8.

conversely, movements measured by an equal time are not necessarily simultaneous. Movements are both equal and simultaneous if they are delimited simultaneously, that is if they begin at the same instant of time and end at the same instant. If movements are delimited simultaneously, they are neither before nor after in time. They are therefore in the same time because time only differs with respect to the before and after.

Other Interpretations

In this section, I discuss a few other proposals advanced by commentators to resolve the problem of time's unity.

Tim Loughlin

Tim Loughlin affirms that there is an inconsistency between the claims that time is the number of motion and that time is simultaneously the same everywhere; both cannot be true. He proposes to resolve this inconsistency in arguing that Aristotle is committed seriously to one and loosely, in a weak sense, to the other.[389] Aristotle is truly committed to his definition of time, and he would acknowledge that this implies as a consequence that there is a multiplicity of simultaneous times. Yet, he would also attempt to accommodate and make sense of the popular belief that there is a unique time in the universe. According to Loughlin, this is what the analogy with the sameness of numbers is meant to accomplish.[390] On the one hand, it is true that as equal numbers of different things are different numbers, so the times of equal and simultaneous motions are different times. On the other hand, as equal numbers of different things are the same number in kind, so the numbers of equal and simultaneous motions are the same in kind. Therefore, Aristotle could propose that the belief that time is simultaneously the same everywhere is true in the sense that simultaneous and equal times are the same time in kind:

> It is highly intuitive that time is the same everywhere. So, Aristotle must provide an account of how this is so. To accomplish this, he suggests that, although it is

[389] Tim Loughlin, 'Souls and the Location of Time in Physics IV 14, 223a16-223a29', *Apeiron: A Journal for Ancient Philosophy and Science* 44, no. 4 (2011): 315.
[390] Loughlin, 315.

> not the case that there is only one time everywhere, still we can speak truly when we say that two changes are occurring at the same time because we merely assert that the numbers of the two changes are of the same kind, i.e. the same measure (224a2-15). This establishes that Aristotle is comfortable with reinterpreting common speech about time so that it conforms to his theory.[391]

The problem with this interpretation is that Loughlin assumes that Aristotle is speaking loosely when he writes that time is simultaneously the same everywhere[392], while there is no indication that it is so. According to Loughlin's interpretation, time would be one as a genus, that is as a universal: this is what it implies to say that the time of equal and simultaneous movements is the same in kind as the number of equal collections of different things. But the idea that time is one simply as a genus is contradicted, for instance, by Aristotle's writing at 223b7-10 that motions which are in the same time are delimited simultaneously. This means that motions in the same time are delimited by the instants of a unique time, numerically one. Furthermore, if time was the same as a genus, it would be an abstract number. Indeed, as I have explained before, the number which is the same in kind of equal collections of different things is an abstract number. Therefore, on Loughlin's interpretation, Aristotle would accommodate the belief that time is one at the cost of contradicting his repeated assertion that time is an numbered number. This is very unlikely.

Mark Sentesy and Nathanael Stein

As mentioned before, Mark Sentesy rejects the proposal that time is unique because it is the number of a particular motion. He explains the universal unity of time by the fact that it is a number, and a number has an abstract character. In support of his interpretation, he invokes Aristotle's analogy that equal numbers of different collections are the same number. He comments on this analogy in the following way:

> Though 10 dogs and 10 horses are different groups of 10, the tens do not differ insofar as they are numbers. Since numbers do not, as numbers, differ from one another, the relevant difference that would tie them to particular motions vanishes. So, insofar as time is a number, all individual time units are in principle the same and commensurate.[393]

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[391] Loughlin, 313.
[392] "Aristotle is speaking loosely at 220b5." Loughlin, 315.
[393] Sentesy, 'The Now and the Relation Between Motion and Time in Aristotle', 39.

Sentesy explains that it is by the now that different movements are related universally. Different movements are in the same time if the nows that mark them off respectively coincide.[394] Even though the nows are limits belonging to different movements, the temporal unit of measure they generate does not differ because it is abstracted from the individual motions. As he says, the commensurability of different motions does not imply that time follows a particular motion: "This commensurability does not imply that all times are reducible to a single continuous dimension of time. There is no necessity for there to be a single measure."[395]

Sentesy refers to Nathanael Stein, who defends a similar view. Stein writes:

> All times are parts of some greater time without… [implying] that the greater time is independent of the things and events in time, or … that these times must ultimately compose a single whole … there is no collection of parts that compose to form the whole of time in the way parts compose wholes as standardly conceived.[396]

This view presupposes that time is an abstract number. Indeed, as explained before, the number that is the same for equal collections of different things is a numbering number, an abstract number. As a matter of fact, this is Mark Sentesy's view that time is an abstract number. As explained in Chapter 2, he maintains that time is a unit abstracted from motion as a result of marking off an interval of motion and taking the interval defined as indivisible. He explicitly affirms that it is in virtue of having, as number, an abstract character that time is universally one:

> Times that are equal and together or coincidence are the same, the way the number seven is the same whether it is of a number of dogs or horses. Here, *the abstract character of the number appears to do the work of anchoring the universal*.[397]

The problem with this interpretation is that the assumption upon which it rests – that time is an abstract number – is mistaken. Aristotle makes it clear that time is a number in the sense of that which is counted, not that by which we count. As I have mentioned in chapter 2, Sentesy interprets this distinction as one between time and

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[394] Sentesy, 39.
[395] Sentesy, 39.
[396] Nathanael Stein, 'Aristotle on Parts of Time and Being in Time', *Review of Metaphysics* 69:3, no. 275 (2016): 510.
[397] Sentesy, 39.

the now: Aristotle would say that time is a number that is counted because it is counted by the now.[398] On the contrary, I have argued in chapter 2 that a numbered number designates a number having a subject (discrete or continuous), whereas a numbering number is an abstract number used to measure a numbered number. Since time is a numbered number, it is not an abstract number. If time was an abstract number, why would Aristotle write, in 223a30-b3, that if we suppose that time is the number of each movement, there will be many simultaneous times? This argument presupposes that time is a number having movement as a subject. And why would Aristotle argue, in 220a8-13, that time is different before and after because the subject of which it is the number, movement, is different before and after?

Since time is a numbered number, the problem of the unity of time cannot be solved by invoking the abstract character of number, as Sentesy does. Although the numbers of equal and simultaneous motions are equal numbers, they are not identical numbers for their subject differs.

Ursula Coope

Like Mark Sentesy, Ursula Coope explicitly rejects, as mentioned before, the interpretation that time is the number of a first movement. She does not think that Aristotle's recourse to the analogy with equal numbers to manifest how time is one is problematic: she thinks Aristotle's analogy with equal numbers is meant to undermine a possible objection to his view that time is the number of movement in general: because there are different kinds of movement, one could conclude that there is a different kind of time for different kinds of movement. Aristotle would reply to this objection, answering that as the number of equal collections of things is the same number, even though the things are of different kinds, so the number of equal and simultaneous movements is not a different kind of time, even though the movements are of different kind.[399]

[398] Sentesy, 9.
[399] Coope, *Time for Aristotle*, 116–22.

I think Coope misses the point here. As I have explained before, the analogy poses a difficulty because time is a numbered number, and equal numbers of different things are not the same numbered number. Therefore, if we assume that time is the numbered number of all movement, the analogy on the contrary suggests the conclusion that there will a different time for different kinds of movement, even for individual movements of the same kind.

Coope's explanation for the unity of time is that in counting a series of nows in one change, we also count changes that happen simultaneously; we thus introduce a single, universal order of before and after in all simultaneous changes in the universe, which is what time is. Equal and simultaneous movements are in the same time because they are counted by the same number of nows in the same act of counting. She thinks this is the positive meaning of Aristotle's analogy with numbers, besides showing that there is not a different kind of time for different kinds of movements:

> Just as we could use the same seven pebbles to count both the horses and the men on them, so also we can use the same now to count any changes that are simultaneous. If this is right, then Aristotle is saying that there is one time of changes that are equal and together just because they can (like a group of men paired with a group of horses) be counted in one and the same act of counting. The group of nows serves as a kind of number with which we count. We can count changes that are equal and together using one and the same group of nows. Because of this, all such changes are at one and the same time.[400]

In this explanation, Coope seems to make time a numbering number to account for its unity. Indeed, in the preceding passage, she writes that the group of nows that "serves as a kind of number" is "a number with which we count", and this is precisely the definition of a numbering number. But she denies that time is a numbering number. She also denies that time is the number of one movement. Therefore, time must be one, in her view, because it is "a number of nows' that is not in any particular movement, a universal, abstract entity by which the mind count and order movements. This conception is not consistent with Aristotle's view that time is a numbered number that follows movement.

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[400] Coope, 123-124.

Tony Roark

Like Coope and Sentesy, Tony Roark does not think that Aristotle conceives of time as the number of one movement, but as the number of movement in general. He thinks that Aristotle only considers the first heavenly movement as a standard measure of time and movement on account of its regularity and periodicity, among other reasons.

Roark's explanation of the unity of time is based upon his analysis of the concept of simultaneity. In accordance with his general interpretation that motion is the matter of time and "perception" is its form, he claims that simultaneity must be defined in terms of perception, more exactly in terms of joint perceptibility. To argue his point, he relies upon a passage from *De Anima* in which Aristotle describes how the common sense faculty discriminates between perceptible qualities. Roark writes:

> It is within the power of the common-sense faculty to unify and discriminate various perceptual phantasms… When perceptions are appropriately together, the agent has an awareness of a unitary present that includes diverse movements… These considerations about the unifying power of the common-sense faculty forms the basis for a fundamental notion of the simultaneity relation… Put in the simplest terms possible, the hylomorphic interpretation [Roark's interpretation] analyzes simultaneity in terms of joint-perceptibility.[401]

According to Roark, "kinetic cuts" (momenta) of different motions are simultaneous, in the same 'now' if they are perceptible together by the common-sense faculty of the soul. Consequently, he explains that simultaneous and equal movements are in the same time if the kinetic cuts that delimit them are perceptible together.

Roark does not explain what simultaneity is and why there is simultaneity. He only describes simultaneity by describing one of its consequences: the fact that simultaneous kinetic cuts are perceptible together. Kinetic cuts are not simultaneous because they are perceptible together; on the contrary, they are perceptible together because they are simultaneous. On my interpretation, it is the fact that there is a first movement, by which other movements are caused, that explains simultaneity. The

[401] Roark, *Aristotle on Time*, 183.

kinetic cuts of different movements are simultaneous because they coexist with an instant of time, which follows a kinetic cut of the first movement.

According to Roark, what fundamentally explains the unity of time is the unifying power of the common-sense faculty. As we could read in the last quote, he writes that "the unifying power of the common-sense faculty forms the basis for a fundamental notion of the simultaneity relation." Simultaneous kinetic cuts are in the same now because their perception can be unified, "joined" by the single act of a single faculty. This is also obvious from the way he defines the now. After defining what he calls "a kinetic world slice" as a series of kinetic cuts that are perceptible together, he defines the now as "an individual kinetic world slice *qua* perceptible."[402] For him, the unity of the now is just the product of the joint perception of different kinetic cuts.

This interpretation is not congruent with the text of Aristotle. Aristotle does not define simultaneity in terms of perception. He does not say that events are simultaneous because they are perceptible together, but because they are in the same now. Likewise, he says that the time of different movements is the same because they are measured by a unique time. Moreover, he is clear about the fact that time is something of movement. Therefore, the one time by which simultaneous movements are measured is something that is in movement, not in the mind of perceivers. Since time follows movement, the only possible cause for the unity of time is the unity of the movement it follows.

Two difficulties

According to the interpretation I propose, time is one because it is the number of one movement. This thesis raises two important questions, that can also be seen as difficulties or objections.

[402] Roark, 184.

Time is perceived by Any Movement

Aristotle has observed that we perceive time through movement. Therefore, if time is something of one movement, the first movement in nature, the perception of time should occur through the perception of that movement. But we perceive time by any movement.

This objection is raised by Aquinas in his commentary. Here is how he responds to it:

> Everything whose essence has mobility has it from the first movement, the one caused by the prime mover. Thus, whoever perceives whatever movement, whether it is in sensible things or in the soul, perceives a mobile essence and consequently perceives the first movement which time follows. This is why whoever perceives any movement perceives time, although time does not follow any but one first movement, by which all others are being caused and measured. It is thus that only one time remains.[403]

The first movement in nature is the movement which time follows, so the perception of time follows the perception of that movement. Now, as explained in chapter 1, Aristotle maintains in *Physics* VII and VIII that every movement in nature is caused by the prime mover through the first movement (which it causes immediately). Thus, every movement can be considered an effect of the first movement, insofar as the latter is a mediate cause of movement. Moreover, an effect participates in its cause in the sense that what is in the effect is in the cause and is in the effect because it is prior in the cause. Therefore, by perceiving any movement, we implicitly perceive the first movement in which this movement participates. We also perceive time because the perception of time follows the perception of the first movement.

Since the perception of the first movement is only implicit in the perception of other movements, we need not be aware of perceiving the first movement in order to perceive time. Albert explains this, saying that we don't need to relate the effect to its cause in order to perceive the cause through the effect:

> Time is not an attribute [*passio*] but of the first movement; and this movement is perceived in every movement as the cause in its effect; and it is not necessary, in order for this perception to happen, to relate [*collatio*] the effect to its cause, for

[403] Aquinas, *On Physics* IV, lect. XVII, no. 4. My Trans.

> whatever is in the effect is in the cause, whether it is realized [*advertatur*] and perceived distinctly or not.[404]

Time Is Defined as the Number of Movement in General

Another difficulty remains. Time is not defined as the number of the first movement, but as the number of movement in general. Indeed, the definition does not specify that time is the number of a particular movement; it does not even specify that it is the number of a certain species of movement. This general character of the definition follows from the generality of the premises from which it is concluded. We recall that the first part of the demonstration has established that time is something of movement from the fact that we perceive time through movement; the second part has established that time follows movement with respect to the before and after because the perception of time follows the perception of the before and after in movement; the third part has concluded that time is the number of movement (with respect to the before and after) because its perception requires numbering movement. None of these steps restricts time to a particular movement, indicates that it is relative to a first movement. A conclusion has the same level of universality as its premises, so Aristotle has concluded time is the number of movement in general.

Now, if time was the number of the first movement, should we not expect Aristotle to have defined time as such? This difficulty is serious. This being said, I reiterate that Aristotle's conception of time cannot make sense and must be utterly false if he means to define time as the number of just any movement. He himself shows that he is aware of this as he writes that if time was the number of just any movement, there would be simultaneous times, which is absurd. He also indicates his belief that there is a unique time prior to inquiring its definition analytically: in the dialectical section, he wrote that time cannot be the same as movement because whereas there are many movements, time is simultaneously the same everywhere.[405] Therefore, it is reasonable to suppose that Aristotle presupposes that time follows a unique movement as he seeks its definition.

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[404] Albert, *On Physics* IV, Tract.3, Ch.4. My Trans.
[405] *Phys.* IV. 10, 218b10-15.

As a matter of fact, there are signs that he indeed makes such a presupposition. We have seen that according to Aristotle, the motion which time follows is a movement of locomotion (since locomotion is the only kind of movement which is regular and it is prior to other kinds of motion). Now, Aristotle seeks the definition of time by considering this kind of movement. In the passage leading to the definition, he has argued that because time follows movement, which follows magnitude, the before and after in time and movement follow the before and after in magnitude. The kind of movement that follows magnitude is locomotion. Thus, locomotion is the kind of movement Aristotle considers in his demonstration that time is the number of motion with respect to the before and after. Likewise, in the passage where he argues that the now is different before and after, the now is compared to a moving body undergoing a movement of locomotion; Aristotle maintains that the now is different before and after because it follows the moving body which differs through position. What is likely to explain that Aristotle considers a movement of locomotion in these passages is the presupposition that time follows such a movement, not just any kind of movement.

Another sign is the following. In order to show that time follows movement as a quantity, Aristotle writes: "However much quantity of movement there is, so much quantity of time seems to have passed."[406] In other words, he implies that the quantity of time is equal to the quantity of movement. Now, insofar as movement follows magnitude, the quantity of movement is measured by the distance covered, so it is equal to it. Moreover, motions have different speeds, and a fast movement covers more distance than a slow movement in the same time. This consideration shows that the quantity of time is not equal to the quantity of any movement, for movements of different quantities are measured by the same quantity of time. Time is equal to the quantity of the movement by which it measures other movement. Now, such is the movement that time follows. Thus, Aristotle's assertion that the quantity of time is equal to the quantity of movement is another indication that as he seeks the definition of time, he presupposes that it follows a single movement.

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[406] *Phys*. IV. 11, 219a13-15.

Nonetheless, it is true that the definition of time has a general character and that the argument by which Aristotle concludes it applies to any movement. Robert Labrie proposes the following explanation to account for that, which I find convincing.[407] First, he maintains that the notion of time is analogical. Because time is the measure of movement, it is, in a strict sense, the number of a first movement. But other movements are also numerable with respect to the before and after, and in so far as they are an effect of the first movement, their number can be called 'time', although by analogy – all the more so if they are regular motions and can be used to measure other movements. Therefore, in a broad sense, the notion of time designates the number of movement in general, the number of any movement.

Since Aristotle seeks the nature of time, he seeks the definition of time understood in a strict sense. But time is known by movement, which it follows, and the movements that surround us are much better known to us than the first movement in nature. Therefore, in order to manifest the definition of time in the strict sense, Aristotle shows what defines time in the large sense.[408] Once it is shown that, defined in its general sense, time is the number of movement with respect to the before and after, it is possible to deduce, from the knowledge that there is a unique time, that in a strict sense, it is the number of one movement. Aristotle specifies what he thinks this movement is at the end of his inquiry as he argues which movement is measure par excellence.

Moreover, the definition "the number of movement with respect to the before and after" is true both of the general notion and of the strict notion of time: if time is the number of motion in general, it is also the number of the first movement. Defining time in a general way seems to be an advantage given that we often use regular motions other than the first motion to measure motion and time.[409] However, because

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[407] Labrie, 'Commentaire du traité du temps d'Aristote', 23–31.
[408] This seems to be an application of the methodological principle that we know what is better known by nature from what is better known to us. Cf. *Phys*. I. 1, 184a16-18.
[409] In fact, today, we know that the movement of the fixed stars is not, contrary to what Aristotle had conjectured, the first movement in nature. Accordingly, we never measure motion and time by the first movement.

the strict notion of time is prior in nature to the analogical notion of time[410], the definition first applies and refers to what time is in a strict sense – the number of the first movement – secondarily to what it is in a large sense – the number of movement in general.

In sum, if we suppose that the notion of time is analogical, as Labrie suggests, the idea that time follows a first movement is not inconsistent with the general character of Aristotle's definition of time. There are also indications, pointed out above, that Aristotle in fact presupposes that time follows a first movement as he seeks its definition.

Summary of Part I

The goal of this chapter is to understand how Aristotle explains the fact that time is both everywhere and one. This first part of the chapter has focused on the problem of time's unity. I have explained that this problem arises because Aristotle has defined time as something that follows movement, which seems to imply that many times would coexist. Although Aristotle himself raises this difficulty, he addresses it in an ambiguous way: in order to show that time is one, he proposes an analogy which seems either to reproduce the problem, or create another one by assuming time is a numbering number. This has left room for commentators to speculate about his view.

As a solution, I have proposed that time is one because it is the number of a single movement, not the number of any movement. Other movements are in time because they are measured by the number of that movement which time follows. In light of this explanation, the analogy put forward by Aristotle manifests the universal unity of time in the following way: as the number of quantities of different things is the same because they are measured by the same numbering number, so the time of simultaneous and equal movements is the same because they are measured by the number of the same movement. This solution is implicit, I have argued, in a passage where Aristotle maintains there is a movement which is measure *par excellence* of

[410] It is because time is the number of a first movement that other movements participate in the first movement and that their number can be called 'time', by analogy. However, in the order of knowledge, this is the converse: we know what time is in a large sense before we know what it is in a strict sense.

time and movement. He identifies this motion as the first circular movement, i.e. the movement of the sphere of the fixed stars. Hence, there is a unique time, on Aristotle's account, because it is the number of this first movement. Finally, I have addressed two questions which stand as potential objections to this interpretation: why we perceive time by any movement; and why time is defined as the number of movement in general. The answer I have proposed involves the consideration that all movements in nature participate in the first movement, of which they are an effect, and the related idea that the notion of time can be extended to designate, in a large sense, the number of any movement – especially movements which are regular and proper to serve as measure of other movements.

Part II: The Universality of Time

Having studied the unity of time we will look, in the second part of this chapter, at the other aspect of Aristotle's claim that time is universally one: why it is the case that there is time everywhere in nature. Aristotle answers this question in the following passage, quoted before:

> It is worth examining why it is thought that time is in everything, in the earth, in the sea as well as in the sky. Is it not because it is a certain affection [πάθος] or certain state [ἕξις] of movement given that it is the number of it, and that all these things are mobile (because all are in a place), and that time and movement go together in actuality as well as in potentiality? [411]

In writing that "time is in everything, in the earth, in the sea as well as in the sky", Aristotle means that time is everywhere in the universe. He accounts for this fact, in sum, by the universality of motion. There is movement everywhere in nature because all natural things are mobile. Now, time and movement go together, in actuality and in potentiality, since time is a certain affection of motion, the number of it. This explains why there is time everywhere.

Since time has been defined as something of motion, it makes sense for Aristotle to account for the universality of time by the universality of motion. Yet, this explanation raises several questions. First, according to it, time is wherever there is

[411] "Ἄξιον δ' ἐπισκέψεως … διὰ τί ἐν παντὶ δοκεῖ εἶναι ὁ χρόνος, καὶ ἐν γῇ καὶ ἐν θαλάττῃ καὶ ἐν οὐρανῷ. ἢ ὅτι κινήσεώς τι πάθος ἢ ἕξις, ἀριθμός γε ὤν, ταῦτα δὲ κινητὰ πάντα (ἐν τόπῳ γὰρ πάντα), ὁ δὲ χρόνος καὶ ἡ κίνησις ἅμα κατά τε δύναμιν καὶ κατ' ἐνέργειαν;" *Phys.* IV. 14, 223a16-21.

motion because it is an affection of motion, the number of it. But in Part One, I attributed to Aristotle the view that time is the number of a first movement, not the number of all movement. A number of movement is in the movement of which it is the number. Therefore, if time is the number of a first movement, it seems to imply that there will be time only where the first movement is located, not wherever there is movement.

