TIME AND TIME AGAIN:

A STUDY OF ARISTOTLE AND IBN SÎNÂ'S TEMPORAL THEORIES

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جاء رجل إلى رسول الله صلى الله على و سلم فقال: يا رسول الله من أحق الناس بحسن صحابتي؟ قال: «أمك» قال: ثم من؟ قال «أمك» قال ثم من؟ قال «أمك» قال ثم من؟ قال «أبوك».

A man came up to God's prophet--blessing and peace of God upon him--and said: Oh prophet of God, who is most worthiest of people to spend my time with profitably? [Muhammad] said: "Your mother," "and then whom?" [the man] asked, "Your mother" again was the reply. Again [the man] asked, "and then whom?" and [Muhammad] again said: "Your mother". "And then whom?" "Your father," [Muhammad] replied.

To My Mother

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ABSTRACT

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Jon McGinnis

James Ross

The dissertation examines the temporal theories of Aristotle and the Muslim Aristotelian, Ibn Sînâ (Avicenna). After considering Aristotelian science and sketching Aristotle's theory of physics, the dissertation picks up a series of puzzles concerning the reality of time. The central puzzle is a dilemma, which seemingly shows that the now can neither change nor remain the same. The dilemma is important, since one's solution to it affects the way one envisions time. Aristotle's solution, I argue, is to show how the now remains the same. Thus he adopts a "static" theory of time, i.e., time is a magnitude marked off in motion by an unchanging now, and although time is a magnitude of motion, it itself does not flow or change. In contrast, Ibn Sînâ, who employs much of the same vocabulary as Aristotle, develops a "dynamic" theory of time, which envisions time as the "flow" of an ever changing now, and thus he attempts to explain how the now changes. The dissertation concludes with an application of Aristotle and Ibn Sînâ's accounts of time to McTaggart's argument for the unreality of time and Sydney Shoemaker's contention that conceptually time does not require change. In the end I argue that time must be static and cannot "flow."

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CHAPTER 1

INTRODUCTION

The temporal theories of Aristotle and Ibn Sînâ compel us to think about time and time again. In the following pages, I consider their solutions to a dilemma concerning the reality of time and the accounts of the nature of time which result from their solutions.

One way to approach this dilemma, and thus ultimately Aristotle and Ibn Sînâ's theories of time, is through one of Zeno's paradoxes. Zeno's paradoxes, particularly the so called "dichotomy" paradox, threatened the very theoretical possibility of motion. Aristotle presented a solution to this paradox, which relied on the notion of continuous time. This solution in turn opens a discussion of the reality of time and the above mentioned dilemma associated with the reality of time. This dilemma is not only historically important because the reality of time is presupposed by one of Aristotle's responses to Zeno, but also because the way in which one solves the dilemma profoundly influences the way one envisions time.

A. Physics, Zeno and Time. Ancient theories of time were embedded in the science of physics. Physics comes from the Greek *phusis*, which is a nature or principle of change. The science of physics, then, involves the study of change or motion. There are two general categories of change: change which happens all at once and change which takes place gradually. Change which happens all at once, or instantaneously, concerns substances; for example, when through digestion bread becomes flesh and blood. For the nonce we can set aside this type of change and instead focus on change which does not occur all at once, viz. motion. Motion is technically defined by Aristotle as the actuality of potential *qua* potential or again the reduction of potency to actuality insofar as a thing is potential (*Phys.* III 1, 201a10-11, a27-29, b4-5). Stated informally, we may think of motion in the following terms. When something exists in one state but is capable of existing in another state, and then that thing comes to be in that other state, that which is found between the two states is motion. For example, if a ball is in position x, and then comes to be in position y, the ball's being in the interval between x and y corresponds with the ball's motion. Such motion can occur with respect to place (locomotion), quantity (augmentation/diminution) or quality (alteration) (*Phys.* V 2, 226a23ff). For our purposes, we need only consider locomotion, or the change from one place to some other place.

Locomotion according to Aristotle is the primary type of motion; for all other types of motions, Aristotle argues, require locomotion if they are to occur (*Phys.* VIII 7). Consequently, if locomotion were impossible, then *a fortiori* all other types of motion would be impossible. It was on account of the primacy of motion that Zeno's paradoxes were so dangerous for the entire science of physics. For Zeno's paradoxes were directed at the very possibility of locomotion. Therefore, if the paradoxes stood and locomotion were impossible, then all motion would be impossible and consequently, the very possibility of a science of physics would be undermined. For, as we mentioned, the proper subject matter of physics was motion.

Locomotion is change from one place to another across a spatial magnitude. One question the science of physics must ask concerns the nature of spatial magnitudes. Is spatial magnitude continuous or composed of indivisible spatial units, or space atoms? Aristotle comes down firmly on the side that spatial magnitude is continuous (*Phys.* VI 1). For if space were composed of indivisible space atoms, argues Aristotle, this spatial unit would either have two distinct extremities or not. If the indivisible spatial unit had two distinct extremities, then this unit could be divided into its extremities, which is clearly impossible, on the assumption that it is indivisible. On the other hand, if this spatial unit does not have two distinct extremities, then it is a dimensionless point. That a magnitude, which possesses a dimension, should be composed of that which lacks any dimension, however, is impossible. Thus, since spatial magnitude is not composed of indivisible spatial units, it must be continuous.

Here enters Zeno's "dichotomy" paradox. If space is continuous, then it is infinitely divisible. As a result, in order for a mobile, i.e., the object which moves, to cross some continuous space, it is required to pass through the midway point. Before it reaches that midway point, however, the mobile must pass through another midway point and so on *ad infinitum*. An infinite, though, cannot be traversed in a finite period of time. Thus it would seem impossible that there is motion over a continuous magnitude (even a finite continuous magnitude) in a finite period of time.

Aristotle's solution to Zeno's paradox, and that of most subsequent Aristotelians, relies on the nature of time (*Phys.* VI 2, 233a15-32). Time, like spatial magnitude, is continuous. Hence, just as an infinite number of points belongs to any finite length of spatial magnitude, so an infinite number of nows or moments belongs to any finite period of time. (That is not to say that a finite magnitude is *composed* of an actually infinite number of points or nows, but only that within any finite magnitude there is a potentially infinite number of points or nows.) Hence in any finite period of time there is an infinite number of temporal points (or instants or nows) in which to traverse the infinite number of spatial points. In other words, for each of the infinite number of points a mobile must pass through, there is a corresponding instance in which to pass through it. Thus the reality of a continuous time answers one of Zeno's paradoxes.

But in what sense is time real? Time is certainly not real in the way spatial magnitudes are real; for all the parts of a spatial magnitude can exist together. The parts of time in contrast cannot. For time's parts are the past and the future; however the past has already been and thus no longer is and the future is not yet and thus it is not. The now or the present may be real, but it is not a part of time any more than a point is a part of a spatial magnitude. A part can measure the whole, but the now cannot measure time, just as a point cannot measure a line.

Still the reality of time may be inextricably linked to the reality of the now, such that the reality of the now guarantees the reality of time. Thus, for instance, we may envision time as the flow of an ever changing now, e.g., similar to the motion of a spotlight, where the spotlight is analogous to the now. Or, from a different perspective, we may view time as the interval marked off by a now, where the now remains the same, e.g., similar to a line segment terminated at a point, where the now is analogous to the point. Clearly, if there is a now, it must either change or remain the same; however, since on either account the now entails the reality of time, time would then be real.

But is the now real? Here we are faced with the dilemma alluded to above. As we have mentioned, the now either changes or remains one and the same. Assume that the now remains one and the same. If time is the interval marked off by a now, which remains one and the same, then one and the same now must function as two different termini of a period of time; but it is impossible for one and the same now to be two distinct termini or nows. Consequently, it would seem the now must change. If the now changes, however, then when does the present now cease to be? It cannot have ceased to be when it is; for that is when it is. Furthermore, since the now is a temporal point and in a continuous magnitude no two points are immediately adjacent to one another, the present now cannot have ceased to be in the immediately adjacent now. But if the present now ceases to be in any subsequent now, then the present now must be contemporaneous with all the other "present nows" which exist between the two, which seems absurd.

The solution to this puzzle is of interest for at least two reasons. First, as we have noted, the very possibility of the theoretical science of physics depends on answering Zeno's paradox and Aristotle's preferred solution (and indeed the canonical solution of the Aristotelian tradition in general) requires the reality of a continuous time. Consequently, if the dilemma of the now is not answered, the theoretical possibility of a science of physics is undermined. Second, whatever answer one gives to the dilemma profoundly affects the theory of time one adopts. For if one explains when the now changes, time turns out to be a type of "flow". Consequently, one's theory of time can be characterized as "dynamic". On the other hand, if one grasps the other horn, i.e., that the now remains one and the same, then one's ultimate temporal theory can be characterized as "static"; for time is an interval or measure extending between the now. In the sequel I argue that Aristotle attempts to explain how the now can remain one and the same and yet mark off time and thus adopts a "static" theory of time, whereas Ibn Sînâ envisions time as the flow of an ever changing now and thus explains "when" the changing now changes.

B. The Overall Structure. The first part of this work concerns

Aristotle (384-322 B.C.) and his theory of time. Aristotle's account of time relies heavily on his theory of science in general and also concepts particular to the science of physics. Since I believe that a misunderstanding of Aristotle's scientific methodology is prevalent in both the Aristotelian tradition and current literature, I begin (ch. 2) with a reassessment of Aristotle's theory of science especially as explained in the *Posterior Analytics*, paying close attention to the role of demonstration. I contend that demonstration offers an analytic tool for seeking out first principles. Demonstration can play this role because for Aristotle all genuinely rational and explanatory reasoning processes involving a conceptual transition can be expressed as a demonstration (or at the very least syllogistically) (*PrA.* I 23, 40b17-41b5; I 28, 44b6-8; I 29, 45a36-38). Furthermore, the demonstration has a specific material and formal aspect: materially it is constructed from *per se* premises, while formally it possesses a syllogistic structure. A knowledge of these two aspects of the demonstration furnishes the scientist with the means of breaking down complex scientific questions into more tractable problems, whose first principles are more easily recognized. Consequently, demonstrations aid in scientific investigations and Aristotle's discussion of time provides us a test case of his methodology in action.

That time belongs to motion is an observable fact, Aristotle points out, and thus the scientist must seek the reason why this relation holds, i.e., the natural philosopher must seek the middle term linking motion and time. In order to discover this middle term, the scientist must know what belongs *per se* to the two extremes, viz., motion and time. Hence, I examine Aristotle's account of motion (ch. 3), of which time is said to be a necessary condition (*Phys.* III 1, 200b20-21). I argue, following certain scholastic philosophers, that motion is an "imperfect actuality" which entails an extension. I next delve into the puzzles and opinions surrounding time (ch. 4), which I argue help delimit the viable options of a definition of time. The core *aporia* is the one we have seen involving the nature of the now, viz., whether the now is something changing--thus giving rise to a "dynamic" theory of time--or remains the same--thus giving rise to a "static" theory of time. In his discussion of the opinions of his predecessors, I establish that Aristotle firmly sides against a dynamic conception of time. Finally, I show (ch. 5) how Aristotle's basic demonstrative schema underlies and motivates his articulation and defense of a static theory of time. The static temporal theory, once again, maintains that time is in fact an extension found between different characterizations of an unchanging now. Consequently, extension is the middle term linking time and motion. Clearly this conception of time and the now gives rise to paradoxes, as we have already seen. Aristotle's response, as I set it forth, appeals to the duplex nature of the now; for the now is essentially (*kath' hauto*) one, although accidentally many insofar as it belongs to a mobile as a conceptual division of the mobile's motion.

In the second part of this work I focus on Ibn Sînâ's (Lat. Avicenna: 980-1037) treatment of time as found in his section on physics from the *Shifâ'* (the *Cure*). I briefly treat the development and history of the issue of time as it came down to Ibn Sînâ (ch. 6). In this context I consider various Aristotelian and Neoplatonic commentators' opinions of Aristotle's account of time and also issues surrounding the subject of time which emerged specifically within the Islamic milieu and thus would have been of concern to Ibn Sînâ. I then turn to Ibn Sînâ's own temporal theory (ch. 7). Although Ibn Sînâ employs language reminiscent of Aristotle's, their two temporal theories are fundamentally different. First, Ibn Sînâ offers a proof for the reality of time based on certain observations respecting motion; the argument has no parallel in either Aristotle or what I have seen of the later Aristotelian tradition up to Ibn Sînâ. For Ibn Sînâ, time is a measure which is essentially before and after and by which all other things are judged before and after. So stated, Ibn Sînâ's conception of time sounds strikingly similar to Aristotle's; however, we see that in fact they are fundamentally different when we consider Ibn Sînâ's theory of the now (ch. 8). For Ibn Sînâ the now changes and thus time is dynamic, i.e., time is conceived as the flow of a moving now. Although the idea of dynamic time is not unique to Ibn Sînâ--one need merely recall Plato's definition of time as the moving image of eternity (*Tim.* 37D)--this fact does not detract from Ibn Sînâ's novelty and creativity. Many of his arguments for the dynamic thesis of time and problems associated with this theory are original with him and are embedded within his own theory of logic and ontology. A notable instance is his treatment of when a changing now changes. We recall that the difficulty with this thesis is that the now must seemingly change either all at once (and thus in the now when it is) or gradually (and thus in several nows). Both of these possibilities have philosophical difficulties and so it appears that the now cannot change. Ibn Sînâ resolves the dilemma by offering a third option based upon a logical distinction between "changing in a now" and "not changing gradually". The solution is unique to Ibn Sînâ and still of philosophical interest today. A second point of interest is Ibn Sînâ's proof for the eternity of the world, which is grounded in his novel views of the "necessary", "necessary in another" and "absolutely possible".

I conclude my analysis of Aristotle and Ibn Sînâ's temporal theories with an evaluation (ch. 9). In the end, despite Ibn Sînâ's herculean efforts to extricate a dynamic theory of time from a morass of philosophical difficulties, the position is still left moribund. At least two problems trouble a dynamic temporal theory. First, if time were a flow, it must flow at a certain rate and that rate would itself be defined in terms of time. Second, Ibn Sînâ embeds his account of time within an outdated cosmology which requires an outermost celestial sphere which circles the earth. The coherence of much of Ibn Sînâ's dynamic temporal theory is lost once the ancient closed universe is replaced with a modern open universe (or even an

Einstein-Gödel closed universe). As a result, even if one does not ultimately accept Aristotle's theory of time, one must acknowledge the fundamental Aristotelian insight into time, viz., time is not a type of change or flow.

C. Texts and Translations. All translations, unless otherwise stated, are my own. With respect to the Greek, I have taken my texts from the Oxford Classical Texts editions of Plato and Aristotle. Where I have either adopted the Loeb text or suggested some emendation of the OCT text, I have indicated it in a footnote.

As for Ibn Sînâ and his account of time, the treatise has been translated and commented on by Yegane Shayegan in her dissertation *Avicenna on Time*.[1] However, Shayegan used an uncritical edition of the *Shifâ'*,[2] and in places her translation and commentary seem to distort Ibn Sînâ's meaning. Consequently, there was a need for a new translation and commentary on this interesting treatise. Unlike Shayegan's dissertation, which offers a translation and commentary on all four chapters that make up Ibn Sînâ account of time, I limit myself to the two core chapters on the essence of time and the nature of the now; nevertheless, I do provide translations of the other two chapters (puzzles surrounding time and their solutions) in my appendices. My translation is based on the text established by Said Zayed, which, despite numerous typographical errors, still stands as

[1] Y. Shayegan "Avicenna on Time" (Ph.D. diss., Harvard University, 1986).

[2] *Kitāb ash-Shifā', as-Samā*ᶜ *aṭ-Ṭabīᶜī*, lithograph (Teheran: n.p., 1886).

a critical edition of Ibn Sînâ's *physics*.[3] Further, I have compared Zayed's edition with the Teheran edition and also with the Latin translation of Ibn Sînâ's *physics*, the *Sufficientia*.[4] Moreover, I have translated Ibn Sînâ condensed account of time found in the *Najah* (the *Salvation*), which has never been translated into a European language and have included it as well in the appendices.[5]

I have not attempted to translate Ibn Sînâ's crabbed and contorted Arabic absolutely literally, which would undoubtedly lead to an incomprehensible and unreadable text of little value. But neither have I allowed myself unlimited literary freedom, which might not capture Ibn Sînâ's intended meaning. Rather, I have tried to take the middle path. Thus to the best of my abilities I have rendered Ibn Sînâ's Arabic into natural English and yet made no sustained effort to simplify the philosophical reconditeness of the text. Hopefully my commentaries will straighten up the more oblique passages.

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[3] *ash-Shifā', aṭ-Ṭabīᶜiyyāt*, vol. 1 *as-samāᶜ aṭ-Ṭabīᶜī*, ed. Said Zayed (Cairo: The General Egyptian Book Organization, 1983); all future references to the *Shifā'* are to the *Ṭabīᶜiyyāt* vol. 1 *as-samāᶜ aṭ-Ṭabīᶜī*. Zayed's edition is based on five different manuscripts and their marginalia. Unfortunately, Zayed does not provide exact locations for the manuscripts he utilized; however, we can tentatively identify them based on the bibliographies of Brockelmann, Anawati, Mahdavi and Ergin: al-Azhar (and marginalia) [331 (185-226)], Dar al-kutub [H. 262, H. 753, H. 172 (F. VII)], Damad al-jadîdah [822, 823, 824, 825], Teheran (and marginalia) [I, 144/6 (?)], the British Museum [Suppl. 711].