Furthermore, there is not movement always and everywhere in nature; some things are at rest. But there is time always and everywhere. Thus, how can the universality of time be really explained by the universality of motion?

This part of the chapter will seek to understand Aristotle's explanation for the universality of time by answering these questions and related ones. To ask why time is universal is also to ask the reason why there is time in nature. Accordingly, it will also be a question of what accounts, fundamentally, for temporality.

Why Time is Everywhere

Whereever there is Motion, There is time

Let us begin by the first question: how can there be time wherever there is motion since time is the number of a first motion?

There are two ways for a number to relate to a subject. It may relate to it as an accident, the quantity of that subject. Time relates to the first motion in this way. It is the numbered number of that motion, so it is in the first motion as an accident is in its subject. A number may also relate to a subject as an extrinsic measure. In part one, I have explained that this is how time relates to other motions: it measures them by the quantity of the first motion. Insofar as time relates to motions in this way, it is these motions which are in time rather than the opposite. Indeed, Aristotle has explained that motions are in time insofar as they are measured by time; they are then in time as in a number that measures them.[412] Nonetheless, insofar as time relates to the

[412] "Things are in time like in a number" *Phys.* IV. 12, 221a19-21. He reiterates the point at 221a26ff.

motions that are in time as their measure, we can say that where a motion is in time, there is time.

Moreover, motion is not, on its own, located anywhere. It is mobile beings which are located in a place. We can say that motion is located somewhere in the sense that its subject, the moving being, is somewhere.

With these remarks, we can answer the first question. There is time wherever there is motion because wherever there is a mobile being in motion, there is a motion measured by time.

Mobile Things are in Time

Let us now turn to the second question: how can there be time always and everywhere since there is not motion always and everywhere in the universe?

If there is not motion everywhere and always in nature, it is because, as I have suggested in the introduction of this second part, some natural things are at rest. Moreover, if there is not motion everywhere, there are, however, mobile things everywhere in nature. Indeed, natural things are, by definition, mobile. Now, in his explanation of why time is in everything, Aristotle, in addition to saying that it is because time is something of motion, writes that this is because natural things are mobile: “Is it not because it is a certain affection or certain state of movement given that it is the number of it, and that all these things are mobile?” This suggests that time is in everything because mobile things are in time too, not just their motions. Indeed, if it is true that if a motion is in time, there is time where the motion is, then, it will also be true to say that if a mobile thing is in time, there is time where the mobile thing is located. If mobile things are in time and mobile things are everywhere, then, time will be everywhere.

In order for this solution to work, it must be shown that mobile things are in time. Although we know intuitively that things are in time, it poses a certain challenge for Aristotle’s conception of time to account for this fact since he has defined time as

something of motion, and beings are not motions. Yet, as a matter of fact, Aristotle does show that mobile beings are in time. Let us see how he accounts for that.

Substances Are Measured by Time as Mobile

For a motion, being in time is being measured by time. Therefore, so it is for things: if they are in time, it must be because they are measured by time. Time cannot measure a being in respect of what it is essentially: a human, a tree; it does not measure the quantity of a substance. Yet, substances are in motion, and time measures motion. Therefore, Aristotle shows that time measures substances insofar as they are in movement: "What is moved will not absolutely be measurable by time, insofar as it has some quantity, but insofar as the movement of it has a quantity."[413]

Aristotle explains that time measures not only the movement of mobile substances, but also their rest: "Since time is the measure of motion, it will be the measure of rest too."[414] As explained in Chapter 1, rest is one of the modalities of immobility; it is a privation of motion: is at rest what is naturally capable of motion, but is deprived of it. As a result, the rest of a mobile being has a quantity which is the quantity of movement it is deprived of. It is the quantity of movement the mobile would have undergone had it been in motion instead of at rest. Because this quantity of movement is measurable by time, the quantity of rest is also measurable by time.

The following consideration may help to illustrate this point. Because what is at rest has the natural potentiality to move, a mobile being at rest may have been in motion before and may be in motion again. Let us suppose this is the case. Therefore, the mobile being has begun to rest at the instant of time it has ceased to move, and it will cease to rest at the instant it will resume moving. In between these two instants of time, one before and one after, there is an interval of time that measures the quantity of its rest. This quantity, which is the quantity of movement that the mobile is deprived of, corresponds to a quantity of the movement by which time measures movement (and rest), the quantity delimited by the two instants.

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[413] *Phys.* IV. 12, 221b19-20.
[414] *Ibid.* 221b6-7.

Time thus measures rest. It measures rest secondarily, incidentally, because it measures movement (first and per se). Moreover, as a substance is measured by time insofar as it is in movement, so it is measured by time insofar as it is at rest.

In sum, because mobile substances are in motion or at rest, and time measures their motion and rest, mobile substances are measured by time: "Time will measure what is moved and what rests, insofar as it is moved and insofar as it rests."[415] Substances in motion and at rest are mobile beings, so we can say that time measures beings insofar as they are mobile. Moreover, being in time is being measured by time. Thus, Aristotle, by showing that mobile beings are measured by time, has shown that they are in time.

Time Measures Mobile Beings in respect of their Duration

In the following passage, Aristotle is more specific about the way motion and things are in time. He writes:

> Since time is the measure of motion [μέτρον κινήσεως] and of being moved [τοῦ κινεῖσθαι]… and for motion, to be in time is to be measured by time, both itself and its being [τὸ εἶναι] (time indeed measures together both motion and its being, and this is what it is for motion to be in time: to have one's being measured by time) it is obvious that for other things too, this is what to be in time is: to have one's being [τὸ εἶναι] measured by time.[416]

Aristotle here introduces a subtle distinction between 'being measured in time in itself', and 'being measured in time in one's being'. He writes that time measures both motion and the 'being' [τὸ εἶναι] of motion, or, equivalently, both motion and 'being moved'[τοῦ κινεῖσθαι]; and he writes that things in time have their being measured by time. What is this distinction between 'being measured in time in itself' and 'being measured in time in one's being'? Let us first try to understand what it may mean to say that something is measured by time in one's being.

Being (τὸ εἶναι) has several meanings.[417] 'The being of something' (implied in the idea of 'being measured in one's being') may signify the essence of something, what

[415] *Phys*. IV. 12, 221b16-18.
[416] *Ibid.* 220b32-221a6.
[417] Cf. *Met.* IV. 2, 103a33 ff.; V.

it is: a human, a tree, etc. 'Being' cannot have this meaning in the present context. If it was the case, time would be the measure of substances as what they are essentially, and Aristotle has explained that time does not measure substances in this respect: the quantity that time measures cannot be the quantity of the substance.

As explained in Chapter 1, 'being' also has the meaning of 'existence in actuality', and this seems to be the relevant sense. When we say that something is in time, we mean that it exists in time. If things exist in time because they are measured by time, it suggests that time measures their being in the sense that it measures their existence.

In his commentary of this passage, Aquinas maintains that 'being' has the sense of 'duration'.[418] Duration has a meaning very close to the one of 'existence in actuality'. To say that things have duration, or that they "endure", means that they continue to exist actually; duration can be defined as 'continued existence'.[419]

Aristotle has written that for things, "this is what to be in time is: to have one's being [τὸ εἶναι] measured by time."[420] It makes sense to assume that 'being' here has indeed the sense of 'duration', that time measures the duration, the existence of a being. This is corroborated by common language. We say that things have a duration, and by this we seem to refer to the quantity of their existence (or life) measured by time. If this is right, Aristotle means that mobile things are measured by time in respect of their duration.

Time Measures both Motion and the Duration of Motion

Let us go back to the distinction between 'being measured in time in itself' and 'being measured in time in one's being'. Aristotle presupposes this distinction as he writes that time measures both motion itself and "the being" of motion. Time measures motion itself because motion is a quantity, and time measures properly the quantity of motion. But time also measures the being of motion, i.e. its existence, its duration.

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[418] Aquinas, *On Physics* IV, lect. XX. no.2.
[419] Aquinas claims (*Ibid.*) there is no real distinction between duration and existence, only a distinction of 'reason' [ratio]: something endures insofar as it exists in actuality; and insofar as it exists in actuality, it endures, it continues to exist.
[420] *Phys*. IV. 12, 220b32-221a6.

Indeed, motion endures; it continues to exist because the moving body is continuously actualized by motion until it stops, and motion exists insofar as the moving body is actualized by it. This duration of a movement is measured by time.

Although the existence of motion and what motion is are formally distinct, their quantity is the same. Indeed, the essence of motion is the actuality of the mobile being as mobile, so motion is the mode of existence of a moving being. Therefore, the quantity of the existence (the duration) of motion is the same as the quantity of motion. Aristotle consequently writes that "time measures together (ἅμα) motion and the existence (τὸ εἶναι) of it".

Time Measures the Duration of Mobile Beings by their Motion

In sum, there is the following distinction between the way that motion and things are in time: whereas motion is measured by time both in itself and in respect of its duration, things are measured by time in respect of their duration only. Now, since time measures the duration of mobile beings, and it measures them insofar as they are in motion (and at rest), then time must measure the duration of mobile beings by measuring their motion (as well as their rest).

The following reasoning shows that this is indeed how mobile beings are measured by time. Since motion is a sort of being in actuality – the actuality of a mobile being as mobile – when a mobile being is moving, it exists in motion; in other words, motion is the way that it exists since motion is its actuality. Therefore, time, by measuring the motion and its duration, also measures the duration of the moving substance, since motion exists in the substance and is the way the moving substance exists. A mobile being at rest also has its existence measured by time because rest is just privation of motion in the mobile body.

The following passage supports this explanation. Aristotle says about substances whose duration is measured by time that they have their existence (being) in motion and rest:

> It is obvious that of all things of which [time] measures the being [τὸ εἶναι], all of these have their being in being moved [κινεῖσθαι] and being at rest [ἠρεμεῖν].[421]

Mobile beings exist in motion and in rest. Therefore, by measuring their motion and rest, time measures their existence. This is why mobile things exist in time, and conversely why the things that exist in time are mobile.

Why Time is Universal

Now that it has been established that things, not only motions, are in time, we can understand Aristotle's explanation for the universality of time. Let us read it once again:

> It is worth examining why it is thought that time is in everything, in the earth, in the sea as well as in the sky. Is it not because it is a certain affection [πάθος] or certain state [ἕξις] of movement given that it is the number of it, and that all these things are mobile (because all are in a place), and that time and movement go together in actuality as well as in potentiality? [422]

This explanation can be reformulated and analyzed in terms of the notion of "being in time". Nature is a principle of motion and rest, so natural things are mobile, which means that they exist in motion and rest. As the number of a first movement, time measures extrinsically the motion of natural things; it also measures their rest, the privation of motion in them. By measuring their motion and rest, time measures their existence, their duration. Thus, natural things are measured by time in respect of their duration. As such, natural things are in time.

By measuring natural things, time relates to them. Now, natural things are located in a place. Therefore, we can say that time is located in a place in the sense that it measures the thing located in that place. In other words, there is time somewhere in the sense that there is something there which is in time. Now, there are natural things located everywhere in the universe. Thus, there is time everywhere in the universe because time measures the duration of natural things which are everywhere.

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[421] *Phys*. IV. 12, 221b27-28.

[422] "Ἄξιον δ' ἐπισκέψεως … διὰ τί ἐν παντὶ δοκεῖ εἶναι ὁ χρόνος, καὶ ἐν γῇ καὶ ἐν θαλάττῃ καὶ ἐν οὐρανῷ. ἢ ὅτι κινήσεώς τι πάθος ἢ ἕξις, ἀριθμός γε ὤν, ταῦτα δὲ κινητὰ πάντα (ἐν τόπῳ γὰρ πάντα), ὁ δὲ χρόνος καὶ ἡ κίνησις ἅμα κατά τε δύναμιν καὶ κατ' ἐνέργειαν;" *Phys.* IV. 14, 223a16-21.

To put it differently, because there is time in a place in the sense that there is something located in that place that is in time, the statement "there is time in everything, in the earth, in the sea as well as in the sky" means that all natural things are in time. Thus, asking why there is time in everything in nature is asking why natural things are in time. Natural things are in time because they are mobile. Indeed, as such, they exist in motion and at rest, whereby their existence is measured by time so they exist in time. Aristotle points out that the cause of time's universality is the mobility of natural things as he writes, after asking why time is in everything: "Is it not because … all these things are mobile…?"

Furthermore, by writing "time and movement go together in actuality as well as in potentiality", he implies that time measures not only the motion of natural things, but also their rest. Indeed, what is at rest has the potentiality to move, so rest is motion in potentiality.

The Ontological Source of Temporality

The mobility of natural things explains why they are in time and thus why time is everywhere in nature. Aristotle maintains that the universality of time extends even to things that don't actually exist. At the opposite, he maintains that there are existing things which are not in time. This analysis of what is in time and what is not in time sheds further light on what it is to be in time, to be a "temporal being", and points out the ultimate explanation for temporality in nature.

Temporal Being

Things are in Time like Things in a Number

As movements are in time as measured by time, so it is for things. Since time is a number, in order to show that things are in time in the sense that they are measured by time, Aristotle analyzes what it means for things to be in a number. In one way, something is said to be in a number in the way that properties and parts of a number are in it, that is as something of it. For example, '2' is in the number '6' as a part of it; 'even' and 'odd' are in numbers as properties that exist in them as in their subject.

In another way, to say that something is in a number means that there is a number of the thing (or that it has a number); in other words, it means that it is numbered, and thus measured, by a number. For example, we can say of fishes in an aquarium that they are in number '6', or of students in a classroom that they are in number '20', which means that their quantity is counted, measured by such numbers; or we may say of an army or a crowd that it is in great number, which means that their quantity would be counted by a large number.

Based upon these two senses in which things are said to be in a number, Aristotle manifests the sense in which things are in time. Things are not in time in the way that parts and properties of a number are in a number. Being in time in this way belongs to the instant, and properties such as 'before' and 'after'. However, they can be said in time in the way that things that have a number are said to be in a number, that is because they are measured by a number. Indeed, time is a number and as we have seen, it measures the existence of things. Therefore, things are in time in the sense that they are numbered, measured by the number of time.

Things are Contained by time like things Contained in a Place

Aristotle moreover compares the way things are in time to the way they are in a place:

> Things are in time as in a number. If it is so, they are contained by number in the way that things that are in a place are contained by place.[423]

In *Physi*cs IV. 3, he presents eight senses and modalities according to which something can be said to be in something else. 'To be in place' is one of them: "The most eminent [sense] of all, is as something is in a vessel, and generally in a place".[424] 'To be in time' is not among the senses enumerated there. Aristotle's comparison of 'being in time' to 'being in place' suggests that the sense in which something is said to be in time is reducible to the sense in which something is said to be in a place, that is as something "in a vessel".

[423] *Phys.* IV. 12, 221a18-20.
[424] *Phys*., IV, 3, 210a23-25.

This comparison of time to place makes sense if we understand that Aristotle defines place as the "innermost motionless boundary of the body that contains"[425]. We tend to conceive of place as a sort of empty space interval that preexists and coexists with the body that occupies it. Aristotle criticizes this conception and argues that place does not exist without bodies, but that the place of something is the limit of the body that surrounds and touches it. Accordingly, he can say that the place where a body is located contains the body.

Insofar as place externally delimits the body contained by it, it measures it extrinsically. Thus, as place contains mobile things by measuring extrinsically their body, so time contains them by measuring extrinsically their duration.

Some Non-Beings are Contained by Time

Time is not only present, but also extends in the past and in the future.[426] Therefore, the things that are in time include things that don't exist now, but have existed in the past or may exist in the future:

> Of things which do not exist but are contained by time some were, e.g., Homer once was, some will be, e.g. a future event; this depends on the direction in which time contains them, if on both, they were and they will be. [427]

The things that once existed are in time because their existence is extrinsically measured, and thereby contained by a part of time that is passed. For example, supposing that we knew that Homer existed, when and how long, we could say that he existed for 70 years about 3000 years ago. Future things are in time insofar as they may exist, so their existence may be measured by time; whether they will actually exist, when and how long is not determined.

Time: A Universal Container

To be in time is to be contained by time. Since the things that are in time include the things that have existed in the past, those that exist in present and those that may exist

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[425] *Phys*. IV. 4, 212a20-21.
[426] The problem of how the present, the past and the future exist will be studied in Chapter 4.
[427] *Phys.* IV. 12, 221b30-222a1.

in the future, time can be seen as a global container which encompasses all things that are, that were and that will be:

> Since being in time is like being in a number, it will be possible to take a time greater than all beings that are in time. That is why it is necessary that all beings that are in time be contained [περιέχεται] by time, just as all things that are in anything – for example what is in place is contained by place.[428]

Since the way that things are contained by time is comparable to the way that things are contained by place, the way that all things are in time can be compared to the way that all things are in a place.

The primary, proper location of a natural being is the innermost limit of the body that contains it. However, it can be said that something is located in a place greater than the place that measures it properly, insofar as the body that immediately contains is located in that place. Thus, a place can be a common location for many things that are in it together. Aristotle writes in his inquiry of place:

> There is place which is common and in which all bodies are, and place which is the proper primary location of each body. I mean, for instance, that you are now in the world because you are in the air and it is in the world; and you are in the air because you are on the earth; similarly on the earth because you are in this place which contains no more than you.[429]

Each natural thing has a proper, primary place by which it is measured. But this proper place is part of a larger place, and ultimately it is part of the place which is the limit of the whole universe. Thus, all natural things are in the universe as in a global container. Similarly, each natural thing has a proper time which delimits and measures its existence, from its generation to its corruption. But this proper time is part of a larger time. In this sense, we can say that many things are in the same period of time. For example, we can say that Cicero and Plato both existed in Antiquity. Ultimately, if we assume that time is a whole composed of past and future, infinitely extended in these "directions"[430], we can say that all things are in the whole of time. Indeed, we cannot think of something that existed so far in the past as not to be

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[428] *Phys*. IV. 12, 221a26-30.
[429] *Phys.* III. 2, 209a30-35.
[430] As the quantity of a movement that is eternal (the circular movement of the first heavenly sphere), Aristotle holds that time is infinite, having no beginning nor end. Cf. *Phys.* III. 6, 206a10-12; 206a26-28; VIII. 1, 251b11-15.

contained by time; and we cannot think of something that would be so far distant in the future that it would not be contained by time. Thus, like the universe, time is a universal container which encompasses the existence of all things that once existed, now exist and may exist.[431]

The analogy extends further. Things have an order of position through their place in the universe.[432] Similarly, things have an order of succession in time. The things that are not simultaneous are before or after each other in time. For instance, Socrates existed before Julius Caesar in time. The temporal order of succession is defined relatively to the present instant:

> We say 'before' and 'after' with reference to the distance from the now… In the past we call 'before' what is farther from the now, and 'after' what is nearer, but in the future we call the nearer 'before' the farther 'after'.[433]

Some non-beings are not in Time

We have seen that the things that don't exist in the present are nevertheless in time if they existed in the past or may exist in the future. Consequently, Aristotle explains that what never exists, that is what does not exist, never existed and cannot exist in the future, is not in time. He writes that these are the non-beings whose opposite exist eternally, and gives as an example the diagonal's being commensurate with the side.[434] The commensurability of the diagonal with the side never exists (it is never true) because its opposite, the incommensurability of the diagonal with the side always exists (it is always true). Indeed, in accordance with the principle of non-contradiction, something and its opposite cannot exist (or a proposition and its opposite cannot be true) together in the same respect; thus, something can never exist if its opposite always exists.

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[431] We should yet note this interesting difference between place and time as universal containers. Whereas Aristotle thinks the universe is finite (Cf. *Phys*. III. 5, 205b24-206a8), he thinks time is infinite, as mentioned in the previous footnote. Therefore, there is no such thing as "a whole of time" as there is a whole of the universe. Time contains all natural things in the sense that all natural things that presently exist, ever existed and will ever exist are measured by time.

[432] Aristotle even thinks these positions are absolute since he thinks the universe has a top, a bottom, a left and a right. Cf. *Phys*., IV. 4, 212a21-31; *DC.* II. 2.

[433] Cf. *Phys*., IV. 14, 223a4-13.

[434] Aristotle can call such a proposition (the diagonal is commensurate with the side) a non-being and its opposite (the diagonal is not commensurate with the side) a being because 'truth' is one of the senses of 'being' (and 'falsehood' one of the senses of 'non being'). Cf. *Met.* IX. 10, 1051a34-b4.

Non-Temporal Beings

All things that exist in time are contained by time. Aristotle draws a consequence of this: there are beings which are not in time:

> Since to be in time is like to be in a number, it will be possible to take a time greater than all beings that are in time. That is why it is necessary that all beings that are in time be contained by time, just like all things that are in anything – for example what is in place is contained by place… So that it is obvious that the things that always exist [τὰ αἰεὶ ὄντα], insofar as they always exist, are not in time. Indeed, they are not contained [περιέχεται] by time, neither is their existence measured by time.[435]

Things that are in time are contained by time, having their duration measured by time, so there must be a time greater than the time that measures their duration – as there is a number greater than the number that measures a certain quantity of things. Now, if there are things that are eternal, they always exist. Therefore, if they were in time, their duration would be measured by an infinite time, and there would be a time greater than that. But an infinite quantity cannot serve as a measure (for the infinite is not a determined quantity) and no quantity can be greater than the infinite. Hence, if there are things eternal, they don't have their existence measured by time and accordingly, they are not in time.

Temporal beings are Contingent, Mobile beings

Since neither beings which always exist, nor non-beings which never exist, are in time, the beings that are in time are those that exist, but not always. Aristotle writes that these are the things that sometimes are and sometimes are not, that is those that are generable and corruptible:

> It is necessary that all things that are generable [γενητὰ] and corruptible [φθαρτὰ], and, generally, that at one time are and at another are not, be in time (there is indeed a greater time which will contain [ὑπερέξει] their existence [εἶναι]).[436]

Aristotle has written that it is because their opposites always exist that some non-beings never exist (e.g. the commensurability of the diagonal). Similarly, he writes that it is because their opposites do not always exist, whereby they have the

[435] *Phys*. IV. 12, 221a26-b7.
[436] *Ibid.* 221b28-31.

possibility to be or not to be, that generable and corruptible things at one time exist and at one time don't exist:

> The things whose opposite does not always exist have the possibility to be and not to be (δύναται καὶ εἶναι καὶ μή), and there is generation and corruption of these.[437]

To have the possibility to be or not to be is to be contingent.[438] Indeed, the opposite of the contingent is the necessary, which Aristotle defines as the impossibility of being otherwise:

> Among things which are, some are always in the same state and are of necessity (nor necessity in the sense of compulsion, but that which means the impossibility of being otherwise).[439]

Beings that are necessary don't have the possibility to not be, so they always exist and thereby are not in time. On the contrary, beings that are contingent have the possibility to be or not to be, so at one time they exist and at one time they don't, being therefore in time.