[4] For Teheran edition see footnote 2; *Avicennae perhypatetici philosophi ac medicorum facile primi opera ...* (Venice: 1508) (reprint by Minerva, 1961); henceforth referred to as the *Sufficientia*.

[5] *An-Najah* (Tehran: Danishgah-i Tihran, 1985/6), 225-233.

CHAPTER 2

RETHINKING ARISTOTELIAN SCIENCE

Aristotle's account of time in *Physics* IV 10-14 is a model of Aristotelian science. The elegance of the account, and in general much of Aristotle's practical scientific work, is unfortunately marred by the criticism that there is an unbridgeable gap between Aristotle's explicit theory of science and his actual scientific practises. The criticism is based, I shall argue, on an erroneous interpretation of Aristotle's philosophy of science and a subsequent misunderstanding and misappraisal of his scientific enterprise. The error concerns the role of demonstration (*apodeixis*) presented in the *Posterior Analytics*, Aristotle's explicit account of the philosophy of science. As a consequence of this misunderstanding many commentators have further misunderstood the *Posterior Analytics*' aim, its program for achieving this end and finally the nature of Aristotelian science as a whole. To appreciate the interplay between Aristotle's temporal theory and his theory of science, or indeed simply to comprehend his doctrine of time, we must redress this error.[1]

A. Distinguishing "Scientific Knowledge" from "Scientific Discovery". A key issue for commentators on the *Posterior Analytics* is to explain the role of demonstration within Aristotelian science. Science can be understood in at least two distinct, though not mutually exclusive, ways. One is as the body of knowledge concerning what we believe to be the make-up and nature of the world. The other is the methods, techniques and practices whereby we discover this body of knowledge, e.g., experiments, conjectures and data gathering. We may call the latter type of science "scientific discovery" and the former "scientific knowledge".

At the heart of ancient, medieval and most contemporary readings of the *Posterior Analytics* is the belief that demonstration (*apodeixis*) is the means of merely building up or presenting scientific knowledge. This view most often considers Aristotle's conception of science as either at best indifferent towards scientific discovery or in the worse case actually antipathetic towards it.[2] In contrast to this view, I believe that we can find

[1] To come to terms with all the issues and difficulties modern scholarship has found in this work would be a herculean task which would take us far afield from Aristotle's account of time; nevertheless, as I hope will be clear both in this chapter and subsequent ones, a grounding in Aristotelian scientific theory is essential to understanding Aristotle's actual scientific practices. To hasten our arrival to the discussion of time, I have left untreated numerous issues and questions relevant to the *Posterior Analytics*, but not essential to our topic. Not the least of these is an account of the notoriously difficulty chapter II 19, or the role of "induction" (ἐπαγωγή) in acquiring universals. Despite these deficiencies, the account I proffer is sufficient to show Aristotle's scientific methodology in the *Physics*.

[2] Cf. J. Barnes, "Aristotle's Theory of Demonstration," 138 in *Articles on Aristotle: 1. Science*, eds. J. Barnes, M. Schofield, R. Sorabji (London: Duckworth, 1975): 65-87.

numerous techniques and tools for scientific discovery in the *Posterior Analytics*--even if these methods are far different from our own. Indeed, Aristotle, I believe, intended his account of demonstration to provide the tools for breaking down, literally analyzing (*analuein*), scientific problems into less complex and thus more tractable points of query.

To bear out my thesis I shall limn the general structure of the *Posterior Analytics*, paying special attention to the syllogistic structure of the demonstration and the form and content of first principles. After investigating the individual parts of a demonstration I shall suggest a general schema for an Aristotelian existence demonstration (a model that is equally applicable for demonstrating attributes). This model will in turn illuminate our journey into Aristotle's theory of time in later chapters. The final section will conclude with the place and role of dialectic and division within Aristotelian science.

B. The Structure of the Posterior Analytics *and the Nature of a Demonstration.* The *Posterior Analytics* is conceptually divided into three related parts, even though the work itself is only composed of two books. The first part (roughly. 1-10 of book I) concerns the general nature of demonstrative science, where a "demonstration" is a syllogism (or to be more exact a syllogistic chain), which has necessary, non-derived premises of a special kind. The second part (the remainder of book I) deals with issues related more specifically to the syllogistic structure or inferential pattern of the demonstration (and indeed is the main focus of this chapter), while the third part (book II) covers topics pertaining to the special premises, i.e., the ultimate starting points, of a demonstrative chain.

Aristotle says that we have scientific knowledge of something (in the broad sense of the Greek *epistêmê*) whenever (1) we know the cause on account of which the thing is and (2) that the cause could not be otherwise (*PoA.* I 2, 71b10-12).[3] That is to say, Aristotle envisioned science not only as providing a cause or an account of the various phenomena under scrutiny, but also as providing an explanation of *why* the phenomena must follow given that account. The account explaining why the phenomena must follow is called "knowledge of the reasoned fact" (Grk. *to dioti*; Lat. *propter quid*) and represents the goal of science (*PoA.* II 1-2).

Demonstrations, according to Aristotle (71b16-17), provide the most perspicuous instances of knowledge meeting these two criteria (viz., the account's explaining some phenomenon and the explanation of the necessity of that account). A demonstration is a syllogism, or deduction, constructed according to one of the legitimate inference patterns elaborated in the *Prior Analytics* (71b17-18). Furthermore, the initial premises of a demonstrative syllogism are (1) true, (2) primitive, (3) immediate, i.e., they are not themselves deduced (*ameson*; lit. without a middle [term]), (4) better known than, (5) prior to and (6) explanatory of the conclusion (71b20-22).

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[3] Cf. also Plato's *Theaetetus* 201Dff.

Premises meeting these six criteria are often called first principles since they provide the initial starting points from which the demonstration proceeds. Thus a demonstration in the strict sense is a deduction which proceeds from first principles.

C. Explanations and Errors Concerning Aristotelian Demonstrations. The *Posterior Analytics* historically has been viewed as an attempt to provide a method of demonstration by which science builds up a body of scientific knowledge, i.e., it is a work intent on explaining the logical apparatus by which the scientist deduces scientific theorems or conclusions.[4] The scientist, according to this view, intuitively grasps the first principles of a science and then through the rigorous application of demonstrations proceeds to construct a body of scientific knowledge. Thus the scientist is only doing science if he is generating demonstrations.

Such a picture has created a puzzle for commentators: how is one to reconcile the prescriptions of the *Posterior Analytics* concerning science with Aristotle's actual practices? For Aristotle's actual practices do not systematically and regularly employ demonstrations, but seem to proceed by means of dialectic or other Platonic methods, all of which Aristotle denounces in the *Analytics*. In what follows I consider and assesses the solutions of T.H. Irwin, G.E.L. Owen and Jonathan Barnes' regarding this discrepancy.[5] These discussion will in turn provide the basis for a

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[4] Cf. Thomas Aquinas, *Commentary on the Posterior Analytics of Aristotle*, L. I, l. 1: "The end of the demonstrative syllogism is the attainment of science."

[5] I have chosen these three not because theirs is the final word, but

reevaluation of the *Posterior Analytics* and the role of demonstration within Aristotelian science.

T.H. Irwin, in his article "Aristotle's Discovery of Metaphysics", argues that in the *Metaphysics* Aristotle repudiates the view of science presented in the *Organon*.[6] In the *Posterior Analytics*, Irwin relates, Aristotle had maintained there could be no special science which demonstrated the first principles nor could first principles be scientifically known.[7] In the *Metaphysics*, however, Aristotle calls for a first philosophy, which is the science of being in general and concerns itself with the principles (*archai*) and causes (*aitiai*) of everything *qua* being. One cannot offer a demonstration proper of these principles, continues Irwin, but one can use "elenctic demonstrations" (*apodeixai elenktikôs*), i.e., "a refutation of someone who denies a principle" (IV 4, 1006a10-12). Irwin equates an "elenctic demonstration" with a certain mode of dialectical argumentation, since it can provide the right kind of explanation (i.e., it shows "that the conclusion is derived from true premises which no one can rationally reject") and the right kind of

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because they so well typify the current approaches to the *Posterior Analytics*. Irwin maintains that Aristotle's practice and preaching concerning science are irreconcilable and thus asserts that Aristotle rejected the doctrines of the *Posterior Analytics*; Owen tries to make room for Aristotle's practice by making the standards of the *Organon* more flexible; and Barnes calls for a complete reassessment of the role of Aristotle's theory of science, which in turn makes the theory of demonstration unrelated to the actual practise of science. I have not mentioned those who have tried to turn Aristotle's arguments in the scientific works into full demonstrations, since this project belongs more to ancient and medieval commentators.

[6] In *The Review of Metaphysics*, 31 (December 1977): 210-29.

[7] Ibid, §§I and II.

necessity.[8] Metaphysics, or the science of being, therefore, lays the foundations for the particular sciences. It would therefore appear as if the *Metaphysics* and the "elenctic demonstration" provide for a type of justification of first principles, whereas the *Posterior Analytics* and the demonstration seem not to allow for such a justification. Irwin thus concludes that the theory of science in the *Metaphysics* supersedes that of the *Posterior Analytics.*

Irwin's thesis relies on two interpretive claims concerning the *Posterior Analytics'* conception of science: (1) science only progresses through the application of demonstrations and (2) only demonstrative knowledge is scientific. Thus since in the scientific treatises and the *Metaphysics* Aristotle proceeds by means of dialectic, Aristotle must have abandoned thesis (1), but if Aristotle is to maintain that the various sciences still are sciences he must likewise reject thesis (2) in order to make room for dialectic. In the sequel I shall argue that thesis (2) is false and that (1) can only be retained after properly qualifying it.

G.E.L. Owen takes a less extreme stance than Irwin and argues that the picture of scientific knowledge in the *Organon* makes room for dialectic, especially concerning how the scientist acquires the first principles. For in the *Prior Analytics* Aristotle had claimed that only if we adequately grasp the *phenomena* are the principles of any art or science discovered.[9] Yet Aristotle did not merely mean by

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[8] Ibid, 221-22.

[9] *PrA.* I 30, 46a17-22.

"phenomena" perceptual or physical phenomena, as Owen persuasively displays, but also included the common conceptions (or at least the opinions of the wise) (*endoxa*) on the subject, the philosophical puzzles associated with the subject (*aporiai*) and the common linguistic usages surrounding the subject among the phenomena.[10] All these latter *phenomena* fall within the domain of dialectic. Further, Owen reminds us, Aristotle maintained that the first principles are acquired by induction (*epagôgê*), which is one of the cardinal methods of dialectic.[11] Hence, concludes Owen, for Aristotle the first principles of a scientific argument can be established by the methods of dialectic and thus dialectic plays an essential role in the scientific method.[12]

Two points are troubling about Owen's otherwise well argued and documented discussion: one specific to Owen's position, the other more general. Owen begins his article *Tithenai ta Phainomena* claiming "there seems to be a sharp discrepancy between the methods of the scientific reasoning recommended in the *Analytics* and those actually followed in the *Physics*"; yet he only gives two relevant citations from the *Posterior Analytics*.[13] Owen is more prone to

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[10] "Τιθέναι τὰ φαινόμενα," 84-92 in *Aristote et les problèmes de méthode*, ed. S Mansion, 83-103. 2d ed. Louvain: Éditions de l'Institut Supérieur de Philosophie, 1980.

[11] Ibid, 86-87.

[12] Ibid, 92.

[13] Ibid, 83; the first citation is in footnote 2 to *PoA.* I 13, 78b39, 79a2-6, which is evinced to show that Aristotle uses *phenomena* to refer to "empirical observations", which is what one naturally expects; the second is on page 86 and refers to the use of induction in establishing the first principles of a science.

derive his depiction of Aristotelian science from the *Topics* or the various scientific treatises, e.g., the *Physics*, the *Parts of Animals*, the *Meteorology* and the *Nicomachean Ethics* and occasionally from the *Prior Analytics*. The method of scientific reasoning with which Owen ultimately works, then, is one abstracted from the actual practices followed in the scientific works. Thus Owen shows that the use of dialectic is consistent with Aristotle's practical methods. This issue, however, is not in question. The issue at hand is how to reconcile the scientific method actually employed (which does use dialectic) with the prescribed method of the *Posterior Analytics* (which on the face of it disallows dialectic). Owen's solution for reconciling Aristotle's preaching and practices thus seems to rely on a philosophical sleight of hand.

On a more general note, any position that tries to fit dialectic within Aristotle's conception of science has to address Aristotle's arguments against and distaste for dialectic.[14] I am not saying that Aristotle might not have rejected his earlier position; however, if one claims Aristotle did, then he or she is no longer attempting to reconcile Aristotle's preaching and practices; rather, he or she has adopted a position more aligned with Irwin's.

Jonathan Barnes calls for a total reappraisal of the *Posterior Analytics'* intent and the role of demonstration specifically. The goal of demonstrative science is not to make scientific discoveries, but to present scientific knowledge to the students.

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[14] Cf. *PoA*. I 11, 77a26-35; *Metaphys*. I 9, 24-33.

> ...the theory of demonstrative science was never meant to guide or formalize scientific research: it is concerned exclusively with the teaching of facts already won; it does not describe how scientists do, or ought to *acquire* knowledge: it offers a formal model of how teachers should *present and impart* knowledge.[15]

The actual practice of science, then, may carry on however it sees fit, whether that be through observation and inspection or dialectic. Demonstration merely provides the framework for organizing this body of knowledge in such a way that it is more easily teachable. To this end demonstration is a tool of pedagogy and not of science.

Barnes himself raises the most telling criticism to his own view.[16] If demonstration is a means of presentation and teaching, and, as Barnes himself admits, the so called scientific treatises are in fact lecture notes, then why does Aristotle not employ it in his scientific treatises? Barnes attempts to minimize the force of the objection by asserting that Aristotle's scientific treatises are merely piecemeal lecture notes never intended for formal instruction. "They are progress-reports, not text-books, and as such they need not--indeed cannot--have pedagogic form."[17] This is an odd response. Barnes claims that these treatises are lecture notes and thus we must assume that Aristotle was trying to teach what he had discovered, and yet according to Barnes' own critique Aristotle never (or at most, seldom) uses demonstrations in his treatises. Are we further to

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[15] Barnes, (1975): 77.

[16] Also see William Wians "Aristotle, Demonstration and Teaching" (in *Ancient Philosophy* IX (Fall 1989): 245-253) for a thorough critique of Barnes' position.

[17] Barnes (1975): 145.

assume that Aristotle himself did not believe he had made significant enough progress in *any* of the sciences to present a demonstration? Aristotle certainly believed that some of his definitions and initial premises were true and necessary. Thus even if the treatises were mere progress reports, we still might expect Aristotle to formalize what he had, especially if he was teaching it. The objection is not as weak as Barnes would have us believe and the fact that Barnes attempts to depreciate it should at least give us reason to pause.

D. A Reevaluation: Demonstration as a Tool of Analysis. In contrast to the various views we have considered, demonstration, I contend, offers a means of breaking down intractable, complex scientific problems into simpler, more easily manageable ones. To this end the *Analytics* are aptly titled; for the Greek verb *analuein*, as Patrick Byrne has insisted, literally means to "loosen up" or "resolve", which I argue is the primary role of a demonstration (or at least an extremely important role).[18] According to this position, the *Analytics* provides tools for the scientist, which allow him to begin either from some scientific problem or phenomenon (whether physical or otherwise) and then methodically to break it down into

[18] That Aristotle intended ἀναλύειν to mean "loosen up" is Byrne's main thesis in *Analysis and Science in Aristotle* (Albany: SUNY Press, 1997) ch. 1. "[Analysis] as a process of "loosing up" presupposes the prior givenness of something in need of, or at least capable of, being loosened up.... [F]ar from being a matter of a reduction or a decomposition in which the whole is lost, analysis for Aristotle almost always involved a simultaneous finding of the whole intelligible pattern of interconnections among the constituents" (25). Where I differ from Byrne is the role of "reduction or decomposition". Reduction, far from destroying the whole, helps make the whole intelligible. For as I argue, by reducing complex problems to their elements, analysis simplifies the problems and makes them more amenable to scientific inquiry.

problems whose answers are more easily attained.[19] Indeed, we learn at *Posterior Analytics* II 2 that the activity of science for Aristotle involves hitting upon the correct middle term, and, as we shall see in the sequel, the demonstration helps the scientist recognize middle terms, which provide a true and necessary connection, or conceptual link, between two things.

A demonstration, I must warn, provides no algorithm for recognizing true and necessary relations. One either discerns the relation or not. We come to know these connections, these first principles, Aristotle tells us, only through the state or habit

[19] The *Prior* and *Posterior Analytics* are replete with such analytic tools; however, if one assumes that the *Analytics* are merely concerned with how systematically to build-up a body of scientific knowledge, then these tools appear to be nothing more than logical exercises. Some examples of these tools are: in any demonstration one of the first principles must be affirmative and one universal (it could be the same principle or different ones) (*PrA* I 24, 41b6-22); at least one of the first principles must be like that which is to be explained in form and mood (Ibid, 42b27-31); given the mood and form of the phenomenon being explained, a guide to what the form and mood of the first principles necessary to explain it must be (*PrA* I 26); how to go about seeking out first principles (*PrA* I 27-30); how to reduce non-syllogist inferences to a syllogistic structure (*PrA* I 32-44); how phenomena can be explained by appealing to false premises and which type of false premises can lead to true conclusions (this tool highlights those "first principles" that a scientist should be wary of, since they might logically explain some phenomena and yet not be true first principles, insofar as they are neither true nor explanatory) (*PrA* II 2-4); identifying when extremes and the middle terms are convertible (*PrA* II 22); the syllogistic structure of induction (*PrA* II 23); the nature of first principles (*PoA* I 4); explanation of how we might choose mistaken first principles (*PoA* II 5); how to move from facts better known to us to facts better known by nature (*PoA* I 13); the preferred figure for scientific demonstration (*PoA* I 14); when seemingly true premises lead to patently false conclusions and how to determine the offending premises (*PoA* I 16-17); and the list continues. In many of these examples the scientist is provided with a means of identifying what the first principles of a science must look like, and consequently what he or she must try to discover, if one is to explain certain phenomena, viz., the conclusions of deductions. Thus one begins with the phenomena, or conclusions, and then works his or her way "backwards" to an explanation. In this way the logical tools help "loosen up" that which is to be explained.

(*hexis*) of *nous* (*PoA.* II 19, 100b5-17).[20] Hence, the acquiring of first principles, one may even say the heart of Aristotelian science, involves the habit or state of the scientist. Habits, I would like to observe, cannot be bequeathed through mere techniques or philosophical writings, but must be acquired through actual practises, whether these practices be empirical investigations, considerations of linguistic practices, divisions into genera and species or the like does not matter. I make this point because it shows the limit of what demonstration, and indeed the entire methodology and analytic tools associated with Aristotle's theory of the demonstration, can do. Demonstrations can facilitate scientific inquiry; they can organize scientific data; but they cannot be the summation of science. Scientific knowledge for Aristotle must also include knowledge had by *nous*, i.e., knowledge acquired through investigating the world.

Here we see what is wrong with Irwin's and many other modern scholars' interpretation of Aristotelian science.[21] According to their view a piece of knowledge for Aristotle, by definition, only counts as scientific if it is the conclusion of a demonstration (or

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[20] We can in general take νοῦς to mean the activity of the mind: seeing, thinking, recognizing and discerning. I provide no sustained argument about the nature of νοῦς, although I do make some brief comments concerning it in the sequel. In general I follow Lesher's position in "The Meaning of ΝΟΥΣ in the *Posterior Analytics*" (*Phronesis* 18 (1973): 484-68), whose arguments support and parallel the view of science I develop.

[21] Cf. Irwin (1977), 211; McKirahan, *Principles and Proofs: Aristotle's Theory of Demonstrative Science* (Princeton: Princeton UP, 1992) 28 and 164, fn. 1; Ross, *Aristotle's* Prior *and* Posterior Analytics (New York & London: Garland Publishing, Inc., 1980), 509; for a dissenting views see Byrne (1997) and Bayer, "Definition through Demonstration: The Two Types of Syllogisms in *Posterior Analytics* II.8," *Phronesis* 40 (1995): 241-264.

for Irwin, there is some justification for the proposition, perhaps in the form of a strong dialectic or elenctic demonstration). These commentators justify this interpretation by quoting from (and I would complain, misunderstanding) *Posterior Analytics* II 19 where Aristotle distinguishes scientific knowledge (*epistêmê*) from understanding (*nous*), calling understanding the "principle" or "origin" (*archê*) of scientific knowledge and thus something distinct from scientific knowledge.

In contrast, I maintain that knowledge had by *nous*, like knowledge obtained through demonstration, is scientific. First, let us consider why being the *archê* of scientific knowledge (*epistêmê*) does not preclude the *archê* itself from being scientific. To maintain that knowledge obtained by *nous* is distinct from scientific knowledge because the former is the *archê* of the latter is tacitly to assume that an *archê* cannot be of the same kind as that of which it is the principle or origin. This assumption is questionable. In Aristotle's account of the various meanings of *archê* in *Metaphysics* V 1, there is no mention that an *archê* must be different in kind from that of which it is the origin or principle. In fact, of the six different suggested definitions of *archai*, we see both possibilities. A magistrate is the origin of laws, but clearly a lawgiver is different in kind from the laws which she legislates (1013a10-14). On the other hand, the parents are the origin of their children and obviously are not different in kind from their offspring (1013a6-10). The *Metaphysics* passage also includes the example of the first principles of a demonstration without indicating whether they are different in kind from demonstrations (1013a14-16). Therefore, the mere claim that knowledge had by *nous* is the *archê* of scientific knowledge, does not preclude it from itself being scientific knowledge. An argument must be presented.

Whereas I know of no argument for the opposing thesis, various arguments do readily present themselves for thinking that the first principles of demonstration--i.e., the knowledge had through *nous*--is as much scientific--i.e., *epistêmê*--as knowledge acquired through demonstrations. The difference between knowledge obtained by *nous* and knowledge obtained through demonstrations is that in the latter case our knowledge of a proposition's truth is mediated through a middle term, whereas in the former we have direct knowledge of its truth. Science, we recall, is knowledge which is (1) explanatory (*hê aitia*) and (2) such that the explanation cannot be otherwise (*PoA.* I 2, 71b9-12). Without question one instance of such knowledge is demonstration, but Aristotle goes on to suggest that not all scientific knowledge is demonstrative (*PoA.* I 2, 71b16-17); and in the next chapter he explicitly states as much. "It is clear that not all scientific knowledge (*epistêmên*) is demonstrative; but rather concerning the unmediated things [i.e., the first principles] they are indemonstrable" (*PoA.* I 3, 72b18-20). Knowledge of the first principles of demonstrations is indemonstrable and yet it meets both criteria for scientific knowledge. These principles are grasped or recognized by *nous*, the *archê* or origin of scientific knowledge.

This recognition or grasping (as compared to demonstration) of the true, necessary and causal features of a proposition does not strip them of their scientific content; rather this direct recognition of the true, necessary and explanatory nature of first principles represents the apex of scientific knowledge.

Two further arguments also present themselves in favor of the view that grasping or recognizing first principles is science. First, at *Posterior Analytics* II 1 Aristotle is clear that the number of things known scientifically is equal to the number of things sought by a science (*ta zêtoumena*). Science seeks the fact (*to hoti*), the reason why (*to dioti*), whether something is (*ei esti*) and what something is (*ti estin*) (89b23-5). Now all instances of what a thing is, and certain cases of whether a thing is, Aristotle counted among first principles (*PoA*. I 10, 76a31-34). Therefore, principles are things sought by science and thus known scientifically. The objection that principles are assumed and thus not sought misunderstands what it means to assume a principle; for not any definition or existence claims are assumed, but only ones that the scientist knows to be true and necessary, which only comes after consideration and discernment.

Again, the very nature of the scientific enterprise testifies that some of the objects of scientific enquiry can never be conclusions. Science seeks the middle term (*PoA* II 2), where the "middle term" is shared by two premises linking subject and predicate in such a way that a conclusion can be inferred regarding the relation of the two extreme terms to one another. The terms in the premises of a demonstration, however, are not linked by a further middle term--these propositions are immediate (*ameson*), literally without middle. Further, the middle in a demonstration often is a definition.[22] Aristotle, however, goes to great lengths to show that a definition can never in the strict sense be the conclusion of a demonstration (*PoA* II 3-7). In short, science seeks the middle term, which can be a definition, but definitions are never the conclusions of a demonstration.[23] Therefore some of the things science seeks are not the conclusions of demonstrations, but rather the principles of demonstrations. Irwin and others are wrong to associate science exclusively with possessing a demonstration.

E. Demonstration I: Syllogistic Form. Above I made the case that knowledge of first principles obtained through *nous*--i.e., the immediate recognition or grasping of the truth and necessity of some fact--is scientific knowledge. In the following I argue that demonstration can still play a role in making easier the recognition

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[22] Cf. C. Kahn, "The Role of *Nous* in the Cognition of First Principles in *Posterior Analytics* II 19", in *Aristotle on Science the <<Posterior Analytics>>*, ed. E. Berti (Pauda: 1978), 387-397; McKirahan (1992), 194-97.

[23] Except in a qualified way; cf. *PoA* II 8 for a discussion of in what sense a definition can be the conclusion of a demonstration. The general argument, though not fully explicated at II 8 since it requires conclusions found in II 11, is that there can be different types of definitions corresponding to the four causes with different levels of primacy. Thus one could demonstrate the material definition of x, by assuming x's formal definition in the demonstration and the formal definition through the efficient definition ultimately reaching the primary definition which is in terms of the final cause (cf. *Physics* II 3, 195a4-26). For instance, (1) All animals are composed of the four elements; (2) All humans are (rational) animals; therefore (3) all humans are composed of the four elements. (3) defines humans in terms of their matter, but we could only infer (3) by assuming the formal definition (2) which explains the necessity of the matter.

or grasping of these first principles. Demonstrations, we shall see, are capable of this function since they have a special structure, which can be easily identified and dissected. For instance, demonstrations (1) always are in a valid syllogistic form, mode and figure and (2) they always have premises that are true, primitive, without middle, better know than, prior to and explanatory of the conclusion (*PoA.* I 2, 71b17-25).

Take a demonstration's syllogistic structure. The syllogism (*sullogismos*), Aristotle defines (*PrA.* I 1, 24b18-20), is the account (*logos*) in which certain things being posited certain things other than what were posited occur from necessity from the things being so.[24] With more precision, a syllogism is a deductive scheme of a formal argument consisting of a major and a minor premise, both of which have a term in common, viz., the middle term, and the conclusion which follows from these premises. For instance:

(1) all carnivores have incisors;
(2) all dogs are carnivores;
(3) therefore, all dogs have incisors.

Or again a universal privative syllogism:

(1) no carnivores are ruminant;
(2) all dogs are carnivores;
(3) therefore, no dogs are ruminant.

We can also form syllogisms from particular premises; for instance:

(1) all carnivores have incisors;
(2) some fish are carnivores, e.g. sharks;
(3) therefore, some fish have incisors.

Or a particular privative syllogism:

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[24] Also cf. *Topics* I 1, 100a25-27.

(1) no carnivores are ruminant
(2) some animals are carnivores
(3) therefore, some animals are not ruminant.

Thus, if we return to the first example, we inferred a relationship between being a dog and having incisors (the minor and major terms respectively) and we deduced this relationship from the common or middle term, being a carnivore.

In the *Prior Analytics*, the treatise in which Aristotle develops his account of the syllogism, he indicates fourteen different valid syllogisms, which he took to encompass all of the syllogism's legitimate forms. In the *Posterior Analytics*, Aristotle further argues that for the purposes of science the natural philosopher or mathematician only employs syllogisms in the so-called "first figure" ("figure" refers to the placement of the middle term, in contrast to "mood" which is determined by the kind of propositions (A, E, I, O) that make up the syllogism). Moreover, there are only four valid moods of the syllogism in the first figure, viz., the four represented above.

Aristotle took great pride in his discovery of the syllogism.[25] For in the syllogism Aristotle believed that he had discovered the structure of all genuinely rational and explanatory reasoning processes involving a conceptual transition. The structure would proceed from initial premises and assure that every subsequent step

[25] Cf. *Soph.El.* 34, 183b15-184b8. Note, although συλλογισμός is just the general Greek term for "deduction," when I use it, I intend it to mean the formal structure developed by Aristotle in the first part of the *Prior Analytics*.

operated through major, minor and middle terms with no logical gaps. Simply stated, Aristotle thought that *all* valid explanatory inferences could be expressed by one of the fourteen inference patterns that he had enumerated (*PrA.* I 23, 40b17-41b5).[26] Consequently, any genuine form of scientific discovery could be

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[26] The general argument presented at *Prior Analytics* I 23 is the following. All deductions must involve at least three terms: the two extremes and the middle linking them. Moreover, the middle may link the extremes in one of three possible ways. For example, let A be the major term, C the minor term and B the middle term. Thus the three terms must be linked either as ABC, BAC or ACB; there are no further possibilities. "ABC" corresponds with Aristotle's first figure; "BAC" with the middle, or second, figure; and "ACB" with the last, or third, figure. Therefore, since deductions must involve at least three terms, which can only be linked in one of three ways, and the three ways correspond with Aristotle's three logical figures, Aristotle's three figures exhaust all the possible deductive patterns. The chapter concludes with a discussion of why both hypothetical arguments and arguments *per impossibile* must always use a deduction according to one of Aristotle's three figures. Thus Aristotle concludes that every demonstration and every deduction is formed according to one of his three figures (41b1-3). Whether the syllogism truly is as powerful as Aristotle maintained, however, seems unlikely; for as Galen would observe in his *Institutio Logica* neither Aristotle's syllogism or Chrysippus' hypotheticals could sufficiently cope with relational inferences, e.g. "equal to" or "to the right of," which so often occur in mathematics.

As an aside, an interesting question arises concerning the status of the so called "immediate inferences," i.e., inferences that do not involve a conceptual middle term. For example, given that "all A are B," we can infer that "some A are B" (or that "some B are A") or given that "no A are B," we can infer that "no B are A". Such inferences for Aristotle would not be true deductions (*syllogismoi*) since they do not involve three terms. Unfortunately Aristotle has very little to say about such inferences. In the *Analytics*, the only place where Aristotle attempts to show that conversion (*antistrophê*) must be necessary is at *Prior Analytics* I 2. Unfortunately, his argument there is circular since in order to show that "no A is B" converts with "no B is A," he uses the conversion from "all A is B" to "some B is A"; however, to show that "all A is B" converts with "some B is A" he uses the universal negative conversion he had "proven" above. At another place (*PrA* II 1) Aristotle suggests that conversions are different (necessary) conclusions following from the same deduction; however, he does not say in what way these are conclusions.

As a suggestion for what the status of immediate inferences is, I would offer that our knowledge of such logical inferences as conversion, contraposition and obversion, along with inferences involving contraries, contradictions and subalternations, is on par with our knowledge of the so called "laws of thought", i.e., the law of identity, the law of contradiction (or non-contradiction) and the law of the excluded middle. No one can prove these laws (and inferences) but our normal way of speaking and thinking are committed to them (cf. *Metaphysics* IV 4 and 7); and thus on pain of silence we must accept these laws.

expressed syllogistically. Hence, inferences from a general principle to a particular case or from particular instances to a universal law would all have a syllogistic structure.[27] Such a belief, viz., that all sound inferences (i.e., all true and valid inferences) could be expressed syllogistically, had far reaching effects on Aristotle's position concerning scientific discovery.

The practical scientific application of the syllogism is that it provides a tool for undertaking scientific inquiries and analyses. All inferences for Aristotle can be expressed using a finite set of paradigm syllogisms. (Scientific deductions, in fact, rely solely on the four syllogistic moods in the first figure.) Moreover, the syllogism allows one to infer a relationship between two terms by means of a middle term, e.g., the relation between dog and having incisors, which follows on account of the common term, being carnivorous. Consequently, when the scientist seeks the explanation or cause of some phenomenon (i.e., inquires why a given relationship holds between two terms), he is assured that if there is an explanation, which links the two terms, then the relationship between the terms and the explanation can be expressed as a syllogism. Furthermore, the cause or explanation of this relationship serves as the syllogism's middle term (or terms) (*PoA.* II 11). In other words, since all scientific inferences or discoveries are expressible syllogistically, and since the syllogism has a very specific

[27] Aristotle's belief that inferences from universals to particulars could be expressed syllogistically can be found throughout his logical works; the more questionable belief that inferences from particulars to universal, or what we would term induction (*epagôgê*), is syllogistic is found in *PrA* II 23.

structure, the scientist can use his knowledge of the syllogism to guide his inquiry; for only premises of a certain form and arranged in a special way can constitute a syllogism.

Aristotle makes this point at *Posterior Analytics* II 2.

> When we seek the fact or if something is absolutely, we are seeking whether or not there is a middle term for it; and when, having come to know either the fact or if it is ... we next seek the reason why or what it is, we are then seeking what the middle term is. ... Thus it results that in all our searches we seek either if there is a middle term or what the middle term is. For the middle term is the explanation, and in all cases it is the explanation of what is being sought (89b37-90a7).[28]

Aristotle's claim is that there is a link between causes, i.e., the objects of scientific inquiry, and the middle term, i.e., the fundamental notion of Aristotelian logic. Aristotle is assuring the scientist that all the features that belong to the logical notion of a middle term, likewise hold of scientific explanations and he can thus use this knowledge of logic to facilitate his scientific investigation.

An example of this procedure might clarify. Above we saw the syllogism where dogs' having incisors was inferred through the middle term being carnivorous. Let us assume now that we do not have this complete demonstration, and rather only know that dogs have incisors, but we want to know why. In the teleological universe of Aristotle we have very good reason to believe that there is some cause or explanation of this phenomenon and it is the natural philosopher's task to discover that cause. How, then, might one go about finding

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[28] Translation after Barnes, *Posterior Analytics*, 2d ed. (Oxford: Clarendon Press, 1993); also cf. *PoA* I 6, 75a28-37.

the explanation or cause of dogs' having incisors? For the Aristotelian scientist, his knowledge of the syllogism immediately begins directing the search. The solution must be of the form that the theorem "all dogs have incisors" is logically concluded. The only syllogism that can render such a conclusion, according to Aristotelian logic, is one that is in the first figure and that has all universal affirmative premises. Hence the scientist knows before he ever begins his investigation that the answer (at least in its simplest form) must have the following structure:

(1) all x have incisors
(2) all dogs are x
(3) therefore, all dogs have incisors.