Since temporal beings are contingent, they are generable and corruptible. Indeed, having the possibility to exist when they don't exist, they are generable; and having the possibility to cease to exist when they exist, they are corruptible. Now, if they are generable and corruptible, they are mobile. Indeed, generation and corruption are kinds of change, and they presuppose locomotion, as I have explained in Chapter 1. Therefore, the things that are in time are mobile beings, that is beings which exist in motion and in rest:

> It is obvious that of all things that [time] measures the being [existence], all of these have their being [existence] in being moved and being at rest.[440]

The reason why temporal things are mobile follows from what has been explained before. Time is the measure of motion, so things exist in time as mobile; mobile beings are in time because by measuring their motion and rest, time measures their existence. Consequently, if there are beings which are immobile, they are not in time for they are not measured by time:

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[437] *Phys*. IV. 12, 222a7-10.
[438] The word 'contingency' comes from the latin *contingentia*, which means 'possibility'.
[439] *Met.* VI. 2, 1026b27-32. Trans. Ross.
[440] *Phys*. IV. 12, 221b27-28.

> What is neither moved nor rests is not in time. Indeed, to be in time is to be measured by time, and time is the measure of motion and rest.[441]

In sum, temporal things can be characterized as contingent and mobile beings. These characteristics, mobility and contingency, are intrinsically related and imply each other. If something is contingent, it has the possibility of being otherwise. Now, to become otherwise is to change. Therefore, contingent beings have the possibility to change and to move, so they are mobile. Conversely, if something is mobile, it is contingent. Indeed, change presupposes the possibility to be otherwise: only a being that has the possibility to be otherwise can change. Hence, mobile beings are contingent beings.

Materiality, the Root of Temporality

Contingency and mobility is what characterizes temporal beings and distinguishes them from non-temporal beings, which are necessary and immobile. Accordingly, the reason why beings are temporal is the reason why they are contingent and mobile.

In *Metaph*ysics IX. 7, Aristotle writes:

> No eternal thing exists potentially. The reason is this. Every potentiality [δύναμις] is at one and the same time [ἅμα] a potentiality for the opposite; for, while that which is not capable of being present in the subject cannot be present, everything that is capable of being may possibly not be actual. That, then, which is capable of being may either be or not be… And that which is capable of not being may possibly not be; and that which may possibly not be is perishable… Nor can anything which is of necessity be potential.[442]

In this passage, Aristotle maintains that necessary beings always exist because they have in them no potentiality (‘δύναμις’) to be or not to be. This suggests that on the contrary, contingent beings have in them such a potentiality (‘δύναμις’), and this is why they sometimes exist and sometimes don’t. The following passage from *On Interpretation* corroborates this idea:

> In general, in things that are not always actual there is the possibility [τὸ δυνατὸν] of being and of not being; here both possibilities are open, both being and not being, and consequently, both coming to be and not coming to be.[443]

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[441] *Phys*. IV. 12, 221b20-23.
[442] *Met*. IX. 7, 1050b7-18. Trans. Ross.
[443] *DI*. 9, 19a6-17. Trans. Ackrill.

The things "not always actual", that is the things that don't always exist in actuality, may come to be because they have the potentiality to be, and may not come to be because the potentiality to be is simultaneously a potentiality for the opposite, as Aristotle wrote in the passage of *Metaph*ysics IX.7 previously quoted.

There is thus, in contingent beings, a potentiality in virtue of which they may exist or not exist, and in general be otherwise. What is this potentiality, this principle of contingency? The previous texts indicate that this principle is intrinsic to contingent things, and thereby founded in their essence. Now, contingent beings are mobile beings, as explained before, and mobile beings are natural beings. The essence of natural beings is composed of matter and form.[444] Prime matter is what has the potentiality to receive a form; in this regard it is being in potentiality[445]. Hence, prime matter is the principle of contingency in mobile beings; it is the potentiality in virtue of which they may exist or not exist, and in general be otherwise.

Temporal beings are mobile and contingent, and this is what distinguishes them from non-temporal beings. Since natural things are mobile and contingent because they are essentially composed of matter, we can conclude that matter is what ultimately explains why natural things are temporal. In other words, temporality is rooted in the materiality of natural beings.

It follows implicitly that if there are immaterial beings, these are necessary, incorruptible and immobile beings. Therefore, they don't exist in time and are eternal. Aristotle has mentioned mathematical truths as examples of beings that are not in time. Since he thinks there are immaterial substances[446], it is reasonable to suppose that he also deems these substances as non-temporal.

A Difficulty: Are Incorruptible Bodies in Time?

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[444] Cf. *Phys.* II. 1, 193a10-32.
[445] Cf. *Phys*. I. 9, 192a27-30.
[446] Such is the prime mover of the universe, which he describes as an immaterial intellect, immobile and fully in actuality (Cf. *Phys.*VIII. 6, 258b10-15; 10, 266a10-b28; *Met.*XII, 7). Furthermore, he thinks there are other immobile, immaterial and intellectual substances that are the causes of the movement of the celestial spheres (Cf. *Met*. XII. 8, 1073a23-b3).

According to Aristotle's cosmology, heavenly bodies are incorruptible and eternal. Therefore, we may wonder whether they exist in time. This difficulty arises indirectly in Tim Loughlin's article 'Souls and the Location of Time in Physics IV 14, 223a16-223a29'. In this paper, he argues that since time is defined as the number of motion, it is located where and only where there is a countable change.[447] Now, according to Aristotle's cosmology, the motions of heavenly bodies are eternal. Therefore, they are not countable as there is no number greater than them, so they are not in time. Loughlin concludes that time is not in everything according to Aristotle, since it is not in the heavens:

> If time is identical to change qua countable and changes have locations, then time will be located where and only where countable changes are located… Aristotle explicitly endorses the existence of uncountable changes, specifically in the heavens. So, he must take the belief that time is in everything to be false.[448]

However, against Loughlin's opinion, Aristotle is fairly explicit in two passages that time is universal. First, he maintains in 222b30-a15 that every motion is in time, so this must include heavenly motions. Second, just after, in 223a15-22, he asks why time is thought to be in everything, including in the heavens. Therefore, heavenly bodies and their motion must be in time.[449]

Nonetheless, Loughlin's thesis touches on an interesting problem: how can heavenly motions be in time since they are infinite? And how can heavenly bodies be in time since they are, according to Aristotle, not generable and incorruptible?

First, in reply to Loughlin, let us observe that even though there is no definite time that measures the whole duration of the heavenly motions because they are infinite, still, a part of their motion is countable and measurable by time. This makes heavenly motions to be in time, and Loughlin comes close to recognizing it:

> It seems that Aristotle takes it to be appropriate to measure one change by the time of another change… We can speak truly when we say the time of an

[447] Loughlin, 'Souls and the Location of Time in Physics IV 14, 223a16-223a29', 309–10.
[448] Loughlin, 308.
[449] Loughlin maintains that Aristotle must merely ask why people are inclined to believe that time is in everything, and that this is not his own view. But the reason why Loughlin makes this supposition is because he denies that Aristotle thinks heavenly changes are in time. It is thus incumbent upon him to prove that this thesis is right. As I will argue, this is not Aristotle's view.

> uncountable change is two days by using the sentence to assert only that the number of change of the heavens as marked from the beginning to the end of the uncountable change is two days.[450]

However, he adds that "this response is unavailable" because Aristotle holds that being in time is to be in the number of time.[451] I reiterate that if parts of a motion are measurable by time, they are in the number of time, they are contained by time, so we can say that the motion is in time although the whole of the motion is not measurable by any determined time.

Likely, what prevents Loughlin from rejecting this explanation is the fact that Aristotle maintains that the beings that always exist are not in time because they are not contained by time. But my opinion is that in this passage, Aristotle is not giving the fundamental reason why eternal beings are not in time. He has provided that reason before, as he wrote: "Everything that is neither moved nor in rest is not in time. Indeed, being in time is being measured by time, and time is the measure of motion and rest."[452] The reason why some beings are not in time is because they are immobile and necessary. Since they always exist, it also follows that there is no time that contains their existence as a whole, so Aristotle can provide this as a sign that they are not in time. But this cannot be the reason why they are not temporal. Indeed, as Aristotle wrote in the previous quote, being in time is being measured by time, which is the measure of motion and rest.[453] Therefore, even if something always exists, it will be in time if it is mobile and contingent in some respect. This is the case for the heavenly bodies. Since they are not generable or corruptible, they always exist. Yet, they are in time because they are contingent and mobile in respect of place; because their motion is measured by time, their existence is measured by time, so they are in time.

The fact that eternal beings are not in time, and that something may exist infinitely but still be in time lets us intuit that there is a distinction between "eternity" and

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[450] Loughlin, 313.
[451] *Ibid.*
[452] *Phys.* IV. 12, 221b21-23.
[453] Let us recall that Aristotle says: "Since time is the measure of motion, all the things whose existence is measured by time are mobile." (221b25ff.) He again clearly indicates that things are in time as mobile as he writes that time is universal in nature because natural things are mobile (Cf. 223a17ff.).

“infinite duration”: it suggests that eternity is not infinite duration, but the state of a being which does not exist in time.

Summary of Part II

The cause of the unity of time having been established in part one, the second part of this chapter has focused on the reason why time is universal. Aristotle addresses this question in a dense passage, in which he essentially accounts for the universality of time by the universality of motion. A first analysis of this explanation raised two main questions: since time is something of a first motion, why is there time wherever there is motion? And why is there time even where things are at rest? In answer to the first question, I have explained that there is time where there is motion in the sense that time measures extrinsically the motion of a mobile substance located in a place; thus, there is time somewhere because there is a mobile substance whose motion is in time there. In order to answer the second question, I have explained that time relates not only to motions, but also to natural things. Time measures the duration of natural beings by measuring their motion and rest; thus, natural beings are in time as mobile. Thus, there is time wherever there is a mobile being since mobile beings are in time, whether they are in motion or at rest. Having answered these questions, I gave a complete interpretation of the passage in which Aristotle accounts for time’s universality. There is time everywhere in nature in the sense that time measures the duration of natural things everywhere, so that all natural things are in time, wherever they are. Natural things are in time because they are mobile. Thus, the mobility of natural things is what explains the universality of time.

We have seen that the universality of time extends not only to natural things that actually exist, but also to those that once existed and to those that may exist, which are in time as well. Beings that always exist though, are not in time since they are not contained by time. Temporal beings are characterized by Aristotle as things which are contingent and mobile, so that they don’t always exist and are in time; in contrast, non-temporal beings are beings which are necessary and immobile, so they are eternal and are not in time. Seeking the source of contingency in mobile beings, I have argued that the fundamental cause of temporality in nature is materiality. Being

essentially material, natural beings are contingent and mobile beings. This is why they exist in time.

Conclusion of Chapter 3

The object of this chapter has been to study how Aristotle accounts for the fact that there is a unique time everywhere in the universe. The first part has concentrated on the question of time's unicity. Aristotle maintains that movements are in time, and that many movements may happen in the same time. He writes that the time of simultaneous and equal movements is the same as the number of equal collections of different things. This seems inconsistent with his definition of time. Defining time as the number of movement with respect to the before and after seems to imply that a different time will follow a different movement, so that simultaneous movements will be followed by different times. Many scholars have attempted to resolve this problem by proposing that time is one in the sense that it is one in kind: the time of simultaneous and equal movements would be the same because their number would be generically one. But this is inconsistent with Aristotle's repeated assertion that time is a numbered number, which implies that it belongs to a movement as its subject; therefore, it cannot be the case that time is one as a universal genus, for it would have to be an abstract number.

As opposed to this interpretation, I have argued that there is one time because time is the number of a first movement. This is supported, among other pieces of evidence I have provided, by Aristotle's argument that there is a movement, determined by time, which is the absolute measure of all movement in virtue of its primacy and its regularity: the first circular motion, i.e. more specifically, according to Aristotle's cosmology, the motion of the sphere of the fixed stars. I have maintained that time is the number of this first movement, and that it measures all movement by the quantity of that movement, which it determines. Accordingly, there is one time because time is the number of one movement; and simultaneous and equal movements are in the same time because they are measured by the same number, the number of this movement which time determines. Time is not multiplied by the multiplicity of motions because it measures them extrinsically, by measuring intrinsically the first movement.

The second part of the chapter has taken up the question of time's universality. If time is something of motion, it is puzzling why there is time always and everywhere since some things are immobile. Moreover, if time is the number of one motion because there is one time, it is puzzling why there is not time only where this particular motion takes place. I have shown that on Aristotle's account, this is the fact that natural things are mobile, and that mobile things are in time which explains the universality of time. As mobile beings, natural things are in time because time measures, by the quantity of the first movement, their motion and rest, whereby it measures their existence, their duration. Because there are natural, and thus mobile beings everywhere in the universe, and that all mobile beings are in time as measured by time, time is everywhere. Strictly speaking though, time is not anywhere. Time is everywhere in the sense that anywhere in the universe, there is a mobile being that is in time, and thus measured by time. To put it differently, time is universal in the sense that it measures mobile beings wherever they are, and mobile things are everywhere.

This explanation points out that there is time in nature because natural things are mobile. It follows that if there are some beings which are immobile, not in the sense that they are at rest, but in the sense that they don't have the potentiality to move, these beings are not in time. Aristotle affirms the existence of such beings, and maintains that they always exist because they are necessary; in contrast, he maintains that temporal being don't always exist because they are contingent, having the possibility to be otherwise. Now, the source of contingency in mobile beings is prime matter. Thus, the fact that natural things are essentially material beings is what explains ultimately why they exist in time. Since there is time everywhere in nature because natural things exist in time, we can conclude that according to Aristotle, materiality is the cause of temporality in nature.

In conclusion, the answer to the question that was posed in this chapter – why time is universal and one – can be summarized in the following terms: time is universal and one because natural things, as material, contingent and mobile beings, are measured in respect of their duration by time, the number of a first, unique movement.

Chapter IV: The Existence of Time

Having studied the nature of time in chapter 2, and explained why time is simultaneously the same everywhere in nature in chapter 3, we are ready to go back to a problem so far set aside: time's existence.

The Problem

We encountered the problem of time's existence in chapter 1, as it is raised by Aristotle in the context of the dialectical discussion that opens his inquiry about time. Let us recall that this inquiry opens with the baffling declaration:

> One might well suppose that time either does not exist altogether, or that it exists hardly [μόλις] and obscurely [ἀμυδρῶς].[454]

To justify this assertion, we remember that Aristotle has presented the following aporia. Any quantity of time, however small it may be, is composed of a part that we call "past", which does not exist anymore, and of a part that we call "future", which does not exist yet. Since time is composed of what does not exist, it seems that it simply does not exist.

This objection against the existence of time is followed by a similar one, not presented in chapter 1:

> Besides, of each divisible thing, it is necessary, if it exists, that when it exists, either all of its parts exist or some of them. Of time though, some [parts of it] have passed, others are yet to come, but none of them exist. Yet it is divisible. And the 'now' is not a part [of time]. Indeed, the part measures [the whole], and it is necessary that the whole be composed of the parts. But time does not seem to be composed of 'nows'.[455]

Time is a continuous quantity, and there are two definitions of the continuous: a formal definition, regarding the continuous as composed of united parts, and a material definition, regarding the continuous as being infinitely divisible.[456] Whereas the first version of the aporia proceeded from the formal definition, the second

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[454] *Phys*. IV. 10, 217b32-33.

[455] "Πρὸς δὲ τούτοις παντὸς μεριστοῦ, ἄνπερ ᾖ, ἀνάγκη, ὅτε ἔστιν, ἤτοι πάντα τὰ μέρη εἶναι ἢ ἔνια· τοῦ δὲ χρόνου τὰ μὲν γέγονε τὰ δὲ μέλλει, ἔστι δ' οὐδέν, ὄντος μεριστοῦ. τὸ δὲ νῦν οὐ μέρος· μετρεῖ τε γὰρ τὸ μέρος, καὶ συγκεῖσθαι δεῖ τὸ ὅλον ἐκ τῶν μερῶν· ὁ δὲ χρόνος οὐ δοκεῖ συγκεῖσθαι ἐκ τῶν νῦν." *Phys*., IV, 10, 218a3-8.

[456] See Chap.1.

version proceeds from the material definition. Any quantity of time is divisible into a part that is past and a part that is future, and these parts do not exist. The only thing which actually exists of time is the 'now', the present instant which is the limit between the past and the future. Such a limit, as Aristotle shows in book VI of the *Physics*, is absolutely indivisible.[457] As such, it is not a part of time for any part of time is divisible. Time is not composed of instants any more than a line is composed of points. What we may call "the present time" is not the present primarily and *per* se, for it is divisible into past and future.[458] For example, the "present" year is divisible into nine months past and three months to come; the "present" month is divisible into 16 days past, 14 days to come; the "present" day (today) is divisible into 18 hours past, six hours to come; the "present" hour is divisible into 45 minutes past, and 15 minutes to come; and so on. Thus, only the "now", the indivisible limit between the past and the future, can be said to be "present" *per se* and thus to exist. Since it is not a part of time, time is only divisible into parts that do not exist, so it does not seem to exist.

These arguments can be considered as two versions of the same aporia. Through it, Aristotle has posed the problem of the existence of time, which can in sum be formulated in the following terms: how can time exist if none of its parts exist? We must acknowledge the severity of this problem, which is proportional to the strength of the arguments that motivate it.[459]

Two Basic Positions

Before investigating whether Aristotle has a solution to offer to this problem, it will be relevant to consider some positions taken with respect to the question of time's existence in the history of thought. I will limit myself to presenting two simple, but significant cases.

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[457] Cf. *Phys*. VI. 3, 233b33-234a23.
[458] *Ibid.*
[459] Yvan Pelletier rightly observes: "L'expérience commune nous rend le temps si familier, nous donne une telle sécurité sur son existence, que nous regardons spontanément l'irréalité de ses parties comme l'une de ces énigmes qui pimentent la réflexion philosophique initiale, capable d'ébranler quelque intelligence présocratique, mais qu'assurément Aristote va bientôt résoudre pour nous. Mais non ! La situation est plus grave : en vérité, la réalité n'offre aucune place au temps." "L'absolue précarité du temps", Yvan Pelletier, 'L'absolue Précarité Du Temps', *Peripatetikos* 1, no. 15 (2020): 89.

A) Time Has a Total Subjective Existence

One of these views is relatively famous. It is the one of Augustine. In book XI of his *Confessions*, Augustine observes, like Aristotle, what is paradoxical about time's existence: time seems to have no objective reality since it exists only in the present instant, which has no extension, no duration:

> From what is not yet, through what has no length, time passes into what is now no longer.[460]

Yet, Augustine observes that in his soul, the past and the future exist in the state of the present:

> Perhaps it might be said rightly that there are three times: a time present of things past; a time present of things present; and a time present of things future. For these three do coexist somehow in the soul, for otherwise I could not see them. The time present of things past is memory; the time present of things present is direct experience; the time present of things future is expectation.[461]

Consequently, Augustine is led to think that time exists in the soul; in other words, that it has only a subjective existence. He explains the existence of time as the result of a "stretching out" of the indivisible present by the mind into the future and the past:

> It appears to me that time is nothing other than extendedness.[462]

He ends up suggesting that the reality of time might be nothing more than the stretching out of the soul itself:

> Extendedness of what I do not know. This is a marvel to me. The extendedness may be of the mind itself.[463]

B) Time Has a Total Objective Existence

The other example I shall present is the view expressed by a thinker who, despite being primarily a scientist and mathematician, can also be regarded as a philosopher: Issac Newton. In his *Principia*, he writes:

> Absolute, true and mathematical time, of itself, and from its own nature, flows equably without relation to anything external.[464]

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[460] Augustin, *Confessions*. XI. 21, 27. Trans. Hammons and Watts.
[461] *Ibid.* XI. 20, 26.
[462] *Ibid.* XI. 26, 33.
[463] *Ibid.*
[464] Isaac Newton, *Mathematical Principles of Natural Philosophy*, trans. Motte, University of California Press, vol. 1 (Los Angeles, 1962), 6–8 Scholium to the definitions.

The assertion that time is "absolute" and "flows without relation to anything external" implies that time exists objectively. Moreover, in asserting that time flows "of itself and from its own nature", it is as though Newton implies that time exists *per se* as a flowing substance, that it is a substance in motion. Now, a substance is what exists foremost, in a chief sense.[465] Newton's view is thus a strong statement in favor of time's objective reality.

Aristotle's Position: an Interpretative Challenge

Augustine and Newton can be considered as examples of answers that can be given to the problem: does time exist? They are interesting insofar as they are diametrically opposite. What is Aristotle's answer to this problem? This is an interpretative issue. While Aristotle presents this problem as an essential and very important one as he sets about inquiring into time, he never seems to respond to it afterwards, as though he had forgotten about the issue. Toward the end of his investigation, he does address what may appear as a similar, related problem: how does time depend upon the soul to exist? However, it is not clear what this problem has to do with the initial aporia. Indeed, the latter claims that the parts of time do not exist, while the former appeals to an argument contending that time could not exist without a soul capable of numbering, since time is a number. Moreover, as we shall see, Aristotle's solution to the problem of time's dependence upon the soul is ambiguous and much debated.

This chapter thus proposes to investigate whether Aristotle has a response to offer to the problem of time's existence, and if it so, what it is. Since he has posed this problem in terms of the aporia presented above, the chapter aims more specifically at examining whether it is possible to reconstruct Aristotle's answer to this aporia from his account of time. I will look for such an answer in considering two sections of Aristotle's inquiry in particular: his account of the now and his account of the relation of time to the soul. These correspond to an argument in two parts that I will develop.

[465] At least according to Aristotle.