The scientist inquires after "x" i.e., the middle term that links the terms "dogs" and "having incisors". Granted the syllogism has not provided the scientist with any real answer to the inquiry and thus the scientist must still undertake an empirical investigation. Still such a result fits well with Aristotle's empiricist leanings. Thus as a technique, the scientist's knowledge of the syllogism allows him to take a complex scientific question and break it down into more manageable areas of inquiry and thus it offers a guide for discovering the causes and explanations of various phenomena.

Furthermore, this technique has steered the scientist clear of certain avenues of possible pursuit. For instance, he may neglect any observation that holds only of some dogs or some of the things that have incisors. (The logical reason is that the distribution of either the minor term or the middle term does not extend far enough.)

Similarly, one need not consider all things that do not have incisors. An example would be if one noticed that nothing with a ruminant stomach had incisors and concluded that lacking a ruminant stomach was the cause of having incisors. The syllogism tells us it cannot be; for one can never validly infer a positive conclusion from a negative premise. (Once again the technical explanation is that the middle term does not connect the two terms.) In general, a knowledge of the syllogism saves the natural philosopher or mathematician from taking false steps in his scientific endeavors.

Clearly, being able to place any valid argument into a syllogism greatly expedites the scientist's project. It reduces the number of arguments the scientist must consider; in fact, the scientist ultimately only has to concentrate on arguments in the first figure, which are universally affirmative or negative (viz., Barbara or Celarent) (*PoA* I 14). Further, demonstrations indicate the general form the explanation has to take and thus narrow the scope of the scientist's search (*PrA* I 26; I 32, 47b7-13). Moreover, Aristotle assures us at *Posterior Analytics* I 19-22 that no valid syllogism can have an infinite number of premises. Consequently, since the scientist knows the number of premises in a demonstration must be finite he is assured of the possibility of arriving at an ultimate explanation.[29] The information obtained from our knowledge

[29] Barnes (1993) has gravely misunderstood the intent of Aristotle's argument. Barnes correctly identifies Aristotle's thesis as "proofs can have only finitely many steps", but then adds that Aristotle further "supposes first that there are only finitely many things capable of proof, and secondly that there are only finitely many truths" and then complains that "consideration of the infinite sequence of true and provable propositions in even elementary arithmetic is enough

of the demonstration's syllogistic structure does not provide us with or lead us to new scientific knowledge, but it does greatly simplify the scientist's task.

F. Demonstration II: The Propositions. Just as demonstrations have a special form, they also have a special type of premise and knowledge of this type of premise likewise assists the scientist. In *Posterior Analytics* I 2, Aristotle lists six characteristics belonging to the propositions of a demonstration. They must be true (*alêthôn*), primitive (*prôtôn*), without middle (*amesôn*), more familiar than (*gnôrimôterôn*), prior to (*proterôn*) and the explanation of (*aitiôn*) the conclusion.[30] The ultimate propositions in a demonstration are nothing other than first principles (*PoA.* I 2, 72a6-14; 72a25-b4). Consequently, the propositional form of first principles must be appropriate to a demonstration. Therefore, as our knowledge of the propositions employed in demonstrations and how to identify them increases, so does our knowledge of first principles and how to identify them.

The earmark of a demonstration is its necessity, and to ensure this necessity the premises themselves must be necessary (*PoA.* I 6, 74b5-75a37). Thus to clarify how x holds of y necessarily, Aristotle

to dispose of these two bolder suppositions" (181). I have found no place where the arguments of I 22 require these latter "two bolder suppositions" nor does Barnes make use of them in his reconstruction of Aristotle's arguments. In fact, Aristotle explicitly claims the number of conclusions, i.e., true things capable of proof, is infinite (I 32, 88b6). I am at a loss to explain Barnes' apparent "cheap shot".

[30] A characteristic conspicuous by its absence is necessity (*anangkaiôn*); however, since I 4 and 6 say that a demonstration just is a syllogism proceeding from necessary proposition, we can either take Aristotle to have thought that the list at I 2 implies necessity or as an oversight on Aristotle's part.

introduces at *Posterior Analytics* I 4 (73a28-74a3) three concepts: predicated "of all" (*to kata pantos*), "*per se*" (*to kath' hauto*) and "universally" (*to katholou*). Each of these features has an unique trait that makes it identifiable to the scientist.

1. Predicated of All. A first principle, Aristotle tells us at 73a28-34, as a minimum is predicated of all. As such it is impossible that the proposition cover (*epi*) some cases, but not others, or apply sometimes, but not at other times. Thus, x holds of y necessarily only if all (or no) xs hold of y and x always (or never) holds of y. When seeking a phenomenon's reason why the "predicated of all" characteristic provides a quick test for excluding certain explanations; for if there are certain cases or times when x does not hold of y, then x cannot hold of y necessarily, and hence it is not a first principle.

For instance, say we want to explain the twinkling of the stars and someone proposes that twinkling occurs when a fine dust exists between the viewer and the object viewed, and then further asserts that a fine dust exists in the atmosphere between us and the stars. Such a suggestion certainly has the air of a demonstration; for the latter claim (the minor premise) is a matter of observation, while the former (the major premise) is just a definition. We could test the conjecture by asking whether there are any cases where we view a non-twinkling object through our atmosphere? Of course all the planets exist opposite our atmosphere and yet none of them twinkle; and thus our initial premise does not hold for every case and consequently we can discard it as a first principle.

2. Per Se *Predication.* Another feature of the premises of a demonstration, Aristotle observes at 73a34-b26, is that one thing must be predicated of another *per se* (*kath' hauto*). On the face of Aristotle's discussion of *per se* predication it appears that he distinguished four types of *per se*; however, I shall argue that Aristotle only distinguished two and that the purported other forms of *per se* predication are actually comments indicating the form and content of a *per se* predication.[31]

a. Per Se *1 Predication.* According to Aristotle's first description of *per se* predication (73a34-37), whatever belongs (*huparchei*) to the subject belongs *per se* to the predicate (*to ti estin*).[32] That is to say if x is contained in the essence or is a constitutive factor in the definition of y, then x belongs *per se* to y.[33] In our passage Aristotle gives the examples of line to triangle and point to line. How the one belongs to other can be seen more clearly if we consider Euclid's definitions of triangle and a

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[31] See the appendix "*Per se* predication and the Third Man argument in Aristotle" for my reading of the historical and philosophical background behind Aristotle's distinction between *per se* predications.

[32] 73a34-35; ὑπάρχειν, though not a technical term, is a term which Aristotle uses quite frequently as a copula. As such the predicate term is placed in the nominative case, while the subject goes into an oblique case (the dative). Thus in the proposition "x belongs to y," "y" is the subject of the proposition and "x" the predicate. One should note that the logical subject does not coincide with the grammatical subject.

[33] Ferejohn [1991), 83-91] offers an insightful discussion of formulating the "what it is" of some item and *per se* 1 predication. His strategy is to show how a method presented in *Topics* I 9 can be used to form "chains" of items of which the entire series uniquely identifies the item.

straight line.[34] A triangle is a figure contained by three straight lines and a straight line is a line that lies evenly with the points on itself.[35] We see that the concept of a straight line is contained within the definition of triangle; and similarly we define a straight line in terms of points. The one must belong to the other; for without the one the other can neither be nor be defined.[36]

Another passage germane to this issue is *Posterior Analytics* II 13, in which Aristotle explicitly claims he will describe how we are to seek the things predicated in a definition.[37] The suggestion is to seek all those things that extend beyond the definiendum yet belong to the same genus and taken together uniquely identify the definiendum. The example he gives is the number three. Three is a number, odd, neither the product of two numbers nor the sum of two numbers (one (1) was considered the principle of numbers, but not a number itself).[38] "Number" clearly is not unique to three; "odd" belongs to all numbers not divisible by two; "not the product of two

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[34] Since Euclid was but a single generation after Aristotle it is very likely that his definitions of these terms, or at least definitions similar to these, would have been familiar to Aristotle, and thus will suit our purposes.

[35] Euclid, *The Elements* [trans. Sir Thomas Heath (New York: Dover Publications, Inc., 1956)], Bk. I, defns. 19, 4 respectively.

[36] I stand with McKirahan [(1992), 87] in being somewhat promiscuous about what it means to "be contained in", or a "component of", a definition. Basically, any term that is employed in stating what a thing is belongs to that thing *per se*. Also compare Aristotle's comments at *Prior Analytics* I 35 concerning phrases that function as a single term.

[37] 96a22-23 πῶς δὲ δεῖ θηρεύειν τὰ ἐν τῷ τί ἐστι κατηγορούμενα, νῦν λέγωμεν.

[38] Although I have presented two of the features as negative qualities, i.e., neither the product nor sum of two numbers, I do so for clarification. Aristotle treated these qualities as the two positive qualities being "prime in both ways" (τὸ πρῶτον ἀμφοτέρως).

numbers" is true of all primes; and "not the sum of two numbers" hold for both two and three; however, when all these items are taken together they uniquely define what it is to be three and thus all these items belong *per se* to three.

b. Per Se *2 Predication.* According to the second mode of *per se* predication (73a37-b3), whatever belongs to those things that belong essentially (*enuparchousi*) to what clarifies (*dêlounti*) the predicate belongs to the subject *per se*.[39] I take this opaque claim to mean that x (the predicate) belongs *per se* to y (the subject) if x belongs to y and y is included in x's definition.[40] Aristotle gives the examples of straight and curved in relation to line, odd and even or prime and composite to number, and equilateral and oblong to figure. Unlike *per se* 1 predications "straight" and "curved", for instance, are not predicated as elements in the definition of a line; however, "straight" and "curved" do belong to line (what would a line which was neither straight nor curved be?) and line is included within their definitions (for if we were to say what it is to be straight or curved, we would have to make reference to line). Further, unlike *per se* 1 predications where the subject and predicate are ultimately identical, *per se* 2 predicates only follow upon

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[39] Cf. Ross (1980), 520-21 for the distinction between ὑπάρχειν and ἐνυπάρχειν.

[40] Cf. Ross (1980), 517; Barnes (1993), 112; and McKirahan (1992), 88. M. Ferejohn offer a varying interpretation in *The Origins of Aristotelian Science* (New Haven: Yale UP, 1991), 96-99 where he argues that the second mode of *per se* predication is a relation "that holds between a differentia and the genus it divides."

(*akolouthei*) their subject.[41] In other words, the predicate is not what it is to be the subject, but given the predicate the subject must also hold, whereas given the subject the predicate need not hold. Returning to the straight/curved example, straight is not identical with line; however, given there is something straight, then there must be a line, but not conversely, for there being a line does not entail that the line be straight.

*c. Digressio: The Copula "*akolouthein*" (To Follow Upon).* We should consider the copula *akolouthein* ("to follow, entail, correspond or accompany"), since it plays an important role in Aristotle's discussion of the relation between time and motion. Like the generic *huparchein* ("to belong to or hold of"), the logical predicate of *akolouthein* is placed in the nominative, while the subject is in the oblique case (dative).[42] In contrast with *huparchein* Aristotle uses *akolouthein* more frequently to indicate a *per se* 2 relation, while he uses *huparchein* indifferently to indicate both *per se* 1 and 2.[43] In *Prior Analytics* I 27 Aristotle marks off two types of predication, which are hauntingly similar to the *per se*

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[41] Although Aristotle does not use ἀκολουθεῖν here it is a common copula used throughout the *Analytics*. I shall give my justification for associating it with *per se* 2 predicates in the sequel.

[42] Cf footnote 32.

[43] I am loath to elevate ἀκολουθεῖν to a technical term; for there are certainly instances where Aristotle does not use the verb to denominate a *per se* 2 relation [cf. J. Hintikka, *Time & Necessity: Studies in Aristotle's Theory of Modality* (Oxford: Clarendon Press, 1973) ch. III and E.P. Brandon, "Hintikka on ἀκολουθεῖν," *Phronesis* 23 (1978): 173-78]; however, I am unaware of any instance where Aristotle uses ἀκολουθεῖν to mark a *per se* 1 relation. Thus as a rule of thumb when confronted with the term ἀκολουθεῖν, within a scientific setting, one is not ill served to consider first whether a *per se* 2 relation is involved.

1 and 2 forms found in *Posterior Analytics* I 4. In former passage *akolouthein* is virtually identified with *per se* 2 predications (43b1-5). The passage is intended to provide the scientist with a hands on means of obtaining principles relative to a certain problem. He must first assume the subject itself, the definitions and also whatever is proper to the thing. After this he must lay down whatever accompanies (*hepetai*) the thing and then whatever the thing follows (*akolouthei*) and whatever cannot belong (*huparchein*) to it (43b1-5).[44] The similarity between the grammar employed here and at *Posterior Analytics* I 4 strongly suggests *hepetai* corresponds with a *per se* 1 relation, while *akolouthei* with a *per se* 2 relation. Further, the application of *akolouthein* later in the *Prior Analytics'* passage (43b17-20) and a parallel passage in the *Posterior Analytics* (II 4, 91b1-11) suggest Aristotle intended the verb to denote *per se* 2 predication. Thus we have a presumption for taking *hepetai* to signify a *per se* 1 relation and *akolouthei* a *per se* 2 relation, although we should be careful not to demand too resolutely that Aristotle conform to these strict usages in every case. I mention this nicety of Aristotle's vocabulary, since when we turn to Aristotle's discussion of time, we shall see that time "follows upon" (*akolouthei*) motion as motion follows upon spatial magnitude. Most commentators have taken *akolouthein* to mean merely "to correspond to", whereas I shall argue Aristotle's argument hinges upon us

[44] Δεῖ δὴ τὰς προτάσεις περὶ ἕκαστον οὕτως ἐκλαμβάνειν, ὑποθέμενον αὐτὸ πρῶτον καὶ τούς ὁρισμούς τε καὶ ὅσα ἴδια τοῦ πράγματός ἐστιν, εἶτα μετὰ τοῦτο ὅσα ἕπεται τῷ πράγματι, καὶ πάλιν οἷς τὸ πρᾶγμα ἀκολουθεῖ, καὶ ὅσα μὴ ἐνδέχεται αὐτῷ ὑπάρχειν.

understanding that a *per se* 2 relation holds among these terms.[45]

d. Addenda to the Theory of Per Se *Predication.* At 73b5-73b16 Aristotle expands his account of *per se* predication. Some have viewed his comments here as delineating two further types of *per se* predication, which Aristotle added merely for the sake of completeness, although they are not themselves relevant to demonstrations.[46] On the contrary, I maintain that these additions are not different modes of *per se* predication, but rather they are crucial supplements for Aristotle's scientific theory. Although I give philosophical reasons for denying there are more than two type of *per se* predications, there is at least one piece of good textual evidence for this reading, viz. that when Aristotle recounts the various types of *per se* predicates at the end of *Posterior Analytics* I 4 (73b16-18) and again at the beginning of I 6 (74b7-10) he only includes *per se* 1 and 2 predication.

Let us consider what Aristotle's comments add to our knowledge of *per se* predicates. The first addendum states that any proposition is either *per se* 1 or 2, or if not one of these (*mêdeterôs*), then accidental (73b3-5). Aristotle exploits this dichotomy at I 6 to

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[45] Cf. Ross, *Aristotle's* Physics*: A Revised Text with Introduction and Commentary*, special edition (Oxford: Clarendon Press, 1998) 599; E. Hussey, *Aristotle's* Physics *Books III and IV*, 2d. (Oxford: Clarendon Press, 1993) 142-156. (Although Hussey initially describes *akolouthein* correctly--"the verb ... incorporates the notions both of dependence and of consequent correspondence of structure" (142)--his critique of Aristotle treats the verb as merely indicating a weak form of analogy (154-155). Also cf. Apostle, *Aristotle's* Physics, (Grinnell: The Peripatetic Press, 1980), where Apostle claims that *akolouthein* merely indicates priority in existence (261).

[46] Cf. Ross (1980), 519; Barnes (1993), 112. Byrne [(1997), 95-6] denies there are four distinct types of *per se* predications, but does not see anything of particular interest in Aristotle's development.

show that a proposition is necessary if and only if it is *per se*. Also it provides further textual proof that Aristotle views 1 and 2 as the only legitimate forms of *per se* predications.

i. The Form of Per Se *Predicates.* The second addendum is more interesting (73b5-10). It dictates the form of a *per se* predication. A *per se* predicate is not said of some other underlying thing, such as "the walking" or "the white". In other words, in the cases of legitimate *per se* predication the being of the predicate is not different from that of the subject. That is not to say, the predicate and subject are necessarily identical. The straight is not identical with line; nevertheless, what it is to be straight is to be a line of a certain sort. Aristotle's point is that nothing that belongs to another as in a subject can itself be a subject of *per se* predication. Take one of Aristotle's favorite examples, "the white is log." Greek grammar allows this construction in a way that English does not and thus for Aristotle this sentence would be a grammatically correct one; however, logically it is ill formed.[47] For the logical meaning of the sentence is "the log (which happens to be white) is (a) log" and consequently white is not the *per se* logical subject of log but only its accidental subject.[48] In general, if the subject of predication is being considered insofar as it itself already belongs to a subject, i.e., the subject indicates

[47] Beyond the passage mentioned below, cf. *PrA.* I 46 for further difficulties with this manner of predicating.

[48] Aristotle drives this point home *PoA.* I 22, 83a1-23; cf. Aquinas, *Comm. in PoA.* L. 1, l. 33.

some implicit underlying thing, then there is not *per se* predication.[49]

ii. The Content of Per Se *Predicates.* While the second addendum pertained primarily to the form of *per se* predications, Aristotle's third comment is related to the explanatory or causal nature of their content (73b10-16). Aristotle ultimately establishes the point in book II of the *Posterior Analytics* (1, 8, 10-11), but draws our attention to it here since explanatory connections are *per se* relations. In such a relation, the predicate belongs to the subject *per se*, when the predicate is the subject's reason why (*di' auto*) or the subject is on account of (*to kata*) the predicate; in other words, x belongs to y *per se* when y is on account of or because of x. Aristotle gives two examples: one where a *per se* relation fails--an accidental relation--and one where it obtains--a *per se* relation. An accidental relation is, for instance, where there is lightening (*êstrapse*) when one walks (73b11-13). Certainly the sky being illuminated facilitate walking--e.g., it casts light on the path; nevertheless, the heavens do not lighten (or lightening) for the sake of our walking and thus lightening is only accidentally related to walking.

On the other hand, should something die when it is slaughtered or sacrificed (*sphattesthai*), it dies on account of the slaughter or sacrifice and thus death belongs to slaughter or sacrifice *per se*

[49] Cf. the appendix "*Per se* predication and the Third Man argument in Aristotle," § 4, for the significance of this point.

(73b13-16). I have offered up both "slaughter" and "sacrifice" as translations of *sphattesthai* (σφάττεσθαι) since the nature of the relationship between the subject and predicate depends on how one reads the verb. If one takes *sphattesthai* to mean "slaughter", then the predicate (the slitting of the throat) actually brings about the subject (the death of the victim) and an efficient causal relation holds. Slitting the throat of the victim (i.e., slaughtering it) effected the victim's death. On the other hand, if one takes the verb in the sense of "sacrifice", then one denotes a relation of final causality. The victim died for the purpose of appeasing the gods (i.e., sacrificing). Either sense fits Aristotle's intention, since he is highlighting the fact that inherent causal relations are *per se*.

That Aristotle would want to associate explanatory relations with *per se* predications should not surprise us. In fact he explicitly does so at *Posterior Analytics* II 11 (94a20), where he observes that we only truly know something when we recognize its causes (*aitia*) or reason why (*to dia ti*).[50] These causes are the famous four: material, formal, efficient and final.[51] All of them,

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[50] Also cf. *Phys.* II 3, 194b17-20; *Met.* 1 2, 982b2-6; I 3, 983a24-26.

[51] Ross claims [(1980), 638-640] that the four causes mentioned at *PoA.* II 11, 94a20-24 are other than the usual four causes arguing that by τὸ τίνων ὄντων ἀνάγκη τοῦτ' εἶναι ("from certain things being it is necessary that this be") Aristotle does not intend the material cause, but rather the syllogism, or more generally "the relation of ground to consequent." First, although the term "matter" does not show up in this passage, given that Aristotle identifies four causes (αἰτία), three of which are the canonical ones of *Physics* II 3 (and elsewhere), there is a presumption that the fourth one is the material cause. Indeed, a likely reason that the term "matter" does not show up here, is that the *Posterior Analytics* is more properly a logical text, whereas "matter" is a term used in physics. Second, Aristotle's comments, I contend, should be viewed in

Aristotle continues, are exhibited through the middle, i.e., they play the role of the middle term in demonstration and we become aware of them as causes through paying attention to the middles employed in demonstrative syllogisms (94a35-6; 94b7-8; b23-26; 95a10-14). A series of examples in *Posterior Analytics* II 11 attempts to establish the point with varying degrees of effectiveness.[52] In the end, though, Aristotle takes it as confirmed that a middle term is one of the four causes. Aristotle, however, had argued earlier (II 2, 89b37-90a14, 90a23-34) that the middle term is nothing other than what something is (*to ti esti*) or the reason why something is (*to dia ti*). Now what something is just is its definition; and since Aristotle claims the reason why something is also is the same as what something is, the reason why is likewise a definition (90a14-23). Therefore, since the causes are middle terms and middle terms in many cases prove to be definitions, causes too are definitions, or to be exact, the constitutive factors of definitions. In other words, causes belong to what something is, which is just to belong to it *per*

light of *Phys.* II 9, 200a30-31 (and explained more fully at *De partibus animalium* I 1). Matter, we are told in the *Physics'* passage, is the necessary in natures (τὸ ἀναγκαῖν ἐν τοῖς φυσικοῖς τὸ ὡς ὕλη λεγὸμενον, 200a30-31). In general, if a certain form holds, then what is necessary for that form to hold is the matter; thus x is the matter for y when x is necessary if y is to come to be or already is. For example, if the form of an axe is going to be, there must be something hard, i.e., some type of metal; for what it is to be an axe includes cutting and if something is to cut, it must be able to hold an edge and withstand a certain force in the way metal does. Similarly, if there is to be a given conclusion, then it is necessary that there be two propositions, whose extremes are linked by a middle term. Thus τὸ τίνων ὄντων ἀνάγκη τοῦτ' εἶναι does indicate a material *pace* Ross. For a different interpretation of the *Posterior Analytics* passage see R. Dancy "On some of Aristotle's Second Thoughts about Substances: Matter" in *The Philosophical Review*, LXXXVII (July 1978): 372-413, especially 373-377.

[52] I lean towards Barnes' position [(1993), 225-233] that Aristotle's general point is clear enough, but the examples are obscure and even under the best interpretations do not easily make Aristotle's point. Ross takes a more extreme

se. Aristotle's discussion of explanatory connections and *per se* is not to demarcate a further *per se* predicate, but to set forth a characteristic true of all *per se* predicates.

To summarize quickly, Aristotle identifies two types of *per se* predication. One mode is where the predicate term makes clear the essence of the subject term, as for instance, in a definition. The second mode is where the subject term is included within the account that makes clear the essence of the predicate term, as in a proposition where one term presupposes the other, but not necessarily conversely; an example might be "snub (pred.) belongs to nose (subj.)".[53] Aristotle goes on to make various points about the form and content of *per se* predications. The most important one for our purposes is that a causal relation, according to one of Aristotle's four causes, must hold between the terms of the proposition if they are related *per se*.

3. Universality. Along with being predicated "of all" and *per se*, the principles of demonstrations must hold universally (*katholou*). A predicate, Aristotle tells us, belongs universally when it meets two criteria (73b32-33): (1) we can exhibit the predicate of any chance (*tuchontos*) case and (2) the case is primitive (*prôtou*). Aristotle clarifies the criteria with an example (73b33-14a3).[54] When does one know universally and absolutely that

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position [(1980), 638-47] and finds the whole account confused.

[53] There cannot be snub without a nose in which it inheres, but the converse is not true, viz., that there cannot be a nose which is not snub; for there are aquiline noses.

[54] Cf. J.J. Cleary, "On the Terminology of 'Abstraction' in Aristotle,"

(73b33-14a3).[54] When does one know universally and absolutely that every triangle *qua* triangle (and not merely as scalene or isosceles or equilateral) has internal angles equal to two right angles (2IRA)? We begin with a sensible triangle, say a bronze equilateral, and ask ourselves "does the property 2IRA still exist when we subtract the bronze? Yes." We subtract another attribute and repeat the procedure. When the property 2IRA is eliminated with the subtraction of a certain attribute, the immediately preceding attribute is the primary subject. Of course this subtraction follows a specific order of descent, taking what is most specific and then successively more generic divisions. The "by chance" stipulation guarantees the genus is not too broad, while the primitive criterion ensures the genus is not too narrow. The two criteria working in tandem target a particular genus as the primary subject.

4. Necessity and Per Se *Predication.* Among the three features belonging to first principles, *per se* predication took pride of place. Aristotle explains why at *Posterior Analytics* I 6. We only have scientific knowledge when the knowledge is necessary, but a proposition is necessary if and only if it is *per se*. Aristotle made the claim that "if a proposition is *per se*, then it is necessary" at I 4 (73a21-27) and given the nature of the relation between the terms in a *per se* predication, he is obviously correct. The task still before Aristotle is to prove that if a proposition is necessary, it

[54] Cf. J.J. Cleary, "On the Terminology of 'Abstraction' in Aristotle," [*Phronesis* XXX/1 (1985): 13-45, especially, 22-23] for a more detailed discussion of this passage and the method of abstraction (ἀφαίρεσις).

(2) If x is predicated *per accidens* of y, then x is not predicated necessarily of y.

From (1) and (2) we can infer the following:

(3) if x is not predicated *per accidens* of y, then it is predicated *per se* of y (disjunctive syllogism, 1);
(4) if x is predicated necessarily of y, then x is not predicated *per accidens* of y (transposition, 2);
(5) therefore, if x is predicated necessarily of y, it is predicated *per se* of y (hypothetical syllogism, 3, 4), QED.

Barnes has complained that though Aristotle's argument is valid, it is unsound. He contends that (1) and (2) are mutually incompatible, since "predications of properties and "[*per se* accident]" are necessary but not I-predications."[55] An "I-predication" is a proposition (a) of the form "every x is y" and (b) "true in virtue of the fact that [x] holds of [y *per se*].[56] In short, "I-predication" is what holds of every *per se* whether it be *per se* 1 or 2 predication. Barnes, however, offers no principled reason for disallowing properties from being *per se* predications. He simply claims that they are. Furthermore, Barnes own claim smells wrong. He says "[*per se* accident]" are necessary but not I-predications"; however, I-predications are just *per se* predications. Thus the objection implies *per se* accidents are not *per se*, which has to be false or at least in need of some qualification. Barnes provides none.

Barnes' criticism, I believe, stems from confusing what we

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[55] Barnes (1993), 126; I have bracketed "*per se* accidents" for Barnes' "in itself incidentals" only to bring Barnes terminology in line with my own. The meanings are the same. I define "I-predications" in the body.

[56] Ibid, 112.

might call *"per accidens"* predication and "predicating an accident". *Per accidens* predications concerns the manner in which a predicate belongs to its subject, viz. accidentally, while predicating an accident concerns the nature of the predicate that belongs to the subject, viz., an accident. No instance of *per accidens* predication is necessary, but that does not preclude an accident belonging to its subject necessarily. Having a bad sense of humor may be predicated of me *per accidens*--and thus as a non-necessary feature of me--but risibility certainly could not be, even though it is an accident.

G. Demonstrations III: A Schema for Demonstration. Having spoken of the structure of demonstration and the premises of demonstration we must turn to the demonstration *simpliciter*.

1. A Dilemma Concerning Definitions and Demonstrations. Before we begin, however, we must briefly consider an apparent inconsistency concerning Aristotle's account of definitions and demonstrations. The significance of this point becomes clear in chapter 5 when we consider the demonstration of time's existence. Within Aristotelian science there are, to use McKirahan's terminology, the primary subject, the derivative subjects and the definitions of the primary and derivative subjects (*PoA.* I 10, 76a31-36).[57] The scientist must assume the meaning (*sêmainei*) of all the definitions and likewise the existence of the science's primary subject; however, one must prove (*deiknunai*) the existence of the derivative subjects (*PoA.* I 10). This seems to be as it ought; for one cannot show that x exists, if

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[57] McKirahan (1992), 195.

one does not know what "x" means. At *Posterior Analytics* II 7, however, Aristotle adds a further wrinkle. He asks how are we to show (*deixei*) what something is? To know what a human or anything else is, one must also know that it is; for one cannot know what something is, if it is not. Stated differently, that which does not exist does not have an essence, and consequently cannot have a definition. (What is the genus and differentia of goat-stag?). Thus we find ourselves in the following dilemma: we have to know what x means in order to show that x is, but we cannot know what x is unless we know that x is.

Aristotle presents this dilemma at *Posterior Analytics* II 7, although he does not explicitly provide an answer; nevertheless, he makes a distinction from which we can reconstruct a solution. The distinction is this. To know what the essence of x is (*to ti estin*) differs from knowing what the word "x" signifies (*ti sêmainei*) (92b3-39). Science must assume the meaning or signification, the *ti sêmainei*, of all its terms, but not what their essences are, except in the case of the primary subject. Let us take an example from Aristotle's *Physics*. The primary subject of physics is change or motion. In addition to motion two of physics' derivative subjects are the void and time (*Phys.* III 1, 200b20-21). The existence of motion is assumed, but whether there is or is not a void or time must be proven. As a first step towards addressing the issue of the void Aristotle requires us to grasp what is meant by the name (*Phys.* IV 7, 213b30-31).[58] He then goes on to show that nothing in the case of the void corresponds to this name. Something analogous occurs in his account of time. He say "let us lay down" (*hupokeisthô*) what time is (219a29-30) and proceeds to demonstrate that something does exist corresponding with this definition.[59] Various properties or attributes believed to be associated with the subject under investigation could play the role of the definientia in these initial definitions or nominal definitions. Thus the scientist would not be required to know what the essences is, but merely characteristics that would identify the derivative subject should it exist.[60]

2. A Schema for Existence and Attribute Demonstration. We are now in a position to consider how to demonstrate the existence of derivative subjects. Unfortunately, Aristotle nowhere succinctly describes the conceptual underpinnings of the demonstration, although he drops numerous hints and suggestions. My sketch of an Aristotelian existence demonstration is based upon the works of Thomas Aquinas and McKirahan, although I have significantly expanded and supplemented their initial work.[61]

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[58] Πρὸς δὲ τὸ ποτέρως ἔχει δεῖ λαβεῖν τί σημαίνει τοὔνομα.

[59] Ὑποκείσθω (3rd person imperative of ὑπόκεμαι) where Aristotle employs the verb ὑπόκεμαι for the passive of ὑποτίθημι--"to hypothesize or lay down".

[60] Greg Bayer [(1995), 251-2] has suggested that propria might act as the identifying characteristics; however, to pick out some y (or set of ys) as propria of x is to assume x exists as the subject of which the propria are predicated. I assume that though attributes can be predicated of non-existents, e.g., having a horn or horse-like shape of an unicorn, propria cannot be. On my understanding, propria, although they do not indicate the essence of a thing, flow from the essence of the thing; hence, since non-existents do not have essences, neither have they propria.

[61] Aquinas, *Commentary on the* Posterior Analytics *of Aristotle*, L I, 1 xi;

The scientist begins with the primitive subject A and shows that it entails some derivative subject B. That is to say, he might ask upon what subject(s) does the primitive subject follow. For even though A's existence is assumed, it still may entail other subjects, whose existence A requires if it is to exist. In other words, the scientist seeks the *per se* 2 predicates that belong to the primary subject of the science. Next the scientist presents various *per se* 1 predicates, c_1, c_2, ... c_n, which belong to B. He then lays down that the meaning of some new derivative subject D is just the predicates c_1, c_2, ... c_n. Consequently, the existence of the new derivative subject D has been demonstrated. For D is identified with the set (or at least one of the set) of attributes c_1, c_2, ... c_n, which belongs to B *per se* and thus necessarily. Moreover, B must exist because its existence is required if A is to exist; however, A is the primary subject of the science and its existence was taken for granted. Let us formalize and fill out the above adumbration. Using the various copulae suggested and the syllogistic form we obtain:

> (P1) the primary subject, A, (logical predicate) *follows upon* the derivative subject, B, (logical subject) (*per se* 2 predication);
> (P2) B (logical predicate) *has* certain features, c_1, c_2 ...c_n (logical subject) (these feature are constitutive of the derivative subject's essence and thus it entails them *per se* 1)
> //(C1) therefore, A, *follows upon* c_1, c_2 ...c_n (*per se* 2 predication)
> (P3) a third subject, D, (logical subject) $\text{is}_{\text{defn.}}$ the set of (or at least one of the) predicates c_1, c_2, ... c_n (logical predicate) (*per se* 1 predication);
> //(C2) therefore, A *follows upon* D.[62]

McKirahan (1992), 188-197; also cf. Bayer (1995).

[62] I should make two points here: one of warning and the other of

However, since the primitive subject, A, is assumed to exist, we conclude that the derivative subject D exists.

One final technical point must be made. Various *per se* characteristics or features of B made up the logical subject of (C1), upon which the primary subject follows. The scientist must consider whether any of these characteristics are proprium of the primary subject. The earmark of a proprium is that (1) the predicate does not indicate the essence of the primary subject, but (2) the predicate is convertible with it (*Topics* I 5).[63] In the case where

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clarification. First, modern readers should not understand the copula "follows upon" as equivalent to the modern material implication/conditional. To say "A follows upon B" is not the same as to say "if B, then A" and certainly different from saying "if A, then B". "Follows upon" indicates that a special type of causal, *per se* relationship exists between the terms (cf. the section "Digressio: The Copula "*Akolouthein*" (To Follow Upon)" in this chapter).

Second, although the schema provided in the body indicates the most salient scientific features of the demonstration, a presentation of the bare logical structure is also useful. Thus we can reconstruct the demonstration as follows:

(1) All B is A
(2) All C is B
// (3) All C is A
(4) All D is C
// (5) All D is A.

The demonstration, at least ideally, involves all affirmative universal premises and concludes in figure 1.

[63] Note that according to my suggestion, propria are expressed as instances of *per se* 2 predication. Both Barnes and Ferejohn have argued against propria being instances of *per se* 2 predication. Ferejohn argues based on his belief that *per se* 2 predicates are differentiae and thus are included with the subject's essence (and consequently fail requirement (1) above), whereas counter-examples make up Barnes' argument. Ferejohn's objection rests upon his idiosyncratic reading of *per se* 2 predications, which he sees as exclusively indicating differentiae [Ferejohn (1991), ch. 5]. Should one not accept his interpretation of I 4, which I do not, then his complaint fails. On my reading *per se* 2 are not necessarily differentiae and thus are not necessarily part of the subject's essence. One need merely consider male and female [Barnes (1993), 114]. Gender belongs to animals according to *per se* 2 predication, but it is not a differentia of animals.