Part I: The Objective Reality of Time

Clarifying the Problem

The aporia about time's existence is certainly perplexing. Yet, we cannot help but resist its conclusion since it contradicts our conviction that time exists, a belief well rooted in our experience. In Chapter 2, I have pointed to some signs that time exists: the word 'time' permeates our language, we measure it, we ascribe effects to it, etc. It is not because Aristotle has questioned the existence of time that he doubts that it exists. On the contrary, there are many indications that he takes the existence of time as a matter of fact. We have seen that he acknowledges quite spontaneously that time is everywhere in nature. His explanation for this is that "time and motion go together [ἅμα] in potentiality and in actuality"[466]. Time exists because it is "something of" motion, and motion exists. Furthermore, we have seen that Aristotle thinks natural things exist in time. Accordingly, he also thinks that time exists. He writes: "This follows necessarily, that if something exists in time there be some time that exists when this thing exists, and that a motion exists when there is something in motion."[467] Besides, he observes that time is a cause by accident (through motion) of some effects: corruption, decay, forgetting.[468] Since it is clear that these effects of time exist, time must exist as well. Finally, we can add the following as an indication that Aristotle does not doubt that time exists: although he has shown its existence to be problematic, he sets out on a search for its definition. Now, as explained in Chapter 2, Aristotle thinks that seeking the definition of something presupposes to know that it exists.[469] Therefore, the fact that he does not deem it necessary to show that time exists before seeking its essence indicates that he takes its existence for granted.

The objections raised by Aristotle against the existence of time are made in the dialectical part of the inquiry; therefore, they are dialectical arguments which, although being compelling, do not conclude with necessity. We have seen that in face

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[466] "ὁ δὲ χρόνος καὶ ἡ κίνησις ἅμα κατά τε δύναμιν καὶ κατ' ἐνέργειαν". *Phys*. IV. 14, 223a20-21.
[467] "ἐκεῖνο δ' ἀνάγκη παρακολουθεῖν, καὶ τῷ ὄντι ἐν χρόνῳ εἶναί τινα χρόνον ὅτε κἀκεῖνο ἔστιν, καὶ τῷ ἐν κινήσει ὄντι εἶναι τότε κίνησιν". *Phys*. IV. 12, 221a24-25.
[468] Cf. *Phys.* IV. 13, 222b16-28. *Per se*, naturals things get corrupted because they change; but because change happens in time, the latter is a cause of corruption by accident.
[469] Cf. *APo*. II, 8, 93a19-27.

of these arguments, Aristotle concludes that we can suppose that "time either does not exist altogether, or that it exists barely (μόλις) and obscurely (ἀμυδρῶς)"[470]. The fact that the existence of time is much ascertained by sensible experience suggests it is the second member of the disjunction that is true: time exists barely and obscurely. In other words, rather than showing that time does not exist at all, the objections raised against its existence show that its existence is puzzling, that it is not clear how it exists.

In light of these considerations, we can reasonably assume that the problem Aristotle is interested in is not: whether time exists; but rather: how does it exist? Accordingly, such is the problem for which we may expect to find a solution in his account of time.

The Root of the Problem

We can observe that the existence of time is problematic because a parallel problem concerns the existence of motion: like the parts of time, the parts of movement do not exist. Movement, like time, is divisible into a part before and a part after. Applied to movement, these terms, 'before' and 'after', are relative to the *momentum* of the moving body, which corresponds to its actual position on a path. A part of movement is said to be 'before' because it corresponds to a part of the path that the moving body has crossed; therefore, this part does not exist; and a part of movement is said 'after' for it corresponds to a part of the path that the moving body has not crossed yet; therefore, this part does not exist either. Thus, movement is composed of parts that do not exist. What exists of movement is the *momentum* which delimits the part that has been completed from the one which remains to happen, for the *momentum* corresponds to the actual existence of the moving body in some position. However, the *momentum* is not a part of movement because movement is divisible and the *momentum* is not divisible, being a division of movement. Hence, it seems impossible for movement to exist.

The same problem arises about time because time follows movement. The past does not exist because it follows a part of movement which is done, and the future does not

[470] *Phys*. IV. 10, 217b32-33.

exist because it follows a part of movement which has not begun yet. What exists of time is the now because it corresponds to the *momentum*, which is what exists of movement; and because the *momentum* is not a part of movement, the now is not a part of time either. Thus, it seems impossible for time too to exist because it seems impossible for movement to exist.

Even more than for the case of time, the idea that motion would not exist is absurd since there is barely anything we are better acquainted with by experience than motion. Aristotle thinks the existence of motion is as certain as the existence of nature[471]; we may not be able to explain what motion is and how it exists, but the fact that things are moving and that there is motion cannot honestly be denied. Thus, as for time, the aporia about the existence of motion is more a paradox than a reason to conclude, following Parmenides and Eleatic philosophers, that motion does not exist.[472]

Hypothesis of Solution

The paradox about time's existence is that its parts do not exist. Nevertheless, the 'now' seems to exist. In this regard, it is significant that the now is called "the present". The concept of 'present' connotes the idea of 'existence', and thus of something that exists. Therefore, the fact that the now is called "present" signals that it exists. We can also observe that the past and the future imply a reference to the present: as Augustine wrote in one of the previous quotes, the past is a present that is not anymore, and the future is a present that is not yet. This reference of the past and the future to the present is reflected in ancient Greek: the same word, *νῦν*, serves to designate both the present instant and any other instant, future and past. *Νῦν* literally means 'now', thereby designating primarily the present instant; its meaning has been extended to designate instants that are past and future. In referring to future and past

[471] In his criticism of the Eleatic philosophers, who denied the existence of motion, he writes: "We, on the other hand, must take for granted that the things that exist by nature are, either all of some of them, in motion – which is indeed made plain by induction." *Phys.* I. 2, 185a13-15. Also, Aristotle's solution to Zeno's objections against the existence of motion will be discussed to some extent further in this chapter.

[472] Cf. the following fragment from Parmenides: DK, B8.1-6. Zeno's arguments against the existence of motion will be discussed further.

instants by the name that refers chiefly to the present instant, the Greek language underscores the pre-eminence of the present instant in time, revealing that what exists of time is always the ‘now’.

Moreover, in Chapter 2, we have seen that we perceive time by perceiving the ‘now’ being before and after, and that we cannot perceive time otherwise.

These considerations suggest that time exists in the now. The now may not be time or a part of time; nevertheless, it belongs to time, it is something of time: its limit. And how could the limit of something exist without this thing existing?

In the dialectical part of the inquiry, the now was the object of an aporia which made its existence seem impossible: it must be either identical or different over time, but either of these alternatives apparently involves contradictions. When presenting this difficulty, I had explained that the point of it seemed to reinforce the objection that time does not exist. It was argued that time cannot exist because the future and the past do not exist. But someone could have replied that the present exists, and contended that time exists in the now. In order to forestall this avenue of solution, which is precisely the one I propose to explore, an additional aporia was presented to cast doubt about the existence of the now as well. Yet, at the end of chapter 2, we have seen that Aristotle, after defining time, solves this aporia by showing that the now is both identical and different over time, although in different respects. This difficulty having been removed, we can presume that the now exists, and conjecture that time might exist through the now.

When discussing Aristotle’s solution to the paradox involving the identity and otherness of the now, I have explained that this solution unveils the essence of the now. The now has been defined as the moving body insofar as it numbers movement (with respect to the before and after); or equivalently, as the *momentum* as it numbers movement. This definition shows that the now exists because it is “something of” the moving body, and the moving body exists. Moreover, the *momentum* is what exists of motion as the now is what exists of time. Indeed, the *momentum* is something of motion – its limit – and it exists insofar as it corresponds to the moving body which

exists. This suggests a parallel solution for the problem of motion's existence as for the problem of time's existence: motion exists in the moving body. Furthermore, because it is time that follows movement, not the converse, these considerations indicate that the solution to time's existence is the following: time exists in the 'now' because motion exists in the moving body.

Solution

In fact, we find toward the end of Aristotle's account of the 'now' a statement which supports this proposal. Aristotle writes:

> Clearly, too, if there were no time, there would be no now, and if there were no now, there would be no time. Just as the moving body and its locomotion exist together [ἅμα], so too do the number of the moving body and the number of its locomotion.[473]

In writing "if there were no time, there would be no now, and if there were no now, there would be no time", Aristotle means that time and the now imply the existence of each other. Aristotle infers this conclusion from the same premise which has served to conclude the attributes of the now (sameness, otherness, limit and measure of time): the now follows the moving body as time follows movement: as time is the number of movement, so the now is "the number of the moving body" (i.e. the moving body as it numbers motion.[474] Therefore, if movement exists with the moving body, proportionally, time, the number of movement, must exist with the now, "the number of the moving body".

As we have seen, both the existence of motion and time is problematic because their parts do not exist. Now, if the now and the moving body exist, and if time exists with the now as motion exists with the moving body, this implies that time exists in the now because motion exists in the moving body. Thus, Aristotle's argument in the previous passage – that time and the now exist together because motion and the moving body do – is an implicit solution to the problem of time's existence. In other

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[473] "φανερὸν δὲ καὶ ὅτι εἴτε χρόνος μὴ εἴη, τὸ νῦν οὐκ ἂν εἴη, εἴτε τὸ νῦν μὴ εἴη, χρόνος οὐκ ἂν εἴη· ἅμα γὰρ ὥσπερ τὸ φερόμενον καὶ ἡ φορά, οὕτως καὶ ὁ ἀριθμὸς ὁ τοῦ φερομένου καὶ ὁ τῆς φορᾶς." *Phys*. IV. 11, 219b33-220a4.

[474] As explained in chapter 2, the expression "the number of the moving body", which is a way to define the moving body by analogy with time, has the advantage of manifesting that the relation of the now to the moving body is proportional to the relation of time to motion.

words, we find in this argument a response to the aporia presented at the beginning of the inquiry.

Yet, this is insufficient to understand how time exists. The argument that time exists in the now rests on the premise that motion exists in the moving body. Now, although we may have some intuition that this premise is true, it requires explanation and justification. Moreover, it must be explained how it solves the difficulty about motion's existence, which is in sum the following: motion has extension since it is a quantity, but it has no extension in reality. The moving body may exist, but it corresponds to the *momentum*, and the *momentum* has no extension: it is indivisible. Thus, if we want to understand how time exists, we must understand how motion exists in the moving body.

How Motion Exists

Aristotle does not justify the claim that motion exists in the moving body in the context of his account of time, in *Physics* IV. However, elements that point toward an explanation can be found in what he says about the notion of 'being', in the *Metaphysics*, and by recalling his definition of motion and some of its implications.

All change consists in this: something that does not exist comes to exist from its opposite.[475] Thus, change itself does not seem to be "a being" for as long as a change is happening, the end of the change, which is some being, does not exist yet. Does it mean that change – and thus locomotion, which is one of its species – does not exist? As mentioned before, this is impossible, for we have the obvious experience that things are changing.[476]

'Be-coming' as a Sense of 'Being'

In the *Metaphysics*, Aristotle explains that 'being' is said in many ways:

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[475] Cf. *Phys*., I, 5.

[476] In this sense, Aristotle writes: "We … must take for granted that the things that exist by nature are, either all or some of them, in motion—which is indeed made plain by induction." *Phys*., I, 2, 185a13-15.

> There are many senses in which a thing is said to be, but all refer to one starting-point; some things are said to be because they are substances, others because they are affections of substance, others because they are process toward substance, or destruction or privations or qualities of substance or productive or generative of substance, or of things which are relative to substance, or negations of some of these things or of substance itself.[477]

'Being' is an analogous notion: it is said in many ways, or senses that all refer to a chief sense, which is 'substance'. Chief among these senses are quality, quantity, relation, position, possession, etc.[478] They are commonly referred to as 'categories' of being. Some of these categories are evoked in the previous passage as Aristotle says that some things are said to be because they are "affections", "qualities" of substance or "relative" to substance. But as the passage suggests, there are other senses of 'being' than the categories. Other things can be said to be relatively to the categories and ultimately to substance. Even 'non-being' can be said to be insofar as it is a privation of being.

The analogy of 'being' makes room for change to be attributed existence in a certain way. As said before, in every change, something comes to being from nonbeing. Thus, if change is not absolute being, it is neither absolute nonbeing; change is "be-coming", the coming to being of something which does not exist yet. Change is thus a process toward being: substance, quality, quantity, position. In the previous passage, Aristotle has written that some things are called 'being' "because they are process toward substance… or of things which are relative to substance." Therefore, change can be said to be insofar as it is a coming to existence, a process toward being; and since motion is a species of change, a change with respect to location, it can be said to be, to exist.

Be-Coming Must Be Referred to 'Being'

Since change is a becoming, its existence must be referred to what exists according to some of the categories of being. In the chapter where he defines change, Aristotle writes:

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[477] *Met*. IV, 2, 1003b5-10.
[478] *Ibid.*1003a33-b4.

> There is no such thing as motion over and above the things. It is always with respect to substance or to quantity or to quality or to place that what changes changes. But it is impossible, as we assert, to find anything common to these which is neither 'this' nor quantity nor quality nor any of the other predicates. Hence neither will motion and change have reference to something over and above the things mentioned; for there is nothing over and above them.[479]

In a change, what comes to be is either a substance, a quality, a quantity or a position in space. The existence of change must therefore be referred to these categories of being; locomotion to place, alteration to quality, growth and decay to quantity, and substantial change to substance.

Moreover, let us recall that every change presupposes the existence of a subject that remains identical. In the case of accidental change, the subject is a substance: change of quality exists because there is some substance which becomes of some quality; a change of quantity exists because there is some substance which becomes of some quantity; a change of place exists because there is some substance which comes to exist in a location where it was not before. Thus, the existence of motion ultimately depends and refers to the existence of a substance, which exists in the first sense of 'being'.

From these considerations, we can conclude that locomotion, change of place, exists insofar as there is some substance, which exists in the first sense of 'being', that comes to be in some place.

Motion: A Certain Being in Actuality

Being is also said in these two fundamental ways: something can exist "in actuality" or "in potentiality". Being in actuality is the mode of existence of what really exists. Therefore, if motion really exists, it must be a being in actuality. In fact, motion is precisely defined by Aristotle as a being in actuality: it is defined as "the actuality of what is in potentiality, as such." Hence, motion really exists.

In the definition of motion, we verify the points made before. Motion is the actuality of a substance, so its existence depends upon the existence of a substance. Moreover,

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[479] *Phys.* III. 1, 200b32-201a4. Trans. Hardie and Gaye.

motion exists in a substance insofar as the latter is in potentiality of being something which it is not actually yet. Motion thus implies a reference to being. Likewise, because the substance in which motion exists remains in potentiality until the movement ends, motion is becoming, not full being. It is a mix of actual and potential being. For this reason, Aristotle explains, what motion is and its existence are difficult to grasp:

> Motion is thought to be a sort of actuality, but incomplete, the reason for this view being that the potential whose actuality it is is incomplete. This is why it is hard to grasp what motion is. It is necessary to class it with privation or with potentiality or with simple actuality, yet none of these seems possible. There remains then the suggested mode of definition, namely that it is a sort of actuality, or actuality of the kind described, hard to grasp, *but not incapable of existing*.[480]

Motion Exists in a Successive Mode

Insofar as motion is an incomplete actuality, it exists in a different way from substances, which exist in actuality. In this sense, Aristotle explains in *Metaphysics* IX. 6 that 'being in actuality' is not a univocal notion:

> But all things are not said in the same sense to exist actually, but only by analogy… for some are as movement to potentiality, and the others as substance to some sort of matter.[481]

Afterwards, as examples of things that do not exist like substances, that is fully in actuality, he gives the examples of infinite and void:

> The infinite and the void and all similar things are said to exist potentially and actually in a different sense from that in which many other things are said so to exist…The infinite does not exist potentially in the sense that it will ever actually have separate [real] existence; its separateness is only in knowledge. [482]

The mention of the infinite in this passage is interesting: it will help us to understand better how motion exists. Aristotle explains how the infinite exists in *Physics* III:

> The infinite has a potential existence. But we must not construe potential existence in the way we do when we say that it is possible for this to be a statue—this will be a statue, but something infinite will not be in actuality. Being is spoken of in many ways, and we say that the infinite is in the sense in which we say it is day or it is the games, because something other and other always comes to be. For even in these things there is existence in potentiality and

[480] *Phys*. III. 2, 201b32-202a3. Trans. Hardie and Gaye.
[481] *Metaph*. IX, 6, 1048b6-15. Trans. Ross.
[482] *Ibid*., 1048b9-11. Trans. Ross.

> existence in actuality. We say that there are Olympic games, both in the sense that the games may occur and that they are actually occurring.[483]

Aristotle illustrates how the infinite exists by contrasting two modes of existence: on the one hand, the mode of existence of a statue; and on the other hand, the mode of existence of "day" and "Olympic games". A statue exists totally in actuality, for when it exists in potentiality in a material like bronze, and the latter is actualized, all the parts of the statue exist in actuality. As a result, the statue has a simultaneous mode of existence.

In contrast, day and Olympic games are examples of things that exist both in actuality and in potentiality. To take the case of Olympic Games, when the third day of the games is actually happening, the fourth day is potentially happening. As a result, the Olympic Games have a successive mode of existence.

From the cases where the infinite most obviously exist – time, the generation of human beings and the division of magnitudes – we observe that it exists in the following way:

> Generally the infinite has this mode of existence: one thing is always being taken after another, and each thing that is taken is always finite, but always different.[484]

The infinite never exist totally in actuality for there is always a part of it that remains in potentiality. Indeed, it is always possible to add some quantity to a definite quantity. For example, in the case of the division of magnitudes, it is always possible to divide a magnitude one more time. Insofar as the infinite exists both in actuality and in potentiality, it exists like day and the Olympic Games, not like a substance.

The text previously quoted of *Metaphysics* IX suggests that insofar as the infinite does not exist fully in actuality, its actuality is like the one of motion, not like the one of a substance. Thus, the way Aristotle has characterized the mode of existence of infinite in *Physics* III should apply to motion as well. Aristotle has compared the mode of existence of the infinite to the one of day and Olympic Games. Now, we can

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[483] *Phys.* III, 6, 2016a18-25. My Trans.
[484] *Phys*. III, 6, 206a27-30. Trans. Hardie and Gaye.

observe that in fact, the mode of existence of movement is very like the one of Olympic Games, to take this example. Like the Olympic Games, motion exists successively: its parts do not all exist together as the parts of a statue, but one after the other. This is why, in chapter 1, motion has been classified among quantities whose parts don't have position since they have no permanence. In fact, there is not even a part of motion that exists simultaneously; what exists at one time is a *momentum* of motion.

According to the explanation of *Physics* III, this is because Olympic Games exist both in actuality and in potentiality that they exist successively. This is also why motion exists successively. As I have explained, the definition of motion – the actuality of something in potentially *as in potentiality* – implies that that it is not a full actuality, but a mix of potentiality and actuality. As a result, motion is not actualized at once, but successively, through the *momentum* corresponding to the moving body. For example, a moving body is in motion at a position insofar as it is potentially in a further position; this is why it passes successively through different positions, and why the parts of its motion are completed one after the other.

Motion Exists in a Successive Mode in the Moving Body

In sum, motion exists because there are different ways to exist. Motion exists because there is an existing substance, the moving body, that is in the process of being in a certain way – in a certain place. This process, this be-coming is a being in actuality, but not in the same sense as the actuality of a substance; it is not a total actuality, but one mixed with potentiality. Consequently, motion exists in a successive mode, not in a simultaneous mode.

Having investigated how motion exists, we are in a position to understand Aristotle's claim that "motion and the moving body exist together"[485]. Motion is the actuality of a moving body as mobile. Therefore, if there is a moving body, it is actualized by motion and motion exists as the actuality of it. Aristotle writes: "That this is what motion is, and that it happens [συμβαίνει] whenever the actuality [ἐντελέχεια] itself

[485] 11, 220a1-2.

exists, and not before nor after, is clear."[486] Conversely, if motion exists, there must be a moving body actualized by motion.

Solution of the Aporia about the Existence of Motion

This enables us to resolve the problem of the existence of motion. Let us recall that this problem arises because none of the parts of movement exists, but only the indivisible of movement: the *momentum*.

General Answer

The *momentum* is the moving body regarded as before and after; it corresponds to the moving body being in a particular position. Now, if the moving body exists, motion must exist in it. Therefore, motion exists at any *momentum* of the movement; indeed, at any *momentum*, the moving body exists and motion exists in it. However, as it moves, the moving body is in different positions successively. Accordingly, motion, which exists in the moving body, exists successively too. This explains why motion does not exist as a whole, and why not even one of its parts exists. Motion exists on a successive mode in the moving body (or through the moving body, or by the moving body).

The Momentum Is Not an Actual Division of Movement

The objection that motion cannot exist because what exists of motion is only a *momentum* (and a *momentum* is not motion, being indivisible) can be answered by distinguishing, as Aristotle does in his account of the now[487], two aspects of the moving body: a material aspect and a formal aspect. The formal aspect is the moving body regarded as before and after. The *momentum* is the moving body regarded under this formal aspect. In this respect, the moving body is different over the movement and thereby makes movement divisible; this is why movement is divisible by the *momentum*.

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[486] "ὅτι μὲν οὖν ἐστιν αὕτη, καὶ ὅτι συμβαίνει τότε κινεῖσθαι ὅταν ἡ ἐντελέχεια ᾖ αὐτή, καὶ οὔτε πρότερον οὔτε ὕστερον, δῆλον·" *Phys*. III, 2, 201b5-7.
[487] Cf. Chap. 2.

Since the *momentum* is the moving body regarded under its formal aspect, it is materially identical with the moving body; in other words, the subject of the *momentum* is the moving body. Considered under its material aspect, i.e. as a subject, the moving body is a certain substance in motion, and it makes movement continuous since it is identical over the movement: it is the same substance that is moving before and after.

Thus, as a limit between parts of movement, the *momentum* is only a potential division of movement. Indeed, its subject is the moving body which makes movement continuous. If the *momentum* was an actual division of motion, the moving body would actually be in a particular position corresponding to the *momentum*; it would rest there. Rather, the actuality of the moving body at any position is motion itself; the moving body is only passing through a position in order to arrive at another position.

Thus, we see that the objection that motion cannot exist for it would have to exist in a *momentum* proceeds from a false assumption, namely that the *momentum* actually exists. But it is not the case. What actually exists is the moving body, and motion exists continuously through it. The *momentum* exists as a division of motion only for the mind, which divides motion when it regards the moving body as being before and after.

An analogy may help to understand this point. If we look at the picture of a moving object, for example a runner, we cannot see its motion on the picture, we cannot see it moving; what we see is the runner being in one position. Accordingly, there is objectively no difference between such a picture and the one of someone which rests, stands still in the same position. However, the runner was moving when the picture was taken, so the picture represents someone who in reality is running.

The situation is similar with our knowledge of motion. Because motion exists successively, it is impossible to perceive motion, strictly speaking. What we in fact perceive when we say that we perceive motion is the moving body being at different positions in a successive way. In doing so, the mind divides movement and gives the

momentum actuality. But in reality, motion is not divided and the *momentum* does not actually exist, otherwise the mobile body would be at rest.