Barnes gives two counter examples as an argument against propria being instances of *per se* 2 predication [Barnes (1993), 113-4.]. The first is "'Being capable of understanding' is proper to man; but 'all men are capable of understanding' is not a [*per se* 2] predication." Isn't it? Aristotle would recast the proposition as "the capacity (or potency) to understand (predicate) one of the characteristics $c_1 \ldots c_n$ is a proprium, we derive the further premise:

(C1´) c_n (logical predicate) follows upon A (logical subject).

If we further covert P3, which is just a definition and thus its conversion causes no problem, we arrive at the new conclusion:

(C2´) D *follows upon* A.

Once again, the existence of A entails the existence of some derivative subject D, but in this case A further makes clear the essence of the derivative subject. This point is of interest; for as we shall see in chapter 5, time is a proprium of motion. Thus, the reality of motion not only entails the reality of time, but likewise

belongs to humans (subject)" which is a well formed instance of *per se* 2 predication. Further, since capacities or potencies reside in the natures of substances or subjects, the subject is implicitly contained within the predicate [Cf. *Met.* V (D) 12, 1019a15-23; also cf. Ferejohn (1991), 129; who further cites Waterlow [*Nature, Change and Agency in Aristotle's* Physics (Oxford: 1982)] chapter 1]. Next Barnes proffers the example "being deciduous is a [*per se* accident] of vines, but not a property of them." Barnes must intend "property" in the sense of a proprium (otherwise I am at a loss what "being deciduous" is if not a property). Barnes' complaint, however, has at best shown that *per se* accidents and propria are not identical, but not that they cannot both be types of *per se* 2 predication. Furthermore, although "being deciduous" is not a proprium of vines Aristotle observes that it does follow (ἀκολουθεῖ) vines, but exceeds (ὑπερέχει) them (*PoA.* II 17, 99a23-24). Vine is here a primitive universal (πρῶτον καθόλου), i.e., something which taken individually does not convert with its subject, but taken together with its fellows does. Thus although "being deciduous" is not a proprium of vines alone, it is a proprium of the class {vines, fig tree, etc.}. Aristotle frequently warns us to be careful of skipping over kinds which do not constitute a single named item (*PoA.* I 5, 74a17-25; II 14, 98a13-16). The kind {vines, fig tree, etc.} is not an arbitrary medley but a natural kind which simply lacks a common name. The arguments against interpreting propria as instances of *per se* predications are unconvincing, while there is not only good textual evidence but also a long commentary tradition which associates *per se* 2 predication with propria. For instance, compare Aquinas' commentary on *PoA.* (L. 1, l. 10); "The second mode of saying *per se* is when this preposition *per* implies a relationship of material cause, in the sense that that to which something is attributed is its proper matter and subject. ...[Since] the being of an accident depends on its subject, its definition--which signifies its being--must mention that subject. Hence it is the second mode of saying *per se*, when the subject is mentioned in the definition of a predicate which is *a proper accident* of the subject" [emphasis added].

the reality of time implies the reality of motion.

The same structure, with slight modifications, can likewise be used to show that certain predicates must belong to their subject. For example, experience tells us that all humans are mortal, yet the scientist wants to know the reason why and thus might construct the following demonstration:

(1) all humans are animals;
(1´) all animals are material substances;
(2) possessing contraries belongs to material substances;
(2´) whatever possess contraries is corruptible on account of its contraries;
(3) but to be mortal is set down (hypothesized) as corruption on account of contraries;
(4) thus, humans are mortal.

As far as the number of steps, the example demonstration is more complex than the model schema; nevertheless, formally they are identical. Thus we see that premises (1) and (1´) correspond with P1; (2) and (2´) correspond with P2; (3) is just a definition like P3; and (4) is the logical consequence of the foregoing premises. The most notable difference is the example's use of the "to be" copula for the various copulae of the schema. Still one notices that formally they are the same and that were one so inclined he could reconstruct the syllogisms using the *follows upon*, etc. copulae.[64]

[64] All the syllogisms employed are in the first figure giving us:
(1) being a material substance belongs to animals;
(1´) all humans are animals (defn.);
//(C1) therefore, humans are material substance (defn.).
(2) Possessing contraries belongs to a material substance.
//(C2) Hence, possessing contraries follows upon human;
(2´) however, whatever possess contraries is corruptible on account of it contraries (defn.).
//(C2´) Hence, corruption on account of it contraries follows upon human.
(3) But to be mortal is set down (hypothesized) as corruption on account of the contraries.

Such are Aristotle's attribute and existence demonstrations.

3. Benefits of the Demonstrative Schema. The benefits of this schema as a tool for scientific investigation are far reaching. First, (P1) (i.e., the primary subject A follows upon the derivative subject B) requires we look for subjects upon which the primary subject follow. Propositions that indicate this relation involve *per se* 2 predicates. Hence (P1) tells us both about the content and form of the initial premise(s) in a demonstration. Similarly (P2) (i.e., that the set of predicates c_1, c_2, ... c_n belongs to B *per se*) tells us to search out the attributes or predicates that belong to the derivative subject; however, we need not consider every attribute but merely those that are constitutive of the subject, i.e., *per se* 1 predicates. (P3) (i.e., the derivative subject D is set down (hypothesized) as the set of (or one of the set of) predicates c_1, c_2, ... c_n) indicates that the definition of the derivative subject under investigation corresponds with the *per se* predicates sought in (P2). Thus when seeking a definition of some derivative subject we first consider these predicates. Our knowledge that the predicates correspond with one of the four causes further facilitates this project.

When the demonstration schema is presented in the abstract, as it has been here, it may appear excessively complicated; nevertheless, when we consider it in actual practice in our discussion of time, its methodological value will be apparent. A

//(4) Therefore, being mortal belongs to human QED.

general knowledge of the demonstration's structure and the nature of its principles offers a powerful tool for directing our investigation, as it undoubtedly did Aristotle's. Furthermore, this schema provides a means of reducing complex problems to simpler ones, which though still difficult are much more amenable to investigation.

H. The Role of Dialectic and Division in Aristotelian Science. We must now consider how we come to acquire the first principles of demonstrations, i.e., (P1), (P2) and (P3) of our schema above. It is here that dialectic comes to play. Dialectic in Aristotle's philosophy, however, functions differently than in Plato's or as Irwin imagines it. Dialectic for Plato and Irwin offers a strong justification (even a proof or "demonstration") for accepting some definition or first principle, whereas dialectic for Aristotle only helps make clear the immediate truth of some proposition. Dialectic gestures at where one might look for first principles; it does not infallibly lead one to first principles.

How dialectic gestures at first principles becomes clear in part, if we recall Owen's discussion of Aristotle's use of dialectic, especially as it related to the phenomena.[65] Phenomena, Owen rightly observed, were not merely relegated to observable events but also included the *endoxa*, or opinions of everyone or at least the learned, and the *aporiai*, or philosophical puzzles. These opinions and puzzles provide many a possible definition or suggestion as to what some term (or subject) meant. They further bring with them

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[65] *Tithenai ta Phainomena, passim.*

indications for or against accepting one account over another. For example, an *aporia* might function as either a lethal objection against one definition or an indicator of a problem, which the preferred definition should explain. Another phenomenon, not explicitly mentioned by Owen, but implied, is linguistic usage. No definition should do such violence to our actual practices that we cannot recognize the term being defined. Thus if I defined "continuum" simply as spatial magnitude, one could point to a number of things that we call continuous yet are not spatial magnitudes. Further, good candidates for definitions have far reaching explanatory powers. One need merely consider Aristotle's discussion of his definition of motion, where he points to the difficulties it can solve (*Physics* III 2-3).

None of these means establishes or proves that one definition is the right one. For if we could actually establish or justify one definition (or more generally, a first principle) as the right one, then, for Aristotle, the inference by which we establish or justify it could be formed as a demonstration. Consequently, the supposed definition would have a middle term by which we inferred it and thus would not be immediate (*ameson*). Definitions, however, are first principles and as such must be without middle (*ameson*). Dialectic, then, merely points us or at most nudges us in the direction of a preferred definition or first principle. Ultimately the scientist must simply recognize the truth of the definition or proposition, then lay it down as a first principle. The situation might be compared to someone who when presented with the duck/rabbit illusion only sees the duck. Everyone else might claim to see the rabbit; they might even indicate where and how the person should view the image; however, the ultimate justification only comes when the person actually sees the rabbit in the drawing. Similarly, that which ultimately establishes the first principles of a science is not that every one, or at least the most learned, hold them, or that they solve puzzles, or they are consonant with our linguistic usages, but that we simply recognize that the propositions are true.

Clearly then there is no algorithm that guarantees we shall hit upon the first principles, i.e., upon the middle term(s) of a syllogism. Nevertheless, Aristotle does provide at *Posterior Analytics* II 13-14 a hands on approach to facilitate our search.[66] The approach requires that the scientist compile lists based upon anatomies and divisions (98a1-2). The lists are veritable genealogies, where one traces which items are observed to entail others and which to follow upon others. The method of creating such compilations, Aristotle tells us at *Posterior Analytics* II 13, has three desiderata (97a23-6). The first desideratum, (D1), is to take what is predicated in what the thing is. The next, (D2), is to ensure that these items are properly ordered. Finally, (D3) is to make certain we take all of them, i.e., to see to it that nothing is left out. The first desideratum requires the scientist accurately to identify the genus (or the primary subject). Having identified the

[66] Also cf. *PrA.* I 27-31.

genus, the scientist orders those thing that fall under it. The taxonomy requires the scientist to take that item which follows all the others, but which the others do not follow. Finally, to ensure that nothing is left out, the scientist, when ordering the terms, must see that each subsequent division takes the primitive items such that the genus is cleanly divided and nothing falls outside the division.

Let us fabricate an example. We begin by providing the genus animal. Should we divide the genus animal into full-winged and split-winged, we note that animal follows whatever is full-winged or split-winged. (There are no cases were something is either full-winged or split-winged, where there is not an animal.) Thus we have properly met (D2). On the other hand, the division does not cleanly split the genus animal and thus we have failed to meet (D3); for some animals are neither full-winged nor split-winged. Thus instead we might take land-dwelling and water-dwelling as our first division.[67] Land-dwelling would eventually be divided into winged and pedaled, then feathered and leathern, and only then into full-winged and split-winged. Thus we would know that whatever *per se* predicates belonged to either animal, land-dwelling, winged and feathered would likewise belong to something split-winged, since split-winged follows upon all of these.

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[67] Cf. I 1 *The History of Animals*; whether this division would be the first is difficult to answer; 487a15 and 487b18, however, make it clear that Aristotle thought it cleanly divided the animal kingdom. Also, note that although birds fly in the air, they do not make their, homes, eat, rear their young etc. in the air, but on land. Thus, properly speaking birds are "land-dwelling".

Michael Ferejohn has observed an important feature about such lists and the role they play in constructing demonstration.[68] If during the course of tracing the lineage of some items A and C (such that the scientist is seeking the descendents of A, but the progenitors of C) he hits upon a common relation B, then the scientist has not only discovered that a demonstration exists linking A and C, but also what the middle term of that demonstration is.[69] For instance, if we wanted to show that every feathered creature is land-dwelling we would consult our list and if it has been constructed carefully and completely all the intervening divisions between our two termini would provide middle terms for a demonstration that all feathered creature are land-dwelling. Conversely, should the scientist in his search come across an item B which is the progenitor of A, but excludes any C, then he has the substance for a universal negative demonstration.[70] We can find an examples of this method in one of Aristotle's own lists, the *History of Animals*. We observe that no insect has feathered wings and ask "why?". Checking Aristotle's list we note that all feathered and leathern creature are warm blooded, but no insect is warm blooded; therefore etc..[71] The method presupposes that we have compiled our list and that we did so accurately; but provided we have, it presents

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[68] Ferejohn (1991), 19-32; cf. *PrA.* I 27-8.

[69] Ferejohn (1991), 30.

[70] Ibid, 31.

[71] I 5, 490a6-8; insects have membranous wings, which evidently follows a different genealogy than feathered and leathern wings.

the scientist with a powerful tool.

This method of division is clearly platonic in flavor and yet it is not Plato's method. The Platonic method of division, at least as understood by Aristotle, is intended to furnish and even demonstrate definitions.[72] Aristotle's technique merely provides a way of collecting premises. In fact, Ferejohn has insisted that the most an Aristotelian division can accomplish is guarantee that the premises are primitive and immediate.[73] Consequently, unless we further recognize that the connections and relations depicted in the lists are prior to, better known than and explanatory of any conclusion drawn from them, they cannot even be candidates for scientific principles.

Similarly, *per se* propositions must indicate an explanatory connection between the terms; yet there need be nothing inherently explanatory about a proposition discovered through Aristotelian division. For instance, in the *History of Animals* (III 26), Aristotle observes there is a relation between men with varicose veins and becoming bald, but we hardly think (nor, I hazard, would Aristotle have thought) that varicose veins are a cause of baldness.

Finally, Aristotle himself harangues the Platonist, protesting that though division provides the scientist with a fertile supply of information, the Platonist misemploys division when he attempts to demonstrate or prove by means of it (*PrA.* I 31, 46b24-25); for, as

[72] Cf. *PrA* I 31 and *PoA* II 5 attitude towards Platonic division.

[73] Ferejohn (1991), 24.

Aristotle complains, division is at best a sickly syllogism (Ibid, 46a32-3). Aristotle's common complaint in both the *Prior* and *Posterior Analytics* is that the Platonic method of division begs the question.[74] Consider a proof for the mortality of humans based upon division. The divider assumes every animal is either mortal or immortal; continuing to divide he further assumes that humans are animals; thus humans are either mortal or immortal; and then concludes by assuming humans are mortal. Aristotle rages that instead of demonstrating that humans are mortal, i.e., explaining why they are mortal, the Platonist has merely assumed it.

Aristotle thus does make room for division and dialectic within his overall theory of science; however, they are no longer the robust methods associated with Platonic philosophy. For Plato and the academy, at least as Aristotle presents them (*PoA*, I 11; *Metaphys.* I 9), dialectic, which includes the methods of division, induction and appeals to *aporiai* and *endoxa*, is a universal science, which is capable of proving all things. Aristotle, on the other hand, demotes dialectic and its various methods to the proto-scientific stage of fact gathering.

I. Conclusion. This chapter has made many points and lest we miss the proverbial forest for the trees, we should remind ourselves of their purpose. At the outset, I claimed that the traditional view of demonstration in Aristotelian science was faulty. Where the traditional view maintained that demonstration is a means of

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[74] *PrA.* I 31, 46b2-25; *PoA.* II 5, 91b12-92a5.

marshalling scientific knowledge or even equated science with possessing a demonstration, we have seen that demonstration is primarily a tool for reducing complex problems into more tractable ones. As such, demonstrations facilitate scientific discovery. The demonstration's form--the syllogism--and content--*per se* propositions--evince this view. Since for Aristotle all valid inferences can be formed syllogistically, two valuable qualities accrue to the demonstration. First, any so-called scientific argument could be rendered into a syllogism and checked for formal validity. Second, but arguably more important, when presented with some fact, if an explanation exists, then the scientist can explain the connection between subject and attribute through a syllogism. Consequently, the scientist need only consider propositions that satisfy the formal requirements of a syllogism and since only syllogisms of a specific mode and figure lead to certain conclusions, one need only seek propositions that fulfill these requirements. In short, the syllogistic form limits and direct scientific inquiry. Similarly, since the propositions of a demonstration are necessary and the only necessary propositions are *per se* ones, the scientist can restrict investigation to propositions that conform to one of the two *per se* modes of predications in form and content. Also, the demonstrations employed in science have a unique structure (whether for existence or attribute demonstrations), which further focuses the research. Finally, we have looked into Aristotle's uses of dialectic and the difference between Aristotelian and Platonic division.

Aristotle turns these Platonic tools to his own purpose--once again as a means of organizing and directing scientific research. The *Posterior Analytics*, I contend, is not merely about the nature of science but also a handbook of tools and techniques for approaching scientific investigations. It offers the means for analyzing philosophically and scientifically complex problems into more basic ones, whose solutions, i.e., middle terms, the scientist will hopefully recognize more easily.

CHAPTER 3

AN ANALYSIS OF ARISTOTELIAN MOTION

Aristotle's discussion of time is embedded within his theory of physics. His *Physics*, for its part, conforms to the picture of science we have sketched and employs the techniques we have mentioned. Aristotle begins the work by observing that we only have scientific knowledge when we know the principles (*archai*), causes (*aitia*) and elements (*stoicheia*) (184a1-3). Aristotle here does not associate scientific knowledge with possessing a demonstration, but with knowing (*gnôridzein*) the first principles. The method he adumbrates is to begin with what is more knowable and clear to us and to proceed to what is more knowable and clear by nature (184a16-18).[1] The strategy is essentially the one presented earlier. We begin with some given fact (the *hoti* of the *Posterior Analytics*) or phenomenon, i.e., that which is better known to us, which is confused or complex (*sungkechumenon*), but through a processes of analysis (employing the

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[1] Cf. McKirahan (1992), 30-31, 220-222. Ross complains that the method presented in the *Physics* is just the opposite of the one presented in the *PoA.*, since it "is the very reverse of scientific proof" [(1936), 456-57]. Given my reading of the *PoA.*'s methodology, the two technique are the same. The scientist begins from facts and through analysis (achieved via demonstrations) arrives at the first principles.

techniques mentioned in the last chapter) we come to know the first principles and causes, i.e., that which is better known by nature (184a21-23).

Aristotelian science begins by hypothesizing the meaning and existence of its primary subject; for physics this subject is motion or change.[2] Motion, Aristotle observes at *Physics* I 7, follows upon certain other items or principles. Because the physicist assumes that motion exists, she must likewise posit whatever is required for there to be motion. These are form, matter and privation. Aristotle brings us to a realization that these three principles are required for change by remarking how various cases require them and how his account can solve certain puzzles, whereas the accounts of his predecessors fail to explain motion at all (I 8-9).[3] Book II introduces the four causes--formal, material, efficient and final--which are required if there is to be motion. For, as Aristotle says (II 3, 194b17-23), if we are to have knowledge respecting motion, and this is the primary subject of physics, then we must grasp its first causes. Once again, I would note, the physicist does not have to prove the existence of these causes since motion, which is assumed to

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[2] Of course a science is not free to adopt the meaning of its primary subject "willy-nilly" and then posit its existence; but rather, as we mentioned in the last chapter, the scientist grasps or recognizes the true, necessary and causal features of these first principles. Indeed such recognition often is the product of discernment and much thought, but what it is not, is a conclusion of a demonstration.

[3] Aristotle's initial analysis revolves around the example of the "musical man" and then he has us regard or survey all the instances of becoming (190a13-14; 31-190b1); I 8, on the other hand, shows how his conception of motion answers Parmenides' puzzle, while I 9 shows that Plato's account of motion cannot in fact explain motion.

be, necessitates that its causes be. Let these comments concerning motion's principles and the four causes suffice as a prologue to Aristotle's account of change.

Having laid down the principles and causes of motion, *Physics* III 1 presents Aristotle's definition of motion, which is in turn followed by a series of investigations into the supposed required conditions of motion (*aneu ... kinêsin adunaton einai*) (200b20-21), or what I have called in the previous chapter "the derivative subjects of physics". These include the infinite, the continuum, place, the void and time (Ibid). Since derivative subjects follow upon the primary subject, a full understanding and appreciation of the derivative subjects requires some grasp of the primary subject. Consequently, for us to understand Aristotle's theory of time, we must first grasp his conception of motion and certain discoveries made concerning motion.

A. Act/Potency. *Physics* III 1 begins with a simple division: some things are in a state of actuality (*entelecheiai*), while others are in a state of potentiality (*dunamei*) (200b26-27). We find the distinction in all categories; however, Aristotle is keen to observe the manner in which it is found in the category of relatives.

> Concerning "relative" it is said, on the one hand, with respect to excess and defect, and on the other hand, with respect to agent and patient and in general ["relative" is said with respect to] the mover and the mobile; for the mover moves the mobile and the mobile is moved by the mover (200b28-31).[4]

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[4] τοῦ δὲ πρός τι τὸ μὲν καθ' ὑπεροχὴν λέγεται καὶ κατ' ἔλλειψιν, τὸ δὲ κατὰ τὸ ποιητικὸν καὶ παθητικόν, καὶ ὅλως κινητικόν τε καὶ κινητόν· τὸ γὰρ κινητικὸν κινητικὸν τοῦ κινητοῦ καὶ τὸ κινητὸν κινητὸν ὑπὸ τοῦ κινητικοῦ. One should compare Aristotle's

The act/potency distinction, therefore, applies to things related as mover and mobile, in short, to motion.

Let us linger over this distinction. Aristotle is loath to define actuality and potentiality and generally limits himself to indicating examples, when he discusses the two. For instance, in various places (*Phys.* III 1, 201a16-18, a29-31; *De anima* II 1, 412b27-413a3; *Metaphys.* IX 6, 1048a35-b6) we are told that potentiality is to actuality as the buildable is to the building or as bronze is to the statue or as sleeping is to being awake or as one with closed eyes to one who is seeing. In general, we can conclude that *entelecheia* is the completion (or completing), fulfillment, perfection (or perfecting) or even reality of a thing.[5] The *entelecheia* of x, we might say, is for x to be in the truest and fullest sense what it is to be x, lacking nothing insofar as it is

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phraseology here with that of *Cat.* 7, 6a36ff, where he discusses "relatives". "We call *relatives* all such things as are said to be just what they are *of* or *than* ["of" and "than" are translating the genitive case] other things, or in some way *in relation to* something else," (*Cat.* 7, 6a36-37, Ackrill's translation). Consider the examples of "larger" and "knowledge". We know "larger" is a relative because when we use it, we retain "larger" (it is said to be just what it is) and then append "than" [captured by the genitive case] and the other *relatum* to it, i.e., x is *larger than* y. "Larger" taken in isolation is empty. It needs "than" and the second *relatum*. Similarly, "knowledge" considered alone is empty. We have knowledge *of* something. "Thus knowledge is called knowledge *of* [dative case] what is knowable, and what is knowable knowable *by* [dative case] knowledge" (6b33-34). This example is, *mutatis mutandis*, identical to the motion example Aristotle gives here. ("For the mover is a mover *of* [genitive case] the mobile and the mobile is a mobile *by* [ὑπό; functioning similar to the dative case] the mover.") Thus in order for something to be a mobile there must be a mover, to which the mobile is related. Consequently, if there were nothing that could move the mobile, then we are not actually dealing with a mobile. Likewise, only by actually moving the mobile is a mover a mover.

[5] At this point I am not adjudicating whether ἐντελέχεια denotes progressive or completed aspect, although below I shall.

x.[6] Consider a healthy twenty-one year old male. He needs no more development or nurturing. He is complete; he is what it is to be a man. In other words, he is the *entelecheia* of the man that had existed potentially in the undifferentiated mass of cells of the fetus. *Entelecheia* can also refer to processes (*Phys.* II 3, 195b3-6)[7]; thus the *entelecheia* of jogging is not the completed run, but the exercise of running itself. In both cases, *entelecheia* is the realization of a potentiality.

Aristotelian potentiality likewise is protean and thus difficult to comprehend. Aristotle himself suggests the concept is best grasped by analogy;[8] nevertheless, we should attempt some analysis of this key term. At *Metaphysics* IX 1, Aristotle distinguishes two types of potentialities (*dunameis*), what might be called active potentialities and passive potentialities (1046a16-17). Active potentialities are like the ability to walk or learn, when one is sitting or unlearned; passive potentialities are like the ability of a skillet to be heated when cold or to be brought into the dinning room, when it is in the kitchen. For our purposes we need merely consider passive potentialities. A passive potentiality, I would suggest, is the nexus of privation and matter. Although Aristotle does not explain potentiality exactly this way, most of his discussions of potentiality are couched in either terms of matter

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[6] Cf. *Phys.* II 1, 193b7.

[7] Cf. also *Metaphys.* IX 6, 1048b6-9, although it should be noted that the word there is ἐνέργεια and not ἐντελέχεια.

[8] *Metaphys.* V 12, 1019a32-33; IX 6, 1048a35-b5. Aristotle seems to be

and/or privation.[9] Privation is the contrary of what at some moment actually belongs to something.[10] For instance, privation might be the cold in a skillet which is actually hot, or being at "that place" when someone is actually in "this place". Therefore, a privation is that which a things is not, and yet nothing inherent within the thing prevents the privation from being realized.[11] That which may either possess some trait or is deprived of it and is inherent within the thing is the matter, also frequently called the underlying thing (*hupokeimenon*) (*Phys.* I 7). The type of matter limits or dictates which set of traits a thing can have. Indeed, Aristotle says of matter that "the necessary in nature is called matter" (*Phys.* II 9, 200a31), in the sense that a definite type of matter is required if certain things hold.[12] The "type of matter" in turn is determined by its conditions and the way it is ordered.[13] In short, passive

making the same point at *Phys.* I 7, 191a10-12, when he says that the "underlying nature is known according to analogy".

[9] Cf. *Physics* I 9, 192a25-34; *De anima* II 1, 412a9; II 5, 417a26-27; *Metaphys.* V 121019b5-11; IX 7, 1049a8-12.

[10] *Phys.* I 7, 191a14.

[11] Cf. *Metaphys.* IX 1, 1046a32-35 for several senses of "privation". Τὸ πεφυκὸς ἂν μὴ ἔχῃ most closely captures the notion of "privation" I am working with here.

[12] Cf. footnote 51 of chapter 2.

[13] The point might be clarified if we consider how the matter of a stone can become matter capable of sight. Imagine a stone through a process of erosion becoming the soil which nourishes a wheat field. The wheat is then made into bread, which a man eats and it becomes his blood; an excess of the nutritive quality of the blood is in turn converted into semen according to Aristotelian biology. The semen, when warmed by the menstrual blood in a woman's womb, becomes a potential human; only after the fetus has reached a certain stage of development is there matter capable of sight. The earth of the rock had to undergo no less than four substantial changes in order to become the type of matter necessary for sight: (1) change into the type of matter capable of nourishing a plant, (2) change into the type of matter

potentiality is the privation of a particular trait in an object, where whether that trait can be found in the object is determined by the matter of that object.

B. The Ontological Status of Motion. If actuality and potentiality apply to motion and the act/potency relation applies to all categories, Aristotle asks, is motion one of the categories of being or a super-category standing above multiple categories? (200b33-201a3) The question is nothing less than "What is the ontological status of motion?"[14] Aristotle unequivocally answers that there is no motion over and above the objects (200b2-3).[15]

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capable of nourishing a human, (3) change into the type of matter capable of becoming an human and (4) change into the type of matter capable of sight. In each of these changes, the structure of the matter is fundamentally altered, such that new qualities, characteristics and powers emerge--one type of matter is converted into a new type of matter. Cf. *Metaphys.* IX 7, 1048b35-1049a18; *Phys.* II 2, 194b8-9.

[14] This question is related to, though not identical with, the hotly debated scholastic question whether motion is a *forma fluens* or a *fluxus formae*. The presentation of the problem was first posed by Albertus Magnus in his commentary on this passage (200b32-201a2; or bk. 3, txt.4 in the Latin tradition), although it was foreshadowed in the writings of Ibn Sînâ and Ibn Rushd. Since this problem focuses on reconciling this passage with other Aristotelian texts, while we are only concerned with Aristotle's view as explicitly stated in the *Physics* and since the answer to the question in either direction does not adversely affect the account of time I shall propose, I suggest no solution. Cf. J. Murdoch and E. Sylla "Science in motion" 213-222 in *Science in the Middle Ages* [ed. D. Lindberg (Chicago: University of Chicago Press, 1978): 206-265] and A. Maier "The Nature of Motion" in *On the Threshold of Exact Science* [ed. and trans. S. Sargent (Philadelphia: University of Pennsylvania Press, 1982): 21-39].

[15] οὐκ ἔστι δὲ κίνησις παρὰ τὰ πράγματα. The referent of τὰ πράγματα is not absolutely clear, although it is likely Aristotle just means the movers and mobiles, which change with respect to either the category of quantity, quality or place. Ross objects to this reading maintaining τὰ πράγματα refer to "various respects in which things may change" and not to the things that change. Aristotle's point, Ross continues, is to emphasize that just as there is no such thing as "being" in the abstract, but only concrete instances of being, likewise there is no motion in the abstract [(1936), 536]. I agree with Ross' general point, but to make τὰ πράγματα the "various respect in which things may change" and not the things which change, seems to suggest that there can be "various respects in which things may change" that are independent of

Motion or change is always change in either substance, quantity, quality or place.[16] If motion were something over and above the various mobiles and movers, then it would be (a) common to all of them and yet (b) not one of them. However, when we consider examples of motion, we never find anything that is common to all mobiles and movers and yet is neither substance, quantity, etc.. Consider the following scenario. In the kitchen I make myself an ice cream cone and then go outside to enjoy it (change in place); I consume the ice cream and subsequently my body metabolizes it into usable proteins and sugars (change in substance); further, because I am eating it, the amount of ice cream is decreasing (change in quantity); finally, since I am outside in the sun, the temperature of the ice cream is slowly rising (change in quality). Here are four types of change. Only the ice cream is common to all of them, but the ice cream is a "this", i.e., a substance, and thus fails to meet requirement (b). No matter how much we cast our mind's eye over these various motions we never find anything common to all, and yet not one of the things moved. There simply is no motion over and above the objects of motion.

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concrete changing things, which is just the opposite of Ross' intended point. My point becomes clear if we substitute Ross' suggestion for τὰ πράγματα into the original sentence; thus giving us: "there is no motion over and above [the various respects in which things may change]. Such a reading, Ross would certainly reject.

[16] Although Aristotle's discussion thus far suggests that change might exist in all of the categories, he limits it to the four categories mentioned: substance, quantity, quality and place (200b33-34). Also, Aristotle does not distinguish here between the more specific concept of motion (κίνησις) and the more general concept of change (μεταβολή), which he will make at V 1. Thus at *Physics* V 2 we shall learn that motion can only occur with respect to quantity, quality and place.

C. The Definition of Motion. Having shown that actuality and potentiality must belong to motion and that motion is not something over and above the various objects that are in motion, Aristotle tenders his own definition. Motion is the *entelecheia* of what is in potency *qua* potency (201a10-11).[17]

The exact meaning of *entelecheia* in the definition is a highly controversial issue.[18] Above we noted that *entelecheia* could refer to either a completed act (an actuality) or a progressive action (actualization). Interpreters stand on both sides as to whether Aristotle intended the completed or progressive sense of *entelecheia*. Those who argue that we must understand it progressively, and thus meaning "actualization", point to the fact that motion is a process or passage and not a completed act. To understand motion otherwise is to strip it of its defining characteristic.[19] On the other hand, opponents observe that since actualization is a process, it is a type of motion. Hence if actualization is the meaning of *entelecheia*, then Aristotle would have defined in a circle.[20] Consequently,

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[17] Cf. also 201a27-29, 201b4-5.

[18] Cf. M.L. Gill's "Aristotle's Theory of Causal Action in *Physics* III 3" (*Phronesis* 25 (1980): 129-147), especially footnote 2 for a list of ancient, medieval and contemporary participants in this debate.

[19] Cf. Ross (1936), 537 and J. Ackrill, "Aristotle's Distinction between *Kinêsis* and *Energeia*" in *New Essays on Plato and Aristotle* [ed. R. Bambrough (London, 1965)].

[20] Aquinas *In Physicorum* (L. III, l. 2; 284 [2]) "...aliqui definierunt motum dicentes, quod motus est *exitus de potentia in actum non subito*. Qui in definiendo errasse inveniuntur, eo quod in definitione motus posuerunt quaedam quae sunt posteriora motu: *exitus* enim est quaedam species motus." Also, cf. Gill [(1980), 130], "on the 'actualization' interpretation the definition is circular because a term which means 'process' turns up in the definiens."

these people maintain, *entelecheia* must be taken as indicating a completion and thus it means "actuality".

I side with reading *entelecheia* as actuality. First, as the critics have noted, taking *entelecheia* in a progressive sense makes Aristotle's definition of motion circular. Further, as both Gill and Hussey point out, a process interpretation of *entelecheia* is foreign to Aristotle's own use of the term throughout the corpus.[21] Still we must not merely base our opinion on negative arguments against the progressive reading, but we must also respond to its challenge, viz., how to assure that the definition of motion describes a process, while avoiding process terms in the definiens. The contemporary handling of this issue is wanting. Hussey seems to be unaware of the problem. Gill, on the other hand, who I admit is not primarily interested in this problem, treats it, but introduces "actualizing" into her account and uses it as a synonym for "actuality; however, "actualizing" is as much a process term as "actualization" and thus we must look beyond Gill for a complete account.[22]

Aquinas in his commentary on the *Physics* does present a successful interpretation of Aristotle's *entelecheia*, which avoids the pitfalls mentioned above. Aquinas distinguishes two senses of actuality: perfect and imperfect.[23] To be in *perfect actuality* is

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[21] Gill (1980), 130-31; Hussey (1983), 60.

[22] Gill (1980), 131-3.

[23] Aquinas *In Physicorum* (L. III, l. 2; 285 [3]) "Considerandum est igitur quod aliquid est in actu tantum, aliquid vero in potentia tantum, aliquid vero medio modo se habens inter potentiam et actum [id est aliquid quod in actu imperfecto est (my addition)]. ... Ipse igitur actus imperfectus caloris in

to be only in act, i.e., to have been completed. We might say x is in perfect actuality when it is at its terminus *ad quem*, e.g., when one is heating water to boil, the water boiling is in perfect actuality *qua* boiling. On the other hand, to be in *imperfect actuality* is to be in actuality but still to be ordered, or in a series (*ordo*), to a further actuality. To return to our heating example, warm water is not cold, which is to be in potentiality only *qua* boiling, but neither is it boiling, which is to be in perfect actuality *qua* boiling. Warm water is ordered to some further actuality, viz., boiling. Therefore, using Thomas' distinction, we can redefine Aristotle's definition. Thus motion is the *imperfect actuality* of potentiality *qua* potentiality. The definition clearly describes a process, while avoiding process vocabulary in the definiens.