Although, strictly speaking, the *momentum* does not actually exist, we can say that it does in a certain sense. Indeed, the *momentum* corresponds to the moving body as it is actually in motion in a particular position along the path. Thus, it refers to the actuality of the moving body, as opposed to where it was before and where it will be after. In this sense, the *momentum* can be seen as an actual limit of motion. A limit has two functions: it is the continuity and the division of a continuum. The *momentum* does not actually divide motion. However, perhaps we can say that it is the actual continuity between two parts of motion, one before and one after. Understood in this sense, perhaps we could say that motion really exists through the *momentum* (or in the *momentum*, or by the *momentum*, or at the *momentum*). After all, motion exists in the moving body, and insofar as the moving body is before and after, it corresponds to the concept of *momentum*; thus, saying that motion exists through the *momentum* can signify that motion exists through the moving body. In any case, because the *momentum* does not exist as an actual division of motion, it is more exact to say that motion exists in the moving body.

How Time Exists

Now that we understand how motion exists, we can explain how time does.

Time Exists in a Successive Mode through the 'Now'

Let us recall that because movement exists with the moving body and the now follows the moving body, Aristotle has argued that time exists with the now. Given that what exists of time and motion is respectively the now and the moving body, I have explained that the statement that time exists with the now implies that time exists through the now.

More precisely, here is the reasoning supporting this conclusion. The now is the moving body insofar as it numbers movement with respect to the before and after. The now must therefore exist when the moving body exists. Moreover, time is the

number of motion, so time must exist when motion exists. Now, we have established that motion exists through the moving body. Therefore, time must exist through the now for when the now exists, motion exists through the moving body, and time is motion numbered by the now. Furthermore, because motion exists on a successive mode through the moving body, time too, proportionally, exists on a successive mode through the now.

Solution of the Aporia about Time's Existence

We recall that, as it is posed in the terms of the introductory aporia, the problem about time's existence is the following: since its parts don't exist, it seems impossible that time exists. To this objection against time's existence, we can now reply the following.

General Answer

Although the parts of time do not exist, the now exists because it is "something of" the moving body, and the moving body exists. But if the now exists, time must exist through it. Therefore, time exists through the now. The parts of time do not exist because time exists in a successive mode. It exists in a successive mode because it follows motion, which exists successively in the moving body. Time exists by the now, which exists successively because it follows the moving body which is before and after. Thus, time exists successively through the now.

The Instant is not an Actual Division of Time

The objection that time cannot exist through the now on account of its indivisibility can be answered in the same way as the one concerning movement and the *momentum*. From Aristotle's account of the now, studied in chapter 2, we recall that the now has a formal aspect and a material aspect because it follows the moving body, which also has this double aspect. With respect to its form, the now is the moving body as numerable insofar as it is before and after. It thus corresponds to the *momentum* of movement, the formal aspect of the moving body; it is the *momentum* as numerable. Regarded under his formal respect, the now is different over time,

being before and after like the moving body; it corresponds to different instants and makes time divisible.

The now also has a material aspect which is its subject, the moving body as a subject in motion. In this respect, the now is identical over time because the moving body is materially identical throughout motion. As such, the now makes time continuous just as the moving body makes motion continuous through its unity.

In sum, the now is the subject of time, as the moving body is the subject of motion; it can be regarded as a flowing entity which generates the continuum of time in being formally different, but materially identical. We can speak of a "material now" and of a "formal now" in reference to the material aspect and the formal aspect of the now. When we say that the present instant is the indivisible limit of time, we refer to the formal now, or the now under its formal aspect. Indeed, the limit of time is this by which time is divisible, and it is with respect to its formal aspect that the now makes time divisible. But with respect to its material aspect, the now is the continuity of time for it corresponds to the moving body as subject of motion. Hence, the instant, the formal now, only exists potentially – like the *momentum* of movement to which it corresponds. If it existed actually, the now would divide time actually; this would imply that the now be at rest in the instant, and that the flow of time be interrupted. This is of course impossible; time is continuously flowing since the now follows the moving body which is continuously moving. As explained before, the moving body is not actually in any particular position during its motion because its actuality is motion itself. Likewise, we can say that the now is not actually different, before or after over the course of time, but that its actuality is always the one of time.

The objection that time cannot exist in the present instant overlooks the twofold distinction between the formal now and the material now; it identifies the now with its formal aspect and reduces its being to this aspect. It is true that time does not exist in the formal now since it is a division of time. However, the formal now does not actually exist, like the *momentum* of motion to which it corresponds. What actually exists is the material now because it corresponds to the moving body, which is what

actually exists of motion; and time continuously exists through the material now – as motion exists continuously through the moving body.

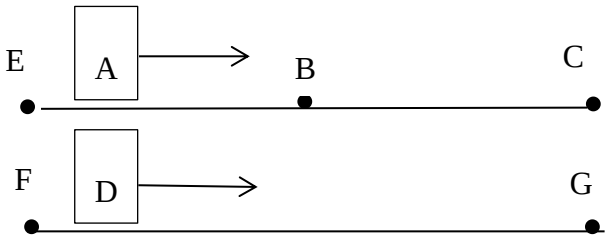
A Variant of Zeno's Paradox

The problem of time's existence and its counterpart, the problem of motion's existence, can be seen as variants of Zeno's paradox. In *Physics* VI, chapter 9, Aristotle mentions four forms of Zeno's paradox. One of them contends that an arrow having been thrown does not really move for the following alleged reason. At any instant during its motion, the arrow is in a certain place and must either move or rest there. But no motion can happen during an instant of time. Therefore, the arrow must be at rest in that position. Now, since this must happen at every instant during the motion, the arrow must be immobile at all points along the path of the motion. The argument thus concludes that the arrow does not move at all.

Before seeing how Aristotle deals with this paradox, let us consider a similar problem that he presents in *Physics* VIII, chapter 8:

> Suppose the line E is equal to F, that A proceeds in continuous locomotion from the extreme point to C, and that, at the moment when A is at the point B, D is proceeding in uniform locomotion and with the same velocity as A from the extremity of F to G: then D will have reached G before A has reached C; for that which makes an earlier start and departure must make an earlier arrival. For A has not simultaneously come to be and ceased to be at B, which is why it is late.[488]

In sum, the situation is that two moving bodies, A and D, are carried at equal speeds over lines of equal length, EC and FG, starting at the same time. We imagine that one of the lines is divided by a point, B, whereas the other line is not. Here is a figure:



[488] *Phys*., VIII, 8, 262b10-17. Trans. Hardie and Gaye.

It is then alleged that A will arrive at C, the term of the line EC later than D arrive at G, the term of the line FG. The reason can be deduced from considerations which Aristotle makes in a preceding passage, as he explains why reflexive motion cannot be continuous[489]. B divides the line EC into two lines, EB and BC. B is therefore double: it is end of the line EB and beginning of the line BC. Moreover, the moving body A cannot be at point B as beginning and end at the same time: it must arrive at it as end and depart from it as beginning at different instants. Therefore, A must pause its motion at the point B. Since there is no such middle point that divides the line FG, D moves over the line FG without stopping. Thus, it is alleged that A will arrive at its destination later than D, which obviously contradicts what we know by experience.

This aporia is akin to Zeno's paradox of the arrow: while in Zeno's paradox, it is argued that the arrow cannot move in the instant, here it is argued that the moving body A cannot move in a point on the path (the point B). If we follow the logic of this reasoning, we could argue, as in the paradox of the arrow, that a moving body cannot move at all on a magnitude for it must always be at a certain point along the magnitude, and it must, at any point, be at rest.

The problem of motion's existence alleges that motion cannot exist, for what of movement exists at any instant is a *momentum*; similarly, the problem of time's existence is that time cannot exist, for what of time exists of is an instant. Since the instant of time follows the *momentum* of motion, and the *momentum* of motion corresponds to the moving body being at one point on the magnitude, these problems can be regarded as corollaries of Zeno's paradox of the arrow, and thereby as variants of it. Indeed, the arrow's paradox essentially contends that a body cannot move because it would have to move in an instant of time; it is thus equivalent to saying that it cannot move in a point of magnitude, or in a *momentum* of motion.

The general response of Aristotle to Zeno's paradoxes is that it rests on a false assumption – that the indivisible exists actually in the continuous.[490] In particular, he responds to the paradox of the arrow by arguing that the arrow is not moved in the

[489] *Ibid.* 261a19-b8.
[490] Cf. *Phys*. VIII. 8, 263a22-263b8.

instant but in time, which is not composed of instants that exist in actuality: "Zeno's reasoning, however, is fallacious … for time is not composed of indivisible nows any more than any other magnitude is composed of indivisibles."[491] Likewise, in the problem of the two bodies moving at the same speed, he essentially argues that a body is not moved at a point, but on a magnitude which is not composed of points existing actually.[492]

Since the problems of time's and motion's existence can be considered as variants of the arrow paradox, Aristotle's solution applies to them as well. As for any of Zeno's paradoxes, the solution consists in distinguishing the potential from the actual. Motion exists at any *momentum* for movement is not composed of momenta, which are only potential divisions. What actually exists is the subject of the *momentum*, the moving body, and motion exists through it since it moves continuously. Likewise, time exists at the present instant for time is not composed of instants, which are only potential divisions. What actually exists is the subject of the present instant, the material now, and time exists through it since it flows continuously.

Summary of Part I

Let us recapitulate and conclude this first part of the chapter. The goal of this chapter is to examine how Aristotle thinks time exists. Aristotle poses the problem of time's existence through the following aporia: time is a quantitative whole, but its parts – the past and the future – do not exist. After observing that this problem arises because time follows movement, and a parallel problem concerns the existence of motion, I have made the suggestion that time may have some objective existence through the limit of its parts, the 'now'.

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[491] *Phys*. VI, 9, 239b5-9. Trans. Hardie and Gaye.

[492] More specifically, he shows that the moving body that presumably arrives late does not stop moving at the point B on account of a principle that he has explained before: no point on the path of a movement exists in actuality (is an actual middle) unless the moving body pauses at that point. If the motion is continuous, a point on the magnitude is only a potential middle. Therefore, the moving body does not arrive and depart from it, but is in it only at an instant: "Therefore we must not hold that when A came to be at B, D was at the same time in motion from the extremity of F; for the fact of A's having come to be at B will involve its ceasing to be there, and the two events will not be simultaneous, *whereas the truth is that A is at B at a sectional point of time and does not occupy time there*." *Phys.* VIII, 8, 262a22-33. Trans. Hardie and Gaye.

This hypothesis has been confirmed. We have seen that at the end of his account of the now, Aristotle maintains that time and the now exist together because motion and the moving body exist together. I have explained that since the parts of motion and time do not exist, this statement implies the following: time exists through the now because motion exists through the moving body. In order to understand why time exists, we thus had to understand why motion exists through the moving body.

An analysis of what Aristotle says about 'being', 'motion' and 'actuality' has led us to understand the following: motion exists as the imperfect actuality of a substance that comes-to-be in a certain position, namely the moving body; as a result, motion exists on a successive mode in the moving body which is before and after, which explains why its parts do not exist. Because motion exists through the moving body, proportionally, time exists through the now, since the now is something of the moving body – "the number of the moving body"[493]– and time something of motion – the number of motion. Moreover, because motion exists successively through the moving body, proportionally, time exists successively through the now; this is why the parts of time do not exist, like the parts of motion. Finally, we saw that the indivisibility of the present instant does not prevent time from existing through the now since the now is twofold: we can distinguish between "a material now" and "a formal now". The instant corresponds to the formal now, which exists only potentially. What exists actually is the material now, and time exists continuously through it because it corresponds to the moving body, and motion exists continuously through the moving body.

Mobile Substance: the Ground of Time's Objective Reality

In sum, we can conclude that according to Aristotle's account of time, time has an objective reality which is grounded in the existence of the moving body. Such is the implication and profound meaning of his claim that "time exists with the now because motion exists with the moving body".

[493] *Phys.* IV. 11, 220a3.

At the beginning of the chapter, I observed that it is significant that the now is called "the present" since 'present' evokes the idea of something that exists. We now understand that the now is called "the present" because it refers to the existence, the actuality of a moving body. The now corresponds to the presence, the actual existence of the moving body as it is before and after in different positions. Because the actuality of the moving body is successive (on account of motion), the "now" is not formally the same over time, but before and after. Considered as before, the now is called "past" because it refers to a prior actuality, state of existence of the moving body; and considered as after, it is called "future"[494] because it refers to a posterior actuality of the moving body. In any case, the now is always "present" insofar as it always refers to the presence, actuality of the moving body. The past is a present that is not anymore, and the future is a present that is not yet.

Since the moving body is a substance, to say that the objective reality of time is grounded in the moving body means that the existence of time is rooted in the existence of a substance. This is coherent with what has been said regarding the notions of 'being' and 'motion'. We have seen that the existence of motion, a becoming, must be referred to the being of what exists in the chief sense, substance. Thus, the existence of time, which follows motion, must also be referred to the existence of substance. More specifically, the existence of time depends upon the existence of a substance as mobile, for time exists in a substance through motion, and it is as mobile that a substance is moving. Glen Coughlin summarizes the point: "Time must be something of a substance which changes, i.e., it is something of a mobile as such... It is of the mobile in virtue of motion. For what belongs to the mobile as such is motion."[495]

Furthermore, since a mobile substance is a natural substance, namely a substance which has nature as a principle of motion and rest *per se* and in itself, the ultimate principle that explains the existence of time is nature. This conclusion is similar and consistent with the one drawn in chapter 3, where we had seen that nature is the

[494] From the latin *futurum*, a participle meaning "what is on the point of being".
[495] Glen Coughlin, 'The Existence and Nature of Time', *Peripatetikos* 1, no. 8 (2012): 131.

principle explaining why things exist in time (that is have their existence measured by time).

Finally, it should be noted that it is not in any natural substance that the existence of time is grounded. In chapter 3, we have seen that time follows a first movement. Accordingly, the existence of time is rooted in the existence of one particular substance: a first mobile. Likewise, the 'now', the present instant which is simultaneously the same everywhere in the cosmos refers to the presence, the actuality of this first mobile substance. I have explained that according to Aristotle's cosmology, such a substance is the outermost heavenly sphere.

Part II. Time's Relation to the Soul

The subject of this chapter is to discuss how Aristotle thinks time exists. In the first part, I have argued that time exists objectively through the now. Yet, this does not solve completely the problem of time's existence. Indeed, let us recall that this problem, which was posed by Aristotle in the opening aporia, is essentially the following: time is a quantitative whole divisible into past and future, but such a whole is found nowhere in reality. The now may exist, and time may exist through the now, but the now is not even a part of time. This suggests that the existence of time is not only objective but also subjective. Indeed, where is it that we find time existing as a whole, if not in the mind? As Augustine said[496], the past exists in the mind thanks to a faculty of memory, and the future thanks to a faculty of expectation.

Thus, it seems that time also depends upon the mind to exist. But what is the nature and extent of this dependence? The conclusion established in the first part of the chapter – time exists objectively in the now – excludes the suggestion that time be entirely subjective, a pure construction of the mind. Nevertheless, if we grant that time only exists as a whole in the mind, we face the problem of explaining how our representation of time can be true, conformed to reality: if only the present exists, is not our conception of time composed of past and future merely a fiction? These are

[496] Cf. the quote in the introduction of the chapter.

some of the questions that will be dealt with in the second part of this chapter, whose objective is to examine the relation of time to the soul.

An Interpretative Problem

Aristotle himself raises and addresses the problem of time's dependence upon the soul toward the end of his inquiry in a small, dense and controversial passage. My discussion of this problem will consequently concentrate upon the interpretation of this passage, quoted here:

> Whether time would exist or not if the soul did not exist, one could doubt [ἀπορήσειεν]. If it is indeed impossible that what will number [ἀριθμήσοντος] exist, then it is also impossible that something numerable [ἀριθμητόν] exist, so that it is manifest that a number cannot exist either. 'Number', indeed, is either what is numbered [τὸ ἠριθμημένον] or what is numerable [τὸ ἀριθμητόν]. If then, nothing else may naturally number [ἀριθμεῖν] but the soul and the intellect [νοῦς] of the soul, it is impossible that time exist if the soul does not exist, except that which, being at a certain instant, time is [τοῦτο ὅ ποτε ὂν ἔστιν ὁ χρόνος][497], for example, if it is possible for movement to exist without the soul. Indeed, the before and after are in movement, and these are time insofar as they are numerable [ἀριθμητά].[498]

In this passage, Aristotle not only poses the problem of the dependence of time on the soul, but also responds to it. However, the text is so dense and ambiguous that it is hopeless to find Aristotle's answer without a good deal of interpretive work. In fact, the sense of the passage has been debated since Antiquity. What is at stake is to know whether Aristotle thinks that the existence of time depends upon the soul, in what way and why.

The origin of this interpretive dispute can be traced back to Boethus of Sidon[499] in Antiquity. In the beginning of the passage, Aristotle draws the conclusion that time could not exist if the soul did not exist from the following premise: a number, which

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[497] The meaning of the formula *τοῦτο ὅ ποτε ὂν ἔστιν* in the context of the passage will be discussed further down.

[498] "Πότερον δὲ μὴ οὔσης ψυχῆς εἴη ἂν ὁ χρόνος ἢ οὔ, ἀπορήσειεν ἄν τις. ἀδυνάτου γὰρ ὄντος εἶναι τοῦ ἀριθμήσοντος ἀδύνατον καὶ ἀριθμητόν τι εἶναι, ὥστε δῆλον ὅτι οὐδ' ἀριθμός. ἀριθμὸς γὰρ ἢ τὸ ἠριθμημένον ἢ τὸ ἀριθμητόν. εἰ δὲ μηδὲν ἄλλο πέφυκεν ἀριθμεῖν ἢ ψυχὴ καὶ ψυχῆς νοῦς, ἀδύνατον εἶναι χρόνον ψυχῆς μὴ οὔσης, ἀλλ' ἢ τοῦτο ὅ ποτε ὂν ἔστιν ὁ χρόνος, οἷον εἰ ἐνδέχεται κίνησιν εἶναι ἄνευ ψυχῆς. τὸ δὲ πρότερον καὶ ὕστερον ἐν κινήσει ἐστίν· χρόνος δὲ ταῦτ' ἐστὶν ᾗ ἀριθμητά ἐστιν."*Phys*. IV. 14, 223a21-29.

[499] An Aristotelian of the first century BC whose work on time is identified by Pamela Huby, 'An excerpt from Boethus of Sidon's commentary on the *Categories*', *Classical Quarlerly* 31 (1981), 398-409.

is numerable, cannot exist without the soul. Boethus is reputed to have objected to this premise by the means of an analogy with the sensibles. Simplicius reports his objection in his commentary:

> Boethus attacks this argument, saying that nothing prevents there being the numerable things quite apart from the numerator, as there can be the perceivable things without a perceiver.[500]

Two General Interpretations

Boethus' objection has given rise to two types of interpretation of Aristotle's passage among commentators.

The "Subjectivist" Interpretation

On the one hand, there are commentators who think that Boethus is wrong: Aristotle is presenting a valid argument whereby he concludes that time depends upon the soul to exist because it is a number and the numerable, which 'number' designates, cannot be without the soul. This interpretation is defended by Themistius, Alexander of Aphrodisias, Simplicius and by several recent commentators.[501] According to this interpretation, Aristotle would maintain that if the soul did not exist, time would not exist but only its subject: movement.

The "Realist" Interpretation

On the other hand, there are commentators who agree with Boethus: they think that the argument concluding that time cannot exist without the soul because it is a number, is invalid. Accordingly, they think that this conclusion does not reflect Aristotle's view. Aristotle's position would be that time exists objectively, and the reason for it would be found in the second part of the passage. This interpretation is proposed by Albert and Aquinas, and by a few modern commentators.[502]

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[500] Simplicius, *On Physics* IV. 759, 18-20. Trans. Urmson.
[501] Sentesy 2017, Harry 2015, Loughlin 2011, McGinnis 2003, Roark 2011, Coope 2005.
[502] Lazzarini 2015, Giordani 1995, Goldschmidt 1982, Dubois 1967, Festugiere 1934.

Discussion of Aristotle's Position

Prior to beginning the exegesis of the passage, it can be noticed that the interpretation claiming that the subjectivist interpretation is unlikely to be correct. It has just been argued that time has objective reality for it exists in the now. And there are other considerations, mentioned in the introduction of the chapter, which signal that Aristotle's conception of time is a realist one. Let us recall these considerations. He acknowledges that time is everywhere in nature and as a reason for that, he writes that "time and motion go together [ἅμα] in potentiality and in actuality"[503]. Thus, if motion exists, time must exist too. Besides, in the section where he analyzes what it is to be in time, he writes: "This follows necessarily, that if something exists in time there be some time that exists when this thing exists, and that a motion exists when there is something in motion."[504]

Given these strong indications that Aristotle thinks time exists objectively, he would likely contradict himself if he were to argue that time cannot exist without the soul. Because only one of the interpretations I have presented saves Aristotle from committing such an inconsistency, I will consider and discuss this interpretation in the first place. Since it is particularly well developed in Aquinas' commentary, I will expound and discuss his reading of the controversial passage. Other readings will be discussed as objections to his.

Aquinas sees two parts in Aristotle's argumentation. In the first part of the passage, Aristotle would present an objection against time's objectivity. In the second part of the passage, he would present his own position. My discussion of Aquinas' interpretation will consequently follow this structure.

An Objection to Time's Objectivity

In the first part of the passage, Aristotle presents an argument concluding that time cannot exist without the soul. Let us first reformulate this argument. Time is a

[503] "ὁ δὲ χρόνος καὶ ἡ κίνησις ἅμα κατά τε δύναμιν καὶ κατ' ἐνέργειαν". *Phys*. IV. 14, 223a20-21.
[504] "ἐκεῖνο δ' ἀνάγκη παρακολουθεῖν, καὶ τῷ ὄντι ἐν χρόνῳ εἶναί τινα χρόνον ὅτε κἀκεῖνο ἔστιν, καὶ τῷ ἐν κινήσει ὄντι εἶναι τότε κίνησιν". *Phys*. IV. 12, 221a24-25.

number, and 'number' [ἀριθμὸς] designates either what is numbered [τὸ ἠριθμημένον] or what is numerable [τὸ ἀριθμητόν]. Now, what is numerable does not exist unless a potency to number [ἀριθμεῖν] exists, and only the soul has this potency – more precisely the rational part of the soul, the intellect [νοῦς]. Therefore, it is impossible for there to be time if a soul does not exist.

Numerable Numbers have Objective Reality

Aquinas thinks this argument draws a false conclusion because it is based upon a wrong premise, namely that a number cannot exist independently of the soul. He writes:

> Things numbered being posed [positis], it is necessary that a number be posed [poni] as well. Therefore, a number depends upon what numbers as the things numbered depend upon it… Now, the essence [esse] of the things numbered does not depend on the intellect. Therefore, neither a number depends on the intellect of the soul; but only its numbering [numeratio], which is an act of the soul, depends upon the intellect of the soul.[505]

A number exists if there are things numbered or numerable. Now, things numbered or numerable do not depend upon the soul to exist. Therefore, neither is it the case for their number. A number of things depends upon the soul only for being counted, that is for having its quantity measured, known by the soul. More specifically, it depends on the intellect of the soul because the act of measuring involves comparing a quantity with a unit (of measure) to grasp a ratio, and comparison (comparatio) is an act of reason (ratio).

According to Aquinas, Aristotle meant this argument to be an objection against the view that time exists independently of the soul. He is not committed to the conclusion of the argument for he does not really think the premise the argument is based upon – that numbers depend upon the soul to exist – is true.

I think Aquinas is correct. As mentioned before, Aristotle defines a number as a multiplicity measurable by a unit.[506] Now, a multiplicity is simply a plurality of

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[505] Aquinas, *On Phys.* IV, lect. 23, no.5. My Trans.
[506] *Met.* X. 6, 1057a2-4.

units[507], and if it is finite, it is measurable by one of its units. Thus, a finite multiplicity is a number, as Aristotle writes in *Metaphysics* V.[508] Moreover, multiplicity is a species of quantity – a quantity whose parts are discrete. Hence, number is a species of quantity. But quantity exists in reality: it is one of the categories of being. A number, which is a discrete quantity, thus exists in reality. In *Phys*ics III, 7, Aristotle writes that "a number is many units and a quantity of certain things."[509] Insofar as there is a multiplicity of things, this multiplicity forms a number and there is a number that really exists. Each thing is a unit insofar as it is individual, can be regarded as indivisible, and the multiplicity forms a number insofar as it is measurable by one of its units. For example, it is clear, in the following passage, that Aristotle regards a multiplicity of horses as a number that exists objectively:

> We measure the number by what is numbered, e.g. by one horse the number of horses… For by the one horse we know the number of the horses itself.[510]

The number exists as the quantity of the horses; it is the multiplicity of the horses measurable by one horse. Likewise, Aristotle shows that he considers numbers exist objectively as he writes, in the passage where he explains the notion of 'same number', that '10 dogs' is not the same 'number 10' as '10 horses', for the things numbered differ.[511] If numbers existed only in the soul, the number '10' would not be a different number depending on the things numbered.

As I have explained in chapter 1, Aristotle thinks there are two modes of existence for numbers: they can exist concretely or abstractly. In an abstract mode, numbers exist without a subject as pure quantities, such as '7'. The number '7' is simply seven times 'one'. Abstract numbers are the result of an abstraction of quantity from sensible

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[507] *Met.* X. 6, 1053a29-30.
[508] Cf. *Met*. V. 13, 1020a13-14. See also *Met.* X. 5, 1056b16-25, where Aristotle explains that 'multiplicity' has two senses, designates two things: a number and a large discrete quantity: " In one sense, [many] means a plurality which is excessive, either absolutely or relatively; and in another sense it means number, in which sense alone it is opposed to the one. For we say 'one or many' just as one were to say 'one and ones' or 'white thing and white things', or to compare the things that have been measured with the measure. It is in this sense also that multiples are so called. For each number is measurable by one; and it is many as that which is opposed to one, not to the few." Trans. Ross.
[509] *Phys*. III. 7, 207b8-10
[510] *Phys.* IV, 2, 220b19-22. Trans. Hardie and Gaye.
[511] *Phys*. IV, 14, 224a12-16.

matter by the mind.[512] Therefore, they exist only in the soul. In a concrete mode, numbers exist as the quantity of a real subject such as horses or dogs, to take the examples that Aristotle used earlier. They thus exist in a real mode.

Aristotle's distinction between numbering numbers and numerable (or numbered) numbers matches this distinction between abstract and concrete numbers. A concrete number is measurable, countable by the mind. This is why it is said to be numerable. Moreover, an abstract number can be used to count a concrete number. Indeed, since a concrete number and an abstract number that are equal have the same quantity, the mind can measure the quantity of a concrete number by applying to it an abstract number of the same quantity. This is why an abstract number is called 'numbering'.

Thus, Aquinas is right to say that numbers do not depend on the soul to exist, but on the things numbered. This is true of concrete, numerable numbers, not of abstract, numbering numbers. Now, it is the existence of numerable numbers that is concerned in the passage. These depend on the soul only to be numbered, for numbering is an act of the soul.

The analogy with sensible qualities, first put forward by Boethus, provides an additional argument to show that numerable numbers do not depend upon the soul. This analogy is the following: as sensible qualities depend upon the soul to be perceived, but not to exist, so it is for numerable numbers: they depend on the soul only to be counted, to have their quantity known. Aquinas takes this analogy up and adds it the case of intelligible essences:

> As sensibles can exist without the sense, and intelligibles without the intellect, so numbers and things countable can exist without something counting.[513]

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[512] This is possible in virtue of the logical priority of quantity over sensible matter: in virtue of this logical prioriry, quantity can be represented in the mind without sensible matter. This is why mathematical entities are defined without sensible matter, which is not essential to their notion; however, they do not exist without it in reality. See Chapter 1: 'Abstract vs. Concrete Quantity'.

[513] "Sicuti ergo possunt esse sensibilia sensu non existente, et intelligibilia intellectu non existente, ita possunt esse numerabilia et numerus, non existente numerante." Aquinas, *On Phys.* IV, lect. 23, no. 5. My Trans.

Objections to Aquinas' Interpretation (1st Part)

It is worth considering objections against Aquinas' interpretation from the point of view of commentators who think Aristotle has presented a sound argument as he concludes that time, because it is a number, cannot exist without the soul. These objections are typically directed at the analogy that compares the existence of numbers to the one of sensibles.

1) Relatives Exist Simultaneously

Replying to Boethus, Themistius, in his commentary, contends that the sensible is relative to the sense, so it cannot exist without the sense. Likewise, numbers could not exist without the soul for the numerable is relative to what can number:

> Yet, says Boethus, 'at least nothing prevents number existing even apart from what does the counting, just as I think there is an object of perception even apart from what perceives.' *But he is in error*. Relatives go together, including ones that are in potentiality related to one another, so that if there is not also something that can count, neither can there be something countable.[514]

Reply: Not all Relatives Exist Simultaneously

There is textual evidence that Aristotle thinks that sensibles exist without a soul capable of perception. For example, speaking about the relatives in the *Categories*, he writes the following:

> Relatives seem to be simultaneous by nature; and in most cases this is true. For there is at the same time a double and a half, and where there is a half there is a double… Also, each carries the other to destruction; for if there is not a double there is not a half, and if there is not a half there is not a double. So too with other such cases. *Yet it does not seem to be true of all relatives that they are simultaneous by nature*. For the knowable would seem to be prior to knowledge. Destruction of the knowable carries knowledge to destruction, but knowledge does not carry the knowable to destruction for if there is not a knowable there is not knowledge but if there is not knowledge there is nothing to prevent there being a knowable… And the case of perception is similar to this; for the perceptible seems to be prior to perception… *Perceptible carries perception to destruction. But perception does not carry the perceptible for if animal is destroyed perception is destroyed, but there will be something perceivable, such as body, hot, sweet, bitter, and all the other perceptibles*.[515]

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[514] Themistius, *On Phys.* IV. 14, Diels. 160, 26. Trans. Todd.
[515] *Cat.* 7, 7b15-8a6. Trans. Ackrill.

In this text, Aristotle clearly asserts that not all relatives exist simultaneously. Examples of relatives that exist simultaneously are half and double, master and slave. Examples of relatives that do not necessarily exist simultaneously are knowledge and the knowable, perception and the sensible.

The reason why some relatives exist simultaneously and others do not has to do with the kinds of relatives they are. We find a typology of relatives in *Metaphysics* V. 15:

> Things are relative (1) as double to half and treble to a third… (2) as that which can heat to that which can be heated… and in general the active to the passive; (3) as the measurable to the measure, and the knowable to knowledge and the perceptible to perception… Relative terms which imply number or capacity, therefore, are all relative because their very essence includes in its nature a reference to something else, not because something else is related to it; *but that which is measurable or knowable or thinkable is called relative because something else is related to it*. For the thinkable implies that there is thought of it… Similarly sight is the sight of something.[516]

From this typology, we can understand that the relatives that are said to necessarily exist simultaneously in the previous text of the *Categories*, like half and double, do so because "their very essence includes in its nature a reference to something else", that is a reference to what they are relative to. This is the case for the two first kinds of relatives, relatives which imply number or capacity. 'Half' cannot exist without 'double', and vice versa, for these depend upon each other for their essence. We can also understand that the relatives which in the text of the *Categories*, are said to not necessarily coexist with what they are related to such as the knowable and the perceptible, are so because they belong to the third kind of relatives: what is called relative because "something else is relative to it". The perceptible such as body, bitter, sweet and hot is relative to the capacity to perceive because the latter is relative to it: there is perception of these objects. Since the perceptible object does not include in its essence a reference to perception, it can exist without it. In Aristotle's words, the destruction of perception or the animal capable of perception does not "carry to destruction the perceptible".

[516] *Met*. V.15,1020b26-1021b1. Trans. Ross.

Aristotle reiterates the point in the *De Anima*. He argues against the view of Pre-Socratics who had held sensible qualities to be dependent upon the perceiver for their being:

> Actual hearing and actual sounding appear and disappear from existence at one and the same moment, and so actual savour and actual tasting, while as potentialities one of them may exist without the other. *The earlier students of nature were mistaken in their view that without sight there was no white or black, without taste no savour.* This statement of theirs is partly true, partly false: 'sense' and 'the sensible object' are ambiguous terms, i.e. may denote either potentialities or actualities: the statement is true of the latter, false of the former. This ambiguity they wholly failed to notice.[517]

A sensible quality cannot be actually sensed without there being an actual sensation of it. However, it is independent of the capacity of sensation to exist: a quality such as white or black exists whether or not there is a soul capable of perceiving it.

This also holds of numerable numbers. These are relative to a soul capable of counting in the sense of the third kind of relatives mentioned by Aristotle: what is said to be relative because something else is relative to it. Indeed, a number is numerable, and thereby relative to the soul, because the soul can count it and thereby know its quantity. This relation with the soul is not part of the essence of a number (which consists in being a multiplicity measurable by a unit). Hence, a numerable number does not necessarily coexist with a soul capable of counting. Its existence is independent from soul, just as sensible qualities' existence is independent from a soul capable of sensation. Thus, it is legitimate for Boethius and Aquinas to use the sensible and the knowable as an analogy to argue that the numerable can exist without the soul. Themistius' objection is mistaken in assuming that "the relatives always go together"; it is not the case for all sorts of relatives.

2) Distinction between 'the Simply Numerable' and 'the Numerable as Numerable'

Simplicius raises a further objection. Criticizing Boethius' analogy, he argues that without a soul capable of perception, qualities may exist, but not as perceptible. Likewise, without a soul capable of counting, something numerable may exist, but not as numerable:

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[517] *DA*. III. 2, 426a15-26. Trans. Smith.

> If things actual are taken in relation to other things actual, and potential things to the potential, if it were impossible for that which will enumerate to exist, the enumerable would also be impossible taking the enumerable to be what can be enumerated. Again, if perception were abolished, while the colour would remain, it will not exist *qua* visible, but simply as colour.[518]

Simplicius borrows this argument to Alexander of Aphrodias, from whom he quotes the following fragment of his commentary:

> That which is contingently capable of being enumerable will exist, such as horses and men, but not the enumerable *qua* enumerable. For in the case of other relatives, if, for instance, there is nobody on the right, he who was on the left, Socrates perhaps, will exist, but the person on the left will not.[519]

Based upon this distinction between the numerable as numerable and the simply numerable (what is capable of being numbered), Simplicius and Alexander maintain that the numerable as numerable and the soul capable of numbering are relatives that must necessarily exist simultaneously. They thus conclude that the numerable, a number, cannot exist without there being a soul capable of counting. Modern examples of this view are explicit in the works of Coope and Harry, among others.[520]

Reply: 'Number' does not Designate the Numerable as Numerable

There is indeed a distinction, as Alexander and Simplicius have it, between what is numerable and what is numerable as numerable – and in general between what is knowable and what is knowable as knowable. Moreover, this distinction being assumed, Simplicius and Alexander are right to say that what is numerable can exist without the soul, but not as numerable. As a matter of fact, there is a text in the *Metaphysics* which basically says that concerning the relation of the sensible to sensation:

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[518] *Ibid*., 760,7-11.

[519] Simplicius, *On Phys.* IV. 14, Diels. 759,1-760,1. Trans. Urmson.

[520] Coope writes: "If there were no counters, change might exist, but the countable aspect of change would not" Coope, *Time for Aristotle*, 169. Harry similarly writes: "While the plurality of things to be counted exists outside of the fact of someone's counting them, the name given to the plurality is only potentially so. In order for a number, as a name, to arise, the plurality – the something to be counted – must be apprehended, thus named. Since on Aristotle's definition, time is a number, and number is either what has been or what can be counted number is arrived at by way of count. Aristotle's claim here is that the number, time, necessarily depends on the counter." Chelsea C. Harry, *Chronos in Aristotle's Physics*, SpringerBriefs in Philosophy (Cham: Springer International Publishing, 2015), 59–60, http://link.springer.com/10.1007/978-3-319-17834-9. More examples will be provided shorly. See the section 'Other interpretations'.

> If only the sensible exists, there would be nothing if animate things were not; for there would be no faculty of sense. The view that neither the sensibles nor the sensation will exist is doubtless true (for they are affections of the perceiver), but that the substrata which caused the sensation should not exist even apart from sensation is impossible. For sensation is surely not the sensation of itself, but there is something beyond the sensation, which must be prior to the sensation; for that which moves is prior in nature to that which is moved, and if they are correlative terms, this is no less the case.[521]

If no soul capable of sensation existed, or more precisely, if it were impossible for there to be a power capable of sensation, the objects of sensation would not be sensible, for the potentiality to be sensed is relative to the potentiality to sense and cannot exist without it. Indeed, these follow under the second category of relatives Aristotle speaks of in *Metaphysics* V. 15 – things that are related as passive and active capacities such as what can heat and what can be heated. The relatives belonging to this category must necessarily exist simultaneously.

However (and it is Aristotle's point in this passage), "the substrata which cause the sensation" would exist even if no soul capable of perception existed. These substrata are what Simplicius and Alexander refer to as the "simply sensible" (as opposed to the sensible as sensible): they are the objects of sensation, qualities such as colours, sounds, savours, etc. These exist independently of the capacity of sensation because as explained before, they belong to the species of relatives which do not necessarily coexist. Qualities are relative to sensation because sensation is relative to them. They are thus "prior to sensation", as Aristotle explains in the last passage, so they can exist without a soul capable of sensation.

The same reasoning holds for the numerable. The numerable as numerable, that is the capacity to be numbered, necessarily coexists with the capacity of numbering, so if no soul capable of numbering were to exist, the numerable would not exist as numerable. However, what is numerable (the simply numerable) would exist.

In sum, Simplicius and Alexander are right to maintain that the numerable as numerable cannot exist without a soul capable of counting, without an intellect. However, they think this legitimates the conclusion that numbers cannot exist without

[521] *Met*. IV.5, 1010b30-1011a2. Trans. Ross.

the soul. This is where, I think, they are mistaken. In order to infer from the nonexistence of a soul capable of numbering the nonexistence of numbers, one must assume that the term ‘numerable’, which number designates, means “the numerable as numerable”, not “the simply numerable” (what is numerable). Indeed, the argument maintains that numbers would not exist if the soul did not exist because number designates the ‘numerable’ (or the ‘numbered’), assuming the premise that the numerable cannot exist without a soul capable of numbering. But we have seen that while it is true that the numerable as numerable must coexist with a soul capable of numbering, it is not true for what is numerable. Thus, the validity of the argument depends upon whether number designates the numerable as numerable, or what is numerable.

As explained before, a number is in essence a multiplicity of units measurable by one unit. This can be either a multiplicity of things such as ‘five horses’, a concrete number, or a simple multiplicity such as ‘5’, an abstract number. A concrete number is said to be numbered or numerable because it is counted or countable by the soul. Thus, the numerable which ‘number’ designates is a multiplicity of things, not this multiplicity as numerable, its potentiality to be counted. If ‘number’ designated the numerable as numerable, a multiplicity would be a number because it is numerable by the soul, rather than being numerable because it is a number. This would imply that numbers exist only in the mind, and that a number attributed by the mind to a plurality of things would be nothing more than the counting of its quantity by the soul, the knowledge of this quantity. For example, ‘three horses’ would be nothing more than the counting of three horses. This would be an idealistic conception of numbers, equivalent, in the realm of sensation, to Berkeley’s thesis that a colour such as ‘red’ is nothing more than the sensation of ‘red’. This is not Aristotle’s view: the texts quoted show that he is committed to realism with respect to sensible qualities, and his conception of quantity and numbers lets us think that he is also a realist about them. This is why Boethus and Aquinas used the analogy of sensible qualities to argue that numbers exist independently of the soul.

Because number designates "the simply numerable", not "the numerable as numerable", the distinction proposed by Simplicius and Boethus between "the simply numerable" and "the numerable as numerable" is of no avail to support their interpretation. Quite on the contrary, this distinction turns out to confirm Boethus' and Aquinas' interpretation, pointing out why, from the premise that number designates the 'numerable', it does not follow that time depends upon the soul to exist. This conclusion would follow if "the numerable" which "number" designates was "the numerable as numerable", whereas it designates "the simply numerable" (what is numerable).

Why an Unsound Argument?

One can wonder why, if this interpretation is correct, Aristotle would have presented an argument whose conclusion is false. It seems that he would either have committed a mistake, or done it voluntarily in order to deceive. Indeed, according to the previous analysis, it may seem that Aristotle would have proposed a fallacious, sophistical argument by playing upon the homonymy of the term 'numerable', which can designate either 'the numerable as numerable' or the 'simply numerable'. Only one of these senses designates a number, and he has not made the distinction.

Aquinas thinks that Aristotle's intention was to present an objection, a reason in favor of the thesis opposed to the one that he thereafter offers as a solution to the problem: "First, he presents a doubt. Second, he objects to the question [*objicit ad queastionem*]. Third, he solves it."[522]

This explanation is consistent with the way Aristotle introduces the argument:

> Whether time would exist or not if the soul did not exist, one **could doubt** [*ἀπορήσειεν* ἄν τις.][523]

The verb *ἀπορειν* means "to doubt" in the sense of "being perplexed, confused". It has the same root as the noun *ἀπορια,* which means puzzle, problem, difficulty, impasse, quandary. One doubts, is perplexed about a question for not knowing which

[522] Aquinas, *On Phys.* IV, lect. 23, no.5. My Trans.
[523] *Phys.* IV. 14, 223a21-22.

one of two opposed answers to adopt. This presupposes a vague sense there are reasons in favor or against either one.[524] We tend to think time exists objectively. However, Aristotle "casts doubt" on this opinion by presenting an objection, a persuasive reason that concludes the opposite: it seems that time cannot exist without the soul for it is a number. Upon reading this argument, one can doubt whether time would exist or not if the soul did not exist. In the rest of the passage, Aristotle will present what he takes as the solution to this problem.

Moreover, in response to the previous concern, we can remark that although the conclusion of the argument is false, it is not so much a sophistical argument as a dialectical one. A dialectical argument uses premises that are probable, often grounded in language and opinion, and this is why its conclusion is also probable and thus, can turn out to be false. In this case, Aristotle has invoked the meaning of the word 'number', which can designate either what is numerable or what is numbered, to argue that a number, and thus time, cannot exist without the soul. It is not an argument that invokes the definition of a number, and it is what explains why its conclusion is not certain and turns out to be false. The intention of Aristotle was not to deceive, but to provide, as Aquinas explains, a probable reason to doubt that time exists objectively.

Aristotle's Solution

Whether Aquinas' interpretation is coherent still depends upon his explanation of the rest of the passage. There we find, he contends, Aristotle's solution to the problem of time's dependence upon the soul.

Time Exists Objectively

Aquinas explains that essentially, Aristotle maintains time does not depend upon the soul to exist but on movement; it can thus exist without the soul. This is what

[524] The verb *ἀπορειν* is often used by Aristotle to refer to the act of dialectic, for dialectic consists in finding arguments against both sides of a problem in order to find which thesis is likely to be true. The use of this verb at the beginning of the passage suggests Aristotle will present a dialectical argument. For more on this, see Chapter 1 (the beginning of the part on Time's dialectical inquiry).

Aristotle implies as he writes, at the end of the passage: “The before and after are in movement, and these are time insofar as they are numerable.” Time is the number of movement with respect to the before and after; in other words, it is the before and after of movement insofar as they are numerable, form a number. Time is thus a numerable number. Now, a numerable number exists in so far as what it is the number of, its subject, exists. Moreover, movement exists, and the before and after exist in movement; and these are the subject of time. Hence, time exists objectively.[525]

We observe that as compared to the first argument, this one assumes that numerable numbers exist objectively, which is the position of Aristotle. Moreover, the middle term of this argument is the essence of time – the before and after as numerable. Therefore, it is reasonable to think that Aristotle intends this argument to be the true response to the question: does time depend upon the soul to exist?

Time Depends Upon the Soul to Exist Perfectly

Time Depends Upon the Soul to Exist Simultaneously

Aristotle, Aquinas continues, adds an important qualification to this answer. Time depends upon movement to exist, not upon the soul. Yet, movement has a successive, fluent existence. This is a point that has been touched upon in the first part of this chapter. Aquinas expresses this idea in saying that movement has no fixed being in reality [*esse fixum in rebus*], as opposed to something that is fully in actuality, like the essence of an individual substance (e.g. a horse). None of the parts of motion exists in actuality for motion exists in the *momentum*, the indivisible of it, which corresponds to the moving body. Consequently, time, the before and after in movement as numerable, cannot exist completely in actuality. Like motion, none of its parts exists in actuality, but only the indivisible of it, the now:

[525] This position must not be confused with an influential interpretation in scholarship, called the “verificationist” interpretation. According to this interpretation, time would depend upon motion for its perception, but would be independent from it ontologically. Defenders of this reading are: (Shoemaker 1969, 365-6); (Sorabji 1983, 75); (Hussey 1993, 142). The verificationist reading is contradicted by my reading of Aristotle’s argument that time is something of motion because we don't perceive time without motion. See Chapter 2.