For Aristotle, motion is a type of actuality; however, not actuality absolutely speaking, but actuality in a qualified way. Motion is the actuality of potential, when the potential is ordered to some further actuality, and thus is not yet fully actualized. Aristotle presents an inductive justification for his definition (201a15-19). When the buildable (a potentiality) has been actualized but is ordered to some further actuality, something is being built (a motion); however once the buildable is complete or fully actualized

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calefactibili existens, est motus: non quidem secundum id quod actu tantum est, sed secundum quod iam in actu existens habet ordinem in ulteriorem actum." There is some evidence in Aristotle that he had a notion of an imperfect actuality, when he speaks of an ἐντελέχεια ἀτελής (*Phys.* VIII 5, 257b8-9); and again in the phrase πᾶσα γὰρ κίνησις ἀτελής ("all motion is imperfect" (lit. without a completed end) (*Metaphys.* IX 6, 1048b29).

(i.e., not ordered to some further state of actuality, but is in a state of perfect actuality), building ceases. The same holds for a plethora of other motions: learning, doctoring, rolling, jumping, ripening and aging (Ibid).[24] All of these are instances of motion and yet each of them involves the actuality of potentiality insofar as there is potentiality.

Aristotle feigns no argument for the existence of motion or his definition of motion. Motion is the primitive subject of physics and thus the physicist must recognize what it is and that it is; "the existence of motion is asserted by all who have anything to say about nature (*Phys.* VIII 1, 250b15)."[25] Nevertheless, although Aristotle does not attempt a demonstration of his definition, he does indicate its adequacy. These indications, although not scientific proofs, might help someone, who had not initially grasped what motion is, come to recognize that indeed Aristotle's hypothesis is correct. One example is what we have just seen. His definition is applicable to a wide variety of different types of motions. Another indication Aristotle gives is that his definition "is clear both from that which others say about it and from the lack of ease in defining it otherwise (201b16-19)." That is to say, his definition is in accord with common opinion (*endoxa*) and that there are a number of difficulties associated with other definitions of motion. Let me reiterate, these indications do not provide the rational basis from

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[24] 201a15-19.

[25] Also cf. II 1, 193a1-6.

which one infers the preferability of Aristotle's definition of motion over some competing definition. At best these indications show that the choice of definitions need not be arbitrary, even though a science must ultimately lay them down or hypothesize them. Rather, Aristotle's definition is a first principle and as such the ultimate justification for adopting it is that one grasps or recognizes that it is true.

D. The Relation of Motion to Spatial Magnitude. Aristotle runs through his account of motion quickly and unfortunately leaves unstated a number of points to which he appeals in his account of time. To remove the charge that Aristotle makes *ad hoc* assertions in order to explain time, I want to make explicit, Aristotle's implicit commitments, which emerge from an analysis of motion. Implicit in Aristotle's definition of motion is the fact that motion has two termini. The completed actuality, which is that from which the mobile began, the *terminus a quo*; and the potentiality or that to which the mobile precedes, the *terminus ad quem*. Another way to consider these two is that which will be *after* a particular motion (the initial potentiality) and that which is *before* the motion (the initial actuality). For example, the cold, which belongs to the skillet before the heating process, is an actuality belonging to the skillet, whereas the state of being hot, which will belong to the skillet after it is heated, is a potentiality belonging to the skillet. Or again, the state of actually being *here*, but of potentially being *there* belongs to me before my journey, while after my journey I am no longer potentially there, but actually there.

These two termini, however, are not sufficient to explain motion; for if they were, the instantaneous change from potency to act, would be a motion--a conclusion Aristotle explicitly denies.[26] Rather, there must also exist the interval or extension between the two termini. In fact Aristotle makes this point explicit at *Physics* V 3:

> Since every change is between opposites and opposites are either contraries or contradictories but there is no intermediate for contradictories, it appears that the interval is between contraries. Now the interval involves three things. For the contrary is a change's extreme; thus the interval is that to which the changing thing naturally arrives before changing into the extreme, according as the changing thing is changing naturally and continuously (227a7-10, 226b26-27, 226b23-25).[27]

The interval is the means between being only in act and being only in potency; it is Aquinas' imperfect actuality bounded, or limited, by the *terminus a quo* and *terminus ad quem*. Thus, when there is motion, there likewise is an interval.

Treating motion as an interval bounded by two termini allows a deeper insight into motion's nature. For instance, it brings out the fact that motion can be treated as a type of quantity. For that

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[26] Cf. *Phys.* VI 6. Although Aristotle gives several arguments against instantaneous motion, one proof that shows up in many different contexts is the following. If x is changing from A to B, then the moments when x is A and x is B must be distinct; for if they were the same moment, then x would simultaneously be A and B (or more explicitly, B and not-B). However, moments, like points, cannot be immediately adjacent to one another; hence between any two points there exists a continuum of points. Since x in its passage from A to B, must pass through all the potential points on this continuum, the motion must be gradual.

[27] Following Ross' reconstruction of the text and its subsequent renumbering.

which is most distinctive about quantities, Aristotle tells us at *Categories* 6 (6a26-35), is that only they admit of being equal and unequal.[28] Certainly two distinct motions, i.e., distinct intervals between termini, can be either equal or unequal; and thus we can treat motion as a quantity insofar as we can treat it as an extension between two termini. For example, the walks of two people can either be equal or unequal (in one sense) just in case the intervals between their starting and stopping are equal or unequal.

Our analysis of motion has revealed that we can treat it as quantity. I want to add a wrinkle, however, and suggest that motion is not a quantity in its own right, although it does belong to something that is a quantity *per se*, viz., spatial magnitude. The significance of this point becomes clearer when we consider the nature of time in chapter 5. For now it is important to grasp that motion *follows upon* spatial magnitude according to a *per se* 2 relationship. In fact, it is on account of motion's relation to spatial magnitude that it can be treated as a quantity. This last point raises at least three questions. First, why is motion not considered a quantity in its own right? Second, why does motion follow upon spatial magnitude? And finally, what is it that makes spatial magnitude a quantity *per se*?

Concerning this last question first, spatial magnitude--lines, planes and the like--are all quantities *per se* since a certain

[28] "...[W]hatever is not a quantity, is certainly not, it would seem, called equal and unequal" (6a30-32, Ackrill's translation).

quantity belongs in the account that says what they are. In general, the reference is to some type of extension, which Aristotle makes the paradigm case of a quantity (*Met.* V 13, 1020a18-19).[29] A line is an extension in one direction; a plane is extension in two perpendicular directions etc.. As such, quantity belongs to spatial magnitude according to *per se* 1 predication.

As for the first two questions, they can be answered together. Consider the types of motion: increase or decrease, alteration and locomotion. Aristotle insists in *Physics* VIII 7 (260a26-b14) that of all motions locomotion is primary.[30] The general argument is that increase and decrease (motion in respect of quantity) involve a change from contrary to contrary, since when x increases, for instance, what is other than x (x's contrary), becomes x; however, a change from contrary to contrary is alteration (motion in respect of quality). Alteration, on the other hand, requires the agent to draw near in order to actualize the potential; however "to draw near" is locomotion (change in respect of place). In short, all motions require locomotion. Obviously, locomotion presupposes or requires a spatial magnitude over which the motion occurs; for locomotion just is motion over a spatial magnitude. Therefore, all motion *follows*

[29] ἐν γὰρ τῷ λόγῳ τῷ τί ἐστι λέγοντι τὸ ποσόν τι ὑπάρχει; it does not matter whether we accept, for instance, the definition of line as a "breadthless depth" (Euclid, bk 1, defn. 2 and also cf. *Topics* VI 6 143b11-144a4) or follow Aristotle and make line's principles the great and the small (βραχέος/μικροῦ, μακροῦ/μεγάλου) (*Met.* I(A) 9, 992a112-12), some kind of quantity is found in the definition.

[30] Cf. Plato's *Parmenides* 162E4-163A2, where it is argued that alteration (ἀλλοιοῦσθαι) deserves precedence over motion (κινεῖται).

upon locomotion, which in turn *follows upon* spatial magnitude. Consequently, motion is a *per se* 2 predicate of spatial magnitude, since the subject (spatial magnitude) belongs within the definition that makes clear what the predicate (motion) is.

E. The Continuum. To this point I have analyzed and developed the account of motion found in *Physics* III 1; we must now turn to later parts of the *Physics* to complete our understanding of motion. According to Aristotle some quantities are discrete, while others are continuous (*Cat*. 6, 4b20). Aristotle assumes that motion is continuous throughout the first part of the *Physics*, but he does not offer a proof until book VI 1. Since his understanding of time plays on the fact that both time and motion are continuous, we should consider both his discussion of the continuum and his proof for the continuity of motion.

The continuous (*suneches*) is understood in relation to the successive (*to ti ephexês*) and the contiguous (*to ti echomenon*) (*Physics* V 3, 226b19-20). "'Successive' is that which is after the beginning either in place, form or some other [aspect] so that nothing of the same kind is marked off between it and that to which it is in succession" (226b34-227a1).[31] Two things are contiguous, when they are not only successive, but they touch at their extremities (227a6). Finally, the continuous is a class within the contiguous; for not only do the extremities touch, but these two limits become one and the same (227a10-13). Consider the following

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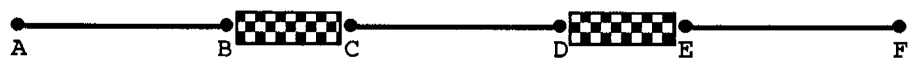
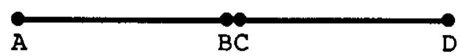
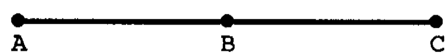
[31] ἐφεξῆς δὲ οὗ μετὰ τὴν ἀρχὴν ὄντος ἢ θέσι ἢ εἴδει ἢ ἄλλῳ τινὶ ὅυτως ἀφορισθέντος μηδὲν μεταξύ ἐστι τῶν ἐν ταὐτῷ γένει καὶ οὗ ἐφεξῆς ἐστιν.

diagrams:

(1) 

(2) 

(3) 

In example (1) the line segment CD succeeds line segment AB, despite the interruption between the two, since that which intervenes is not a line. On the other hand, EF does not succeed AB because the line segment CD (which is of the same kind as AB and EF) is interposed between them. In (2) not only does CD succeed AB, but the extremities of these two, B and C, are also in contact with one another. Finally, in example (3) not only is there succession and contiguity, but there are no longer two distinct limits or extremities between the two line segments; in fact, it is no longer, strictly speaking, correct to say that there are actually two line segments; rather, there is only single line that is potentially divisible.

Having defined the continuous we must now get a better purchase on its nature. Nothing that is continuous, argues Aristotle at

Physics VI 1, can be composed of indivisibles, whether these indivisibles be points or nows.[32] For, Aristotle continues, if a continuum were composed of indivisibles, then the extremities of the indivisibles must either be (a) continuous or (b) touching one another (231a29-b6). But what is indivisible cannot have extremities. For if A were one extremity and B the other, then the indivisible could (at least theoretically) be divided into A and B; however, it is absurd that an indivisible should be divisible. Therefore, since indivisibles have no extremities, the extremity of one indivisible cannot become one and the same with the extremity of another indivisible. Hence the indivisible cannot be continuous. Similarly, again since indivisibles have no extremities that can be in contact with one another, indivisibles cannot compose a continuum by contact. Further, Aristotle tells us at 231b6-10, two indivisibles cannot be in succession. For between any two points there is a line (and hence, we might add, an infinite number of potential points).[33] For if there were not a line between two indivisibles, the two indivisibles would be either continuous or in contact with one another, but both of these options have been shown to be impossible. But two things are successive only if nothing of the same kind lies between them; however, since between any two points there is something of its own kind, no two points can be

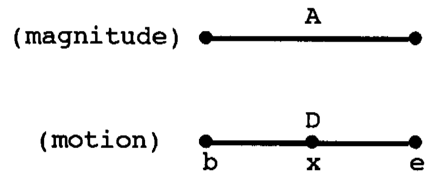
[32] At present I merely introduce nows as the temporal analogue of points. I say more about the nature of the now in subsequent chapters.

[33] Points and nows are the only two types of indivisible that Aristotle considers; however, in relation to his discussion of motion, they are the only relevant ones.

successive.

The same reasoning applies equally well to magnitude, motion and time; for either none of these are composed of indivisibles or all of them are (231b18-232a18). Aristotle's strategy for showing that what applies to magnitude equally applies to motion (and consequently to time as we shall see) is to map the motion of some mobile on to a magnitude, such that whatever is true of the magnitude is correspondingly true of the motion. The justification for the mapping technique is that motion follows upon spatial magnitude. Since motion belongs to spatial magnitude as a *per se* 2 predicate a transitive relation holds between the two, such that what is true of the subject (spatial magnitude) is likewise true of the predicate (motion), since the subject belongs in what makes clear the essence of the predicate.

Thus, at *Physics* VI 1 (231b18-232a22) Aristotle has us assume a mobile's traversing a distance ABC, which is supposedly composed of the indivisibles A, B and C. Now "when motion is present something must be moved and when something moves motion must be present" (231b25-26). Thus since the mobile is moving across ABC, there must be some motion across ABC, call it DEF. Given that each part of ABC is indivisible, each part of the motion DEF must likewise be indivisible. For imagine some indivisible magnitude A, which is traversed during the motion D. If D were not itself indivisible, then where D is divided on its path across A, this division would likewise mark off a division in A. A graph will aid in making the point:



Now if D corresponds with the motion over the indivisible A, but D is divisible, then from the beginning of the motion D until x, only part of A is traversed; whereas from x to the end of D's motion, another part of A will be traversed. We might add that if in either bx or xe the entirety of A were traversed, then the lesser motion (bx or xe) would be equal to the greater (be); however, the lesser cannot be equal to the greater, with respect to the same thing in the same way. Thus A would be divisible at a point corresponding with x, which is impossible given the initial assumption that A is indivisible. Therefore, if the magnitude is composed of indivisibles, so must the motion be.

Let us assume for the sake of argument, Aristotle continues (231b28-232a15), that the motion is indivisible. Certainly, a thing in motion cannot simultaneously be both in motion and have completed its motion, nor could it be at rest (i.e., not have begun its motion), when it is in motion. (I cannot be in the process of writing this sentence either before I begin writing it or after I have finished writing it.) Assuming that the motion D is indivisible, then D cannot be a process by which a mobile traverses A. For when the mobile proceeds through A, then neither is it in the initial state of rest nor has it completed its procession. On the contrary, the mobile is in a state of procession that is between these two states; call this state of procession the intermediate state. Hence if the motion D involved a process, it would be divisible into two parts: the part between being at rest and the intermediate state and the part between the intermediate state and being completed. Consequently, assuming that D is indeed indivisible, the mobile would not actually traverse A after being in a process. However, for a mobile to be in motion just is for it to be in the process of being reduced from actuality to potentiality insofar as it is in potentiality. Thus if the motion D were indivisible, it could not involve a process, i.e., what we normally think of as a motion. Consequently, the mobile would complete its passage over the magnitude A in the motion D, without ever being in process, i.e., in motion. Since the conclusion is absurd, the motion must be divisible.

Aristotle thus has presented us with powerful arguments against an atomistic construction of either motion or magnitude. Furthermore, since the arguments apply to any size magnitude (or motion), all magnitudes are potentially infinitely divisible; for one will never reach an indivisible magnitude. To be potentially divisible *ad infinitum*, however, characterizes the continuous. Therefore, all magnitudes and motions are continuous.

F. Further Aspects of Motion. Insofar as motion can be treated as a quantity it can be measured or assigned a certain number (*Metaphys.* V 13; X 1). For there can be some unit, or one, that can count off the parts of the given quantity. Consequently, since the motion follows upon the spatial magnitude and spatial magnitude can be marked off into parts, which in turn can be measured or numbered, so likewise motion can be measured or numbered according to the parts of the spatial magnitude. The one, i.e., the unit of numbering or measurement, must be indivisible and a "this", which can be found on its own either in place, form or thought (1052b15-17).[34] Squaring this thesis with the continuity of spatial magnitude and motion becomes difficult when we note that the unit of measurement must be of a kind or appropriate to the thing measured (1053a24-25).[35] For that which measures spatial magnitude must itself be a spatial magnitude and also one (i.e., indivisible), yet we have just seen that spatial magnitudes are infinitely divisible.

Although the significance of this problem is not evident yet, its answer has ramifications in Aristotle's temporal theory. Consequently, some answer should be hazarded at this point. Aristotle's solution in *Metaphysics* XIII 3 is to assert that a measure need only be one for the purposes of counting, i.e., the indivisibility of the unit of measurement need only be a mathematical fiction. A full account of the meaning of this claim would involve a detailed discussion of Aristotle's ontology and psychology of mathematics; for our purposes a few, brief remarks will suffice.[36]

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[34] ... τὸ ἑνὶ εἶναι τὸ ἀδιαιπέτῳ ἐστὶν εἶναι, ὅπερ τόδε ὄντι καὶ ἰδίᾳ χωριστῷ ἢ εἴδει ἢ διανοίᾳ.

[35] ἀεὶ δὲ συγγενὲς τὸ μέτρον.

[36] See the appendix on Aristotle's theory of number.

First, mathematicians or measurers posit or lay down some x as an indivisible. X need not be actually indivisible, but they agree to treat x as indivisible for the purposes of inquiry. The situation is similar to a geometer, who draws a ten centimeter line segment on a chalk board and says, "let this line be one meter". Second, the "indivisible" x is in turn used as a unit for marking off segments in the case of continuous quantities (and thus measuring them), and marking off sets in the case of discrete quantities (and thus numbering them). Let us thus consider a case of numbering. Imagine being presented with a pile of shoes and asked "what is the pile's number?" The question only makes sense when we know the number of what; for the question might concern either the number of *pairs* of shoes or *individual* shoes or *parts* of shoes, etc.. In