> If motion had a being fixed in things [*esse fixum in rebus*], as stones and horses, it could absolutely be said that as there is a number of stones even in the absence of soul, so there is a number of motion which is time even when there is no soul. But motion does not have a fixed being in things; neither is there anything of motion in actuality which is fixed in things, but some indivisible of motion which is a division of motion.[526]

However, in the soul, movement can exist completely in actuality. This happens when the soul perceives a moving body being before and after in different positions; the soul then perceives a quantity of movement and represents this quantity as a simultaneous whole. Similarly, when the soul perceives time by numbering movement, time exists completely for a number of parts of movement coexist in the soul:

> The totality of movement is grasped [*accipitur*] by the consideration [*considerationem*] of the soul, comparing [*comparantis*] the prior disposition of the mobile to the posterior…The totality of time is grasped by the ordering [*ordinationem*] of the soul numbering [*numeranti*] the prior and the posterior in movement.[527]

Thus, movement depends upon the soul to exist completely in actuality, as a simultaneous whole. Because time depends upon movement for its existence, so it is for time: it depends upon the soul to exist simultaneously, completely in actuality. Without the soul, time could only exist in so far as movement could, that is incompletely, in the present instant that corresponds to the actual *momentum* of motion. According to Aquinas, this is what Aristotle means to say as he writes:

> If then, nothing else may naturally number but the soul and the intellect [νοῦς] of the soul, it is impossible that time exist if the soul does not exist, *except that which, being at a certain instant, time is [τοῦτο ὅ ποτε ὂν ἔστιν ὁ χρόνος], for example, if it is possible for movement to exist without the soul.*[528]

Because in reality, time only has some existence, an incomplete one, Aquinas writes that it would exist imperfectly without the soul:

> The Philosopher says that time, if the soul does not exist, would have some existence [*utcumque ens*], that is imperfect [*imperfecte*], as if it was said that without the soul, movement can exist imperfectly [*imperfecte*].[529]

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[526] Aquinas, *On Physics* IV, Lect.23, no.5. My Trans.
[527] *Ibid.*
[528] *Phys.* IV. 14, 223a25-28.
[529] Aquinas, *On Physics* IV, lect. 23, no.5.

Aristotle's complete solution to the problem of whether time depends upon the soul to exist can, according to Aquinas' interpretation, be summarized as follows: time exists without the soul because its existence depends upon movement, and movement exists; however, time depends upon the soul to exist perfectly, in complete actuality, for movement does not exist simultaneously in reality. Let us now address two objections faced by this interpretation of Aristotle's solution.

Time Depends upon the Soul to Exist as Actual Number

There is a second reason why time depends upon the soul to exist perfectly. We recall from chapter 2 that the plurality that forms the number of time is the quantitative parts of movement, the before and after, and these do not form a plurality in actuality. Movement is continuous, so the before and after exist only potentially in movement. Therefore, time is not a number that actually exists. It exists in the soul as the result of numbering movement, for the soul then divides movement. Moreover, since the parts of movement are not determined, time depends upon the numbering of the soul for its quantity as a number; it depends upon the choice of a unit for counting movement: the same quantity of movement can be counted in seconds, minutes, hours, etc. Hence, time depends upon the soul to exist as an actual number. Albert explains this in his commentary:

> If movement can exist without the soul, then time can exist without the soul in a certain way, because the before and after are numerable in movement without the soul, but they are not actually a number without the soul. And for this reason time exists potentially without the soul, but receives perfect actuality from the soul numbering.[530]

As it is clear from what Albert says, saying that time depends upon the soul to exist actually as a number does not contradict what has been argued so far: it does not mean that time cannot exist independently of the soul as if movement would not have a number altogether if there was no soul. Aristotle's point in the passage we have been studying is that the before and after form a number that exists potentially in movement, so in this extent, time, which is such a number, has objective reality. This potential objective existence of time as a number is what allows the soul to perceive,

[530] Albert, *On Physics* IV, Tract.3, Cap.16, 57-63. My Trans.

know and measure time by counting movement. Saying that time depends upon the soul to exist because movement does not have an actual number is different than claiming that it is mind-dependent because numbers don't exist objectively.

Summary of Aristotle's Position

Aristotle's complete solution to the problem of whether time depends upon the soul to exist can be summarized as the following, according to Aquinas (and Albert). Time exists objectively because its existence depends upon movement, and movement exists; however, time depends upon the soul to exist perfectly, in full actuality, on two accounts: it depends upon the numbering operation of the soul to exist simultaneously; it also depends upon the numbering operation of the soul to exist actually as a number. These reasons are related: it is because time depends upon the soul numbering movement in order to exist simultaneously that it is defined as number of movement; and it is because it is the number of movement that it depends upon the soul to exist in actuality. Hence, we can conclude that time's successive mode of existence is the fundamental reason that explains its dependence upon the mind.

Objections to Aquinas' Interpretation (2nd Part)

I have expounded what I think is Aristotle's solution to the problem of time's dependence upon the soul, following for the most part Aquinas' interpretation. Some objections have been considered against this interpretation for the first part of the passage. Let us consider objections that pertain to the second part of the passage.

1) Not Exegetically Consistent

One objection faced by Aquinas' interpretation relates to a matter of exegesis. There is uncertainty about the meaning of a Greek formula used by Aristotle: *τοῦτο ὅ ποτε ὂν ἔστιν ὁ χρόνος*. Its signification is critical for the meaning of the passage and the understanding of Aristotle's argumentation. In the Latin edition of Aristotle's text used by Aquinas, the translator, Moerbeke, has rendered this formula as *hoc quod utcumque ens est tempus*. This literally means "that which, however it may be, time

is" or, equivalently, "that which, being in a certain way, time is". Aquinas understands this "being in a certain way" as "some being" and consequently understands the general sense of the phrase as: "if the soul did not exist, time would not exist *but only have some being* [*hoc quod utcumque ens est tempus*], as though movement could exist without the soul."

As we have seen, in accordance with his whole understanding of the passage Aquinas interprets "some being" as meaning "incomplete, imperfect being". This interpretation makes sense if the Greek formula *τοῦτο ὅ ποτε ὂν ἔστιν ὁ χρόνος* indeed has the sense rendered by Moerbeke's translation: "that which, being in a certain way, time is". However, this does not seem to be accurate. A strict, literal reading of the formula would suggest a translation such as: "that which, being at a certain time, time is". The sentence in which the formula appears would then have to be translated as: "It is impossible that time exists if the soul does not exist, except *that which, being at a certain time, time is* [τοῦτο ὅ ποτε ὂν ἔστιν ὁ χρόνος], for example, if it is possible for movement to exist without the soul". If we read the sentence this way, it is difficult to see how it has or suggests the sense Aquinas gives to it – namely that without the soul, time would only have a certain, imperfect being.

Furthermore, there are reasons to think that the formula even refers to the substrate of time, movement. The expression '*τοῦτο ὅ ποτε ὂν ἔστιν*' has been encountered before, in the section where Aristotle speaks about the now.[531] In that context, I have argued it referred to the now regarded under its material aspect. It is indeed used to express a contrast with the now regarded under the aspect of its essence [τὸ εἶναι] or definition [τῷ λόγῳ]. Other instances of the formula, with slight variations, are found in *PA* II. 2 and *Gen. et Corr.* I. 3, where it is again used to designate the substrate of something as opposed to its essence [τὸ εἶναι].[532] This indicates that the formula, which can be expressed under the general form '*τοῦτο ὅ ποτε ὂν* 'X' *ἔστιν*', is an expression used by Aristotle to refer to the the substrate of something, not its essence. It accordingly suggests the following translation for the sentence in which the formula occurs in our

[531] See *Phys.* IV. 11, 219b14-15.
[532] *PA.* II. 2, 649a15 : "ὃ μὲν γάρ ποτε τυγχάνει ὂν τὸ ὑποκείμενον"; *Gen. et Corr.* I, 3. 319b3 : "ὃ μὲν γάρ ποτε ὂν ὑπόκειται τὸ αὐτό, τὸ δ' εἶναι οὐ τὸ αὐτό."

passage: “It is impossible that time exist if the soul does not exist, except the substrate of time [τοῦτο ὅ ποτε ὂν ἔστιν ὁ χρόνος], for example, if it is possible for movement to exist without the soul.” [533] If this is correct, the formula τοῦτο ὅ ποτε ὂν ἔστιν ὁ χρόνος would more exactly designate movement, for movement is the substrate of time. This fits well with the end of the sentence – “for example, if it is possible for movement to exist without the soul” – which seems to confirm that Aristotle is talking about movement. The whole sentence could be paraphrased as: “if the soul did not exist, time would not exist, but only the substrate of time, movement, provided that movement can exist without the soul.”

Alexander and Simplicius have read the phrase this way. In keeping with their interpretation that time cannot exist without the soul because it is a number, they understand Aristotle as saying that without a soul capable of counting, only the substrate of time, movement, would exist. Paraphrasing Alexander, Simplicius writes:

> If time were numerable as the before and after are numerable, if there were nothing to enumerate there would be no time. But nothing prevents the substrate of time, which is change, from existing.[534]

Thus, the sense of the formula τοῦτο ὅ ποτε ὂν ‘X’ ἔστιν, which is likely to be an expression used by Aristotle to refer to the substrate of something, seems to support the interpretation offered by Alexander and Simplicius.

In sum, Aquinas’s interpretation seems based upon a misunderstanding, or deficient exegesis of the formula ‘τοῦτο ὅ ποτε ὂν ἔστιν ὁ χρόνος’. Whether the formula must be understood literally or as referring to the subject of time, it does not appear to have the sense of “a certain existence” – which allows Aquinas to explain that without the soul, time would have an imperfect existence.

Reply

Although these objections are significant, I don’t think they prove Aquinas’ interpretation to be wrong. First, it should be observed that the meaning of the general

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[533] This is, in fact, how some translators have chosen to render the phrase: Pellegrin 2002, Hardie and Gaye 1984, Carteron 1931.
[534] Simplicius, *On Physics* IV. 14, Diels 760,1-12. Trans. Urmson.

formula ‘τοῦτο ὅ ποτε ὂν ‘X’ ἔστιν’ is uncertain; there is no consensus about it among scholars.[535] The adverb *ποτε* could mean in the present context ‘whatever’[536]. The formula would then have a signification such as “that, whatever it is, by being which time is”[537] or “that which, whatever being it has, time is”. This would be roughly equivalent, or at least close to the translation of Moerbeke – *hoc quod utcumque ens est tempus* – which can be rendered in English as: “that which, however it may be, time is”. In that case, Aquinas’ understanding of the sense of the sentence as “without the soul, time would have *some being*”, would turn out to be correct, or at least very defensible.

Moreover, as mentioned previously, the strict, more common meaning for the adverb *ποτε* is “at a certain time”, or “at any time”. Now, in this case, it would be synonym of “at a certain instant”[538], or “at any instant”[539]; and the phrase would become: “it is impossible that time exists if the soul does not exist, except what time is *at any instant*”. Under this translation that uses ‘instant’ as a synonym for ‘time’, Aquinas’ interpretation again turns out to be consistent with the text. Time exists at any instant for it exists in the instant; but it exists incompletely in the instant. Thus, if the soul did not exist, time would only have a certain existence, an imperfect one in the instant.

Aquinas’ interpretation also agrees with the text if we suppose the expression τοῦτο ὅ ποτε ὂν ἔστιν ὁ χρόνος refers to the subject of time. The subject of time does not necessarily refer to movement; it can also refer to the ‘now’. As I have explained before, the now is the subject of time in the sense that time exists in the now. The now generates time as it flows; it makes time continuous because it remains identical

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[535] Ursula Coope, who has done a thorough analysis of the formula and surveyed its interpretations, writes: “The expression occurs only rarely in Aristotle… There is little agreement on how it should be understood.” Coope, *Time for Aristotle*,173.

[536] This is what Coope argues. She points out that *ποτε* has the sense of ‘whatever’ in a passage of Plato’s *Theaetetus:* 160e. Cf. Coope, 173-174. Hussey translates *ποτε* as ‘whatever’ (Hussey 1993, 148).

[537] This is how Coope translates it. Cf. Coope, 159.

[538] Aristotle analyses the meaning of *ποτε* and other temporal expressions after his account of the ‘now’ and show that they all refer to the ‘now’. We say that something happens at a certain time (*ποτε*) because it happens at an instant of time that determines an interval of time with the present instant (Cf. *Phys*. IV. 13, 222a25-28). The fact that we measure and know time by the instant explains why temporal expressions mention or contain an implicit reference the instant. In English, “at a certain time” and “at a certain moment” are fairly synonym expressions.

[539] This is how David Bostock translates it. See Bostock, ‘Aristotle’s Account of Time.’, 150.

as a subject, and makes it divisible because it is different in being before and after. If we read the expression τοῦτο ὅ ποτε ὂν ἔστιν ὁ χρόνος as referring to the now understood as subject of time, the whole phrase can be reformulated as: "It is impossible that time exists if the soul does not exist, except the now [τοῦτο ὅ ποτε ὂν ἔστιν ὁ χρόνος], as though movement can exist without the soul". If the now can exist without the soul, time can also exist without the soul for time exists in the now; but very imperfectly, in the same way as motion can exist outside of the soul – as Aquinas has explained.

In sum, the meaning of the expression τοῦτο ὅ ποτε ὂν ἔστιν ὁ χρόνος is uncertain, but the alternatives examined above suggest that it refers somehow to the now. This makes Aquinas' interpretation consistent with the expression whatever is its exact meaning (subject of time, whatever being time has, what time is at any instant). In any of these cases, it can be argued that what Aristotle means to say is that without the soul, time would have only a certain, imperfect existence through the now. This interpretation is also more coherent with the last member of the phrase: "If, for example, it is possible for movement to exist without the soul". These words strongly indicate that the reason why time cannot exist completely without the soul is because movement cannot, and that time exists outside the soul to the same extent as movement does.[540]

2) Can Time Exist more Perfectly in the Soul?

Another objection to Aquinas' interpretation concerns the statement that time depends upon the soul to exist "perfectly". This seems to imply that something could have more existence in the mind than outside. This view would make Aristotle an idealist, who would think mental objects have more reality than their counterparts in the world.[541]

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[540] If Aristotle thought the reason why time cannot exist without the soul was its being a number, and wanted to say that without the soul, only movement could exist, why would he add: "if it is possible for movement to exist without the soul"? For presumably, according to this interpretation, movement could, as opposed to time, exist without the soul, the reason being that it is not a number.

[541] Like Plato for example, who thought that the Forms have more reality than their sensible counterparts.

On the contrary, Aristotle is a realist. He thinks something can be said to exist in the mind in a certain sense, as true[542], but that it exists in this way insofar as it is a faithful representation of what exists first in reality.[543] Hence, something exists less perfectly in the mind since it depends for its existence upon what exists objectively. In this regard, it would be inconsistent for Aristotle to maintain that time exists more perfectly in the soul than in reality.

Besides, in the case of time, it is even doubtful whether it can be said to exist at all in the mind. Indeed, the mind represents it as a whole divisible in past and future, whereas in reality the past and the future don't exist. Thus, it seems that conceiving of time as a whole is to have a false representation of it. Now, what is false cannot be said to exist.

Reply

It should be remarked, first, that it is not false to represent time as a quantitative whole divisible in future and past. Time is a quantity; it is mentioned by Aristotle as belonging to continuous quantities.[544] Since it is a quantity, it is a whole divisible in parts, for this is essential to quantity to have this characteristic according to the definition of *Metaphysics* V.13.[545] Yet, time is a quantity whose parts do not coexist. We recall that in *Categories* 6, as Aristotle divides quantities between those whose parts have position and those whose parts do not have position, he explains that time belongs to quantities whose parts do not have position because its parts have no permanence, although they have an order.[546] The parts of time do not have permanence, and thereby do not exist simultaneously because time does not exist completely in actuality, as explained before. Like movement, time is actualized successively – through the now that is before and after. However, the mind can perceive, distinguish and compare the now being before and after and thus actualize the parts of time. Time then exists simultaneously, as a whole in the mind.

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[542] Cf. *Met*. IX. 10.
[543] "It is not because we think that you are white, that you are white, but because you are white we who say this have the truth." *Met*. IX. 10, 1051b6-8. Trans. Ross.
[544] Cf. *Cat*. 6, 4b20-25.
[545] *Met.* V. 13, 1020a6-8.
[546] *Cat*. 6. 5a15-30.

It is not false to conceive of time in this way for this representation conforms to what time essentially is: a quantity (of movement). Under this representation, time simply has a different mode of existence than the one it has in reality: it exists simultaneously, instead of successively. What would be false is to judge that time exists in the same mode in reality. Besides, it is legitimate for the mind to represent time in a simultaneous mode for something is knowable insofar as it is actual. Time is not knowable as a quantity the way it exists in reality for its parts are not actual. This is why, in order to know time, the soul must actualize the parts of time, giving them permanence and coexistence.

This also explains why Aquinas says time exists more perfectly in the mind. Time is not said to exist more perfectly in the mind because it would have more "real existence" in the mind, but because it has more actuality as represented in the mind. Indeed, to exist actually is more perfect than to exist potentially.[547] Time depends upon the soul to exist in full actuality, which is not to deny that the real, objective way for time to exist is one that is a mix of potential and actual being. In this regard, the real way for time to exist is an imperfect one.

Parallel to the distinction between simultaneous and successive modes of existence, it seems relevant and helpful to distinguish two other modes of existence for time: a real mode and a cognitive, intentional mode.[548] We can say that time exists as known, in a cognitive mode, and that it exists perfectly in that mode, whereas in a real mode it exists imperfectly.

Critique of Other Interpretations

As I mentioned before, it is a popular view in recent scholarship that according to Aristotle, time does not exist objectively. In this section, I would like to present in detail and discuss two recent instances of such an interpretation.

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[547] Cf. *Met*. IX. 8, 1050a3-b3; 9.
[548] This cognitive mode of being follows upon the recognition of 'truth' as one of the senses of 'being'. Cf. *Met*. IX. 10. 1051b1.

Time as An "Hybrid Being"

Mark Sentesy claims that according to Aristotle, time depends upon the soul to exist. Since time is a number, he thinks the dependence of time upon the soul follows from Aristotle's theory of number and mathematical entities in general:

> The relationship between time and motion can be clarified by examining how being a number differs from and relates to what it numbers, that is, how number is an abstraction of the thing numbered.[549]

Sentesy believes that Aristotle has a constructivist view of numbers. Like geometric figures, numbers are independent entities that the soul would generate by abstracting them from matter, drawing them into activity.[550] Sentesy interprets Aristotle's conception of time accordingly. The temporal number, as he calls it, is generated by the soul which, by marking off motion, abstracts a unit from it. Here is how he describes this process of generation:

> Time comes to be as follows: each motion occurs along an oriented continuity. Marking off this continuity creates a point-like limit, a now… When two nows are marked off, the act of grasping or perceiving the nows as defining an extent generates a temporal unit of measure by drawing it into activity. This is the generation of time as a number. If we take this measure as though it were indivisible, we are taking it as a kind of being separate from and ontologically distinct from motion… Thus, by articulating and perceiving one thing (motion), we generate a new being (number, time) through abstraction, i.e. through separation.[551]

The vocabulary used by Sentesy is evocative of his view that time depends on the soul to exist: it is a new being, generated by the soul, separate and ontologically distinct from motion; the now is *created* by articulating motion.

Sentesy maintains that time is not totally independent from motion. It is because the before and after are in motion, because there is a preceding and following structure in it that its articulation by the soul is possible:

> The capacity for articulation arises in the motion of things, and the articulateness of motion is thereby what makes time possible. When something changes, that is, when motion differentiates the moving thing, these differentiations are possible nows that the soul can articulate and grasp.[552]

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[549] Sentesy, 'The Now and the Relation Between Motion and Time in Aristotle', 9.
[550] Sentesy, 6–8.
[551] Sentesy, 43.
[552] Sentesy, 42.

Because time depends both on motion and the soul, Sentesy calls time "a hybrid being", and qualifies Aristotle's theory of "co-constructivist theory of time"[553]. Similar instances of this interpretation are the readings of Roark and Harry.[554]

As it is clear from the previous description, Mark Sentesy's interpretation is grounded in his understanding of Aristotle's theory of numbers. He assumes that 'number' designates the entities that are the object of arithmetics, abstract numbers. Yet, as I have argued, Aristotle conceives of two modes of existence for numbers: abstract and concrete. Insofar as mathematical numbers are abstracted from matter, it is true that they depend upon the soul for their existence. Concrete numbers, on their part, exist independently of the soul. Time is not an abstract number of the kind of mathematical numbers; it is the number of motion, so insofar as motion exists independently of the soul, time also does. Sentesy assumes that time is the same kind of mathematical numbers because he fails to distinguish the two modes of existence of number. This distinction can be drawn from passages of the *Metaphysics*, which I quote in chapter 1 and that Sentesy does not mention. It is also implied in Aristotle's distinction between number in the sense of 'what is counted' and the sense of 'this by which we count'. As I wrote in Chapter 2 and 3, Sentesy interprets this distinction as one between time and the now, and I have already explained why I think he is mistaken.

Sentesy points out two elements in the text of Aristotle that he considers as evidence in favor of his interpretation. First, in the passage of the dialectical part where Aristotle argues that we don't perceive time unless we perceive motion, he uses the verb *gignesthai*, a verb that in other contexts, may designate the generation of living beings. Here is Sentesy's translation of this passage: "If it happens to us not think time to be whenever we do not mark off any change… while when we perceive and

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[553] Sentesy, 8.

[554] Roark writes: "Aristotle conceives of time as a variety of hylomorphic compound. By "hylomorphic" I mean the kind of analysis Aristotle employs as very many places in his words, according to which the thing under consideration is to be understood as a combination of matter and form, or shape. On the hylomorphic interpretation I endorse, motion is the matter of time, and perception is its form." Roark, *Aristotle On Time*, I. Harry writes similarly: "The actual perception of the before and after contributes necessarily to the being of time." Harry, *Chronos in Aristotle's Physics*, 44.

mark off change then we say that time has come to be [gignesthai], therefore it is clear that without motion and change time is not." Sentesy argues that Aristotle uses this verb intentionally: as living beings are generated, so time is generated by the soul which articulates motion.[555]

But the verb *ginesthai* has more than one meaning. It can mean 'to happen', and this is the sense which it has in the passage that Sentesy quotes. In fact, this is how most translations have it. The line can be translated as: "When we perceive and mark off change then we see that time has happened [gignesthai]". Equivalent translations are "time has has occurred", or "time has elapsed", which are all consistent with the flexible meaning of *gignesthai*. Moreover, Sentesy's point is not consistent with the meaning of the passage. Aristotle argues that we don't perceive time unless we perceive change in order to show that time depends upon change. This is the opposite of suggesting that time depends upon the soul.

The second passage which Sentesy invokes is the one where Aristotle raises the question of the relation of the soul to time. He takes it as evidence that Aristotle thinks time depends upon the soul as a number:

> If number depends on the soul, then if there is no soul, number does not exist. Since time is a number, without soul, time does not exist. The argument is laconic. Aristotle makes no effort to persuade the reader that number or time in fact do depend on souls.[556]

But as I have been arguing, the conclusion of this argument is not what Aristotle thinks. It is meant as an objection.

Finally, in accordance with his interpretation, Sentesy interprets the rest of the passage, which addresses the dependence of motion upon the soul, as following:

> In the final clause, Aristotle raises the question about whether motion can exist without soul. Motion depends on souls to the extent that souls originate them. If there are other sources of motion apart from souls that can count, then motion can exist without time.[557]

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[555] Sentesy, 17-20.
[556] Sentesy, 20.
[557] Sentesy, 21.

Sentesy's reading does not take into account the context of this passage. Aristotle's allusion to the dependence of motion upon the soul must be related to the problem discussed in the passage: how does time depend upon the soul? As I have argued, time depends upon the soul in the extent that motion does; this is why Aristotle suggests that it might exist without the soul if motion does. Given this context, Aristotle's point is not, as Sentesy claims, that motion depends upon the soul because an effective cause is required for there to be motion in nature, but because a mind is required in order for motion to exist simultaneously.

Loughlin's Interpretation

Tim Loughlin interprets Aristotle's discussion of the relation of the soul to time in light of the question that precedes: why time is thought to be in everything? He sees a significant connection between these problems that are juxtaposed in Aristotle's text. As I have explained in Chapter 3, Loughlin thinks that according to Aristotle, time would not really be in everything because heavenly motions, being not countable, would not be in time. The opinion that time is in everything would thus constitute an objection to Aristotle's theory, so he would be compelled to account for it.[558] He would address the question of time's dependence upon the soul because it provides him with a way to account for this belief. Loughlin indeed sees a parallel in the question of time's dependence upon the soul with the question of the universality of time. Aristotle's definition of time would entail that time cannot exist without the soul. He takes the opening argument of the passage as evidence of that:

> Since only intellective souls have the ability to count, nothing would be countable if intellective souls did not exist. Since time just is change qua countable, if countable change were impossible then time would be impossible. This is all pretty straightforward.[559]

Yet, like the opinion that time is in everything, it is also a common belief that time exists independently of the soul, so Aristotle would want to account for it. This is

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[558] "Aristotle must take the belief that time is in everything to be false. However, given Aristotle's somewhat deferential attitude toward folk beliefs… he might feel the need to find some truth in the claim that time is everywhere. Even if he were dismissive of folk beliefs, it would still be incumbent on him to explain why this false belief is so widely held." Loughlin, 'Souls and the Location of Time in Physics IV 14, 223a16-223a29', 308.

[559] Loughlin, 317.

what he would do in the second part of the passage. Time is the before and after a change qua countable, Aristotle writes. Although the before and after in change would depend upon the soul to be countable, they would not do so in order to exist. The fact that the subject of time exists independently would legitimate the belief that time exists without the soul:

> Even though time would not exist if there were no souls, still we might truly think, 'Time would exist even if there were no souls', because the thing that actually is time would exist, i.e. the before and after in change. This account of the relation between souls and time gives us a reason to think that even without souls, time would exist, even though, strictly speaking, time would not exist without souls.[560]

By accounting for this opinion, Aristotle would also implicitly answer why time is thought to be in everything, since the case is similar:

> Since time is the before and after in change qua countable, and the before and after in change still exist even when change is not countable, the before and after would exist in the eternal changes as well. So, the before and after would exist in the motion of the heavens. Since the existence of the before and after in change is what accounts for the truth in claims like, 'Time would exist even if there were no souls', it could also account for truth in claims like, 'Time is in everything – on the earth and in the sea and in the heavens.'[561]

Loughlin's interpretation of Aristotle's position on the relation of the soul to time is biased by his view that Aristotle does not think time is universal. In chapter 3, I have argued that he is mistaken about this. Since Aristotle does think that time is in everything, including in the heavens, and that he explains why before raising the question of its relation to the soul – writing that it is essentially because natural things are mobile – it cannot be that he would address the question of the soul's relation to time as an attempt to answer why time is thought to be universal. The connection between these questions is not that the second is a way to answer the first; they are rather related insofar as they are two challenging, relevant questions pertaining to the existence of time: the first asks why time exists everywhere; the second asks whether time would still exist if there were no soul capable to count. Accordingly, Aristotle's position on the relation of the soul to time cannot be interpreted as a response to the question of why time is in everything; it cannot be Aristotle's intention to account for

[560] Loughlin, 317.
[561] Loughlin, 317-318.

the belief that time is in everything by explaining how, similarly, the belief that time exists independently of the soul is somehow true while it is not, strictly speaking, the case.

It is interesting to observe that Loughlin comes close to acknowledge that Aristotle does think that time exists independently from the soul insofar as motion does. He seems to realize that the fact that time is the before and after in motion qua countable, and that the before and after in motion exists independently of the soul, is sufficient for Aristotle to hold that time exists independently.

What prevents Loughlin to concede that time can exist without the soul, strictly speaking, is that he is fully convinced that the opening argument of 223a21ff expresses the reason why Aristotle thinks time is dependent upon the soul. As we read before, Loughlin takes the premise "nothing would be countable if intellective souls did not exist" as expressing Aristotle's thought. Furthermore, he writes that "that time would not exist without souls follows pretty immediately from claims that Aristotle makes elsewhere concerning time, number, and the soul."[562] Yet, he provides no references to these claims for which it presumably follows immediately that time is dependent upon the soul as a number. On the contrary, for my part, I have argued that numbers exist objectively, providing textual evidence.

Complete Solution to the Initial Aporia

The general problem of time's existence has been posed by Aristotle at the very beginning of his inquiry, through the introductory aporia of the dialectical section. We remember that according to one of these aporiai, the problem of time's existence had the following form: time is a quantitative whole, but none of its parts exist; therefore, it seems that it does not exist or barely exists. Aquinas explains that the answer to this problem follows from Aristotle's solution to the problem of time's dependence upon the soul. It is the following. Time exists in reality, but imperfectly for it is essentially a quantity, and no part of this quantity exists simultaneously in actuality. Without the soul, it barely exists: it only has actuality in the now, which is

[562] Loughlin, 317.

not even a part of time. This is a consequence of the way movement exists. Yet, thanks to the capacity of the soul to actualize the parts of time by numbering movement, time can exist in the soul as a whole simultaneously in actuality, on a representational mode. Thus, time depends upon the soul to exist perfectly. Aquinas writes:

> By these are solved the reasons presented to show that time does not exist because it is composed of nonexistent parts. It is obvious from the previous [remarks] that it does not have perfect being [*esse perfectum*] outside the soul, as neither does movement .[563]

Hence, we see that in the dense passage in which Aristotle discusses the relation of time to the soul lies the complete solution to the core problem of time's existence, posed at the very beginning of the inquiry. This is a point that gives credit to Aquinas' interpretation. Aristotle thinks that the successful inquiry into a topic should be able to account for the difficulties raised about the matter. It is thus reasonable to think that he has wanted his account of time to answer the introductory aporia about its existence. Under Aquinas' interpretation, Aristotle does solve it, even though his solution is not explicit in the text.

Summary of Part II

The object of this second part of the chapter has been to examine the problem of time's dependence upon the soul. I have pointed out that this problem was already implicit in the introductory aporia about time's existence. Yet, it is at the end of his inquiry into time that Aristotle addresses it, in a dense passage whose ambiguity has caused his commentators to debate what solution he argues for. Accordingly, I have focused on the interpretation of this passage by discussing the main two ways to understand it. One interpretation claims time depends upon the soul because it is a number, so that if the soul did not exist, only the subject of time, movement, would exist. The other interpretation claims that time exists without the soul, like movement.. My discussion, which has used Aquinas' commentary to deploy this latter interpretation, suggests that it is the correct one. I shall conclude this part of the chapter by justifying why I think it is so, recapitulating the salient points.

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[563] Aquinas, *On Physics* IV, lect. 23, no.5. My Trans.

First, as it was observed at the outset, Aquinas' interpretation is consistent with the rest of Aristotle's account of time, which contains strong indications that it is a realist one. On the contrary, the competing interpretation is inconsistent with it: Aristotle would contradict himself if he maintained that time cannot exist independently of the soul.

Moreover, Aquinas' interpretation is consistent with Aristotle's conception of numbers, which implies that a number can exist independently of the soul, whereas the other interpretation is not.

Furthermore, Aquinas' proposal that the passage should be understood in two parts – the first being an objection, the second being the solution to the problem – makes a lot of sense. In the first part of the passage, Aristotle offers a dialectical argument – one that invokes the meaning of number – as a probable reason in favor of the thesis that time would depend upon the soul to exist. In the second part, he refutes this position. He then offers a scientific argument – one based upon the very nature of time – which moreover assumes that numbers exist objectively (a proposition consistent with his view on the ontological status of quantity and numbers). Time is the before and after of movement insofar as they are numerable, and movement exists without the soul, although imperfectly; therefore, like its subject, movement, time does not depend upon the soul to exist, although it cannot exist perfectly without it – on account of its successive character. Because this argument has the rigor of a scientific argument, its conclusion is more certain than the one of the first argument. It thus makes sense to think that it is meant by Aristotle to be the solution to the problem.

Finally, the strength of Aquinas' interpretation is to see this solution as being also the solution to the initial aporia about time's existence. The parts of time do not exist, but time depends upon the soul to exist simultaneously as a whole. The fact that this solution is implicitly contained in the solution to the problem of time's dependence upon the soul explains why Aristotle never returns to the initial aporia to solve it explicitly, which would be otherwise puzzling. By pointing this connection between the two problems and their solution, Aquinas shows the coherence of Aristotle's

thought. On the other interpretation, these problems remain isolated, and the first one does not find an answer by the end of the inquiry.

Conclusion of Chapter IV

Aristotle sees the problem of time's existence as central to an inquiry about it. This is clear from the fact that he begins his investigation by noting that time does not exist, or barely exists. In fact, we have seen that the true sense of the problem of time's existence for Aristotle is not whether or not it exists, but how it exists. He poses this problem in terms of the following aporia: time is a quantity, but none of its parts exist. Accordingly, we reasonably assumed we could understand how Aristotle thinks time exists if we knew his solution to this paradox. Since he does not offer an explicit solution, the goal of this chapter has been to examine whether one can be inferred from his account of time.

In the first part of the chapter, I have argued that from Aristotle's account of the now, it is possible to show that time exists through the now. This thesis is implied in the statement that "time and the now exist together because motion and the moving body exist together". The difficulty and objection that time could not exist in the 'now' because it is not a part of time has been resolved thanks to Aristotle's distinction between the formal and the material aspect of the now. With respect to its material aspect, the now is a flowing entity corresponding to the moving body, and time exists continuously through it because motion exists continuously in the moving body. The nonexistence of the parts of time has been accounted for in explaining that time has a successive mode of existence, like movement.

By refuting the argument that time does not exist because its parts don't exist, the first part of the chapter essentially solved the aporia about time's existence. Yet, this was not sufficient to account completely for the existence of time. Indeed, it is essential for a quantity to be composed of parts; therefore, if the parts of time don't exist, it can hardly be said to exist, even though we maintain that it exists successively through the now. Moreover, as opposed to what we observe in reality, the parts of time coexist in our mental representation of it. This observation prompted the suggestion that the

existence of time might depend upon the mind in some way. Thus, in order to fully understand how time exists, we had to clarify the relation between time and the mind.

Aristotle raises explicitly the question of the relation of time with the soul in a debated passage of his inquiry. It has been the object of the second part of the chapter to interpret this controversial passage in order to draw the consequence of it for the problem at stake. The analysis of this passage has revealed that time exists objectively, but depends upon the soul to exist perfectly, in full actuality. The soul actualizes the parts of time by numbering movement with respect to the before and after; therefore, time can exist simultaneously, on a representational mode, in the mind.

In short, the answer to the question "how does time exist?" is the following, according to Aristotle: time exists both objectively and subjectively, although in different ways. In reality, it exists successively, in a fluid mode, without its parts being in actuality, and thus in an imperfect way; in the mind, on the other hand, it exists simultaneously, in a permanent mode, with its parts in actuality, and thus in a perfect way.

In the introduction of the chapter, I presented two positions regarding time's existence. One of them is that time has a full objective existence; I had mentioned Newton as an example of this view. We remember that Newton spoke of time as though it existed in the manner of a substance in motion. The other view considers on the contrary that time has a full subjective existence; I had mentioned Augustine as an example of this opinion. We remember that because the past and the future exist in the soul, but not in reality, Augustine thought time exists in the mind only. Because the past is a present that is not anymore, and the future a present that is not yet, he conjectured that the quantitative extension of time might be but the "stretching out" of the soul itself.

Aristotle's position gains clarity when compared to these views. Like Newton, he thinks time is real; however, he does not think it exists in the manner of a substance. A substance exists independently, on its own. On the contrary, time depends upon a

substance to exist; it is something of a substance through motion. Moreover, a substance exists totally in actuality, whereas not even a part of time actually exists. Thus, on Aristotle's account, time exists very imperfectly as compared to a substance.

Similarly to Augustine, Aristotle thinks that as a whole having coexisting parts, time exists in the soul only. However, unlike Augustine, he thinks this object of the mind adequately represents something which really exists: objective time. Time really is a quantity; however, this quantity exists in a different way in reality; it exists successively, which is why the past and the future don't coexist with the present.

If Aristotle's inquiry into time has explained how time exists, it has also confirmed what he had observed at the beginning: it barely exists. The fact that time depends upon the mind to be unified and acquire permanence exist reveals, as a counterpoint, how precarious and inconsistent is its existence. In this sense, Glen Coughlin writes the following, which is a fitting conclusion for this chapter:

> The mystery at the heart of time is the same as one of those at the heart of motion, the necessity for time and motion to be related to a nonexistent past and future, and so to be referred in some way to mind, a power which transcends becoming and attains unified being. This role of mind in the existence of what are at first thought to be purely natural or extra mental phenomena underscores how tenuous is the being of the world of direct sensible experience and how dependent, consequently, it is on some superior mode of being. [564]

[564] Coughlin, 'The Existence and Nature of Time', 160. About this conclusion, see also: *Met*. I. 1, 980a21-981a12.

Conclusion

In this dissertation, my aim was to give a comprehensive account of Aristotle's conception of time. There are three fundamental, puzzling questions that naturally come to mind as we reflect about time: What is it? Does it exist? Why is it universal and one? It is also debated, in scholarship, what Aristotle's answer is to these questions. Accordingly, I have organized my exposition and discussion of Aristotle's theory of time under the headings of these problems. Having come to the end, what conclusions can be drawn from Aristotle's theory of time in general, according to the interpretation I have given of it?

First, Aristotle's conception of time may seem, on several accounts, at odds with our modern views about time. Aristotle thinks that time is a subject of natural philosophy, whereas modern philosophy deems it as a metaphysical subject. He thinks that time depends upon motion, whereas we think the opposite, that motion presupposes time. He defines time as a number, while maintaining that it is continuous, which seems to us to involve a sheer contradiction. He thinks that there is an absolute time, simultaneously the same everywhere, whereas we believe, in accordance with modern physics, that time and simultaneity are relative to the observer. Furthermore, he thinks time exists objectively, whereas we might be inclined to believe that it is a mental object, an epiphenomenon of our neuropsychological makeup, or one of the a-priori conditions of our apprehension of the world.

An attentive consideration, though, reveals that Aristotle's conception of time is much in agreement with common experience, and consistent in itself. Time presents itself as something of motion, its quantity in respect of succession, as it is shown from the fact that the perception of time is inseparable from the perception of the before and after in motion. Time depends upon motion, not the converse, since the before and after in motion follow the before and after in magnitude, where these exist first through position. There is time because there is a mobile being whose position changes, and its motion has a quantity which follows the magnitude it covers. Likewise, a temporal instant is something of a mobile substance, as shown from the fact that we perceive

instants of time by perceiving a mobile substance being before and after. We perceive time when we mark off motion by instants which correspond to the moving body as before and after. To do so is to divide movement, and thus to number it, with respect to the before and after. Aristotle consequently defines time as the number of movement with respect to the before and after.

However, time is not the quantity of any motion. There is only one time, everywhere the same in nature, but a multiplicity of mobile beings and motions. Moreover, it is an important property of time to measure motion, and a measure is one, whereas the quantities measured by it are many. Thus, time is the number of a first motion, and by determining the quantity of that motion it measures other motions. This is what explains the unity of time and the property of simultaneity: equal and simultaneous motions are in the same time because they are measured by the number of a unique motion. Moreover, since time measures the motion of natural things, it also measures their rest, their privation of motion, as well as their existence, their duration, since they exist in motion and rest. All natural things, insofar as they are mobile and measured by time, are thus in time, which explains why there is time everywhere in nature.

Since there is time everywhere, it seems obvious that time exists. Yet, Aristotle had begun his inquiry by noticing the following difficulty: time is a quantity, but its parts, being past and future, don't exist. In this regard, it seems that time does not exist at all. Aristotle's response to this problem is twofold. On the one hand, time is something of motion, and motion exists in a moving being, which exists in the chief sense as substance. Hence, time has an objective reality grounded in the substantial existence of a mobile being. On the other hand, a moving body does not exist simultaneously in different positions. Motion is a successive actuality, so time, the quantity of motion, does not exist actually as a whole; it exists successively in the now, which corresponds to the moving body as before and after. The now is indivisible, it is an instant that has no duration, so what exists of time in actuality is not even time. However, a soul that has the faculty to compare the now as before and

after can actualize the parts of time and unify it as a simultaneous whole. Thus, time depends upon the soul to exist perfectly, in full actuality.

On account of the successive existence of motion and time, the soul perceives time, the quantity of movement, through the perception of successive instants by which it determines and numbers movement with respect to the before and after. Thus, the successive mode of existence of time is what explains why it is defined as a number, a discrete quantity, although it is continuous. In this sense, Aristotle's conception of time shows that the nature of time is intimately related to its mode of existence.

I have entitled this dissertation: "Aristotle's account of time: a moderate realism." This is because this expression, "moderate realism", characterizes in good part, in my view, Aristotle's conception of time, as well as what I take to be my general contribution to the interpretation of it. The tendency of recent scholarship is to accentuate the place of subjectivity in Aristotle's theory of time. This tendency is manifest as most scholars interpret the notion of 'number' in the definition of time in an analogous sense – measure, order, determinacy, etc. It is also expressed through the popular view that time does not follow a particular motion absolutely, that it is universally one as a genus or as an abstract number by which the mind measures and orders motions. Finally, this tendency is explicit as scholars often interpret Aristotle as thinking that time would not exist if there were no soul capable of counting.

As opposed to this picture, my interpretation presents Aristotle's theory of time as one that is fundamentally realist. Aristotle thinks time is a real number which exists as the quantity of motion of a concrete mobile substance. Moreover, although he would concede that time is relative to motion, so that it is possible to measure motion and time by different motions, he thinks that there is one motion that time follows absolutely. Time is the quantity of that motion, and mobile things and their motion are in time because they are measured by the quantity of that motion. On the other hand, Aristotle's conception of time reveals how little time exists. Time is not a substance, nor the accident or the property of a substance. It is not even the motion of a substance, but the number of motion of a substance. And this number does not exist

in actuality. Time depends upon the numbering faculty of the soul to exist perfectly as a quantity. This is why I qualify Aristotle's realism by the adjective 'moderate'. It is not moderate in the sense that time would be a product of the mind, but in the sense that time lacks actual existence outside of the mind.

In a sense, my interpretation is not original. It is largely inspired by my readings of some ancient and medieval commentators – Simplicius, Themistius, Philoponus, Albertus Magnus and Thomas Aquinas – to whom I have often referred in this dissertation.[565] But their commentaries tend to be ignored in current scholarship on the topic, and my contribution can be seen as showing that these commentators have proposed valuable solutions to the interpretative problems of Aristotle's treatise of time.

Let us go back, as a last concluding remark, to the idea that Aristotle's conception of time reveals how feebly time exists. By doing so, it also reveals the contingent, precarious existence of natural beings. Indeed, the fact that the duration of natural things is measured by time shows that their existence, like that of time, is not simultaneous but successive. As for the time that measures them, there is not a single part of the duration of natural things that is actual. Natural things exist in the now, the durationless limit which marks off their existence past and their existence to come. As the now is continuously different, so it is for its existence, which is continuously before and after. In other words, the existence of natural things is scattered in the flow of temporal succession. Like the time that measures it, the existence of a natural being can only be unified, actualized as a whole by a soul which has the faculty of comparing the thing at different instants of its existence.

As explained in Chapter 3, it is matter which ultimately explains temporality. Natural beings exist in time as mobile, and they are mobile insofar as they are in potentiality, since motion is the actuality of a natural being insofar as it exists in potentiality. Natural things are in potentiality because they are composed of matter, which is potential being. Thus, it is the materiality of natural beings which explains why they

[565] Yet, I have not followed the interpretation of all these commentators on all points.

exist in time. Conversely, because natural beings are material, they are contingent, they have the potentiality to change and thus to move. Now, time follows motion, so natural matter is what explains the existence of time in nature.

When presenting the context of Aristotle's inquiry concerning time, I argued that Aristotle sees time as an object of natural philosophy, whose subject is natural, mobile being. The interest and strength of his conception of time is that it shows how time is related to natural beings through matter, nature, motion, and the first motion in nature. Thus, beyond contributing to our understanding of time, his account contributes to our understanding of nature and natural beings. Thereby, it also contributes to the understanding of ourselves, human beings. Indeed, besides being rational, we are also natural, and thus temporal beings.

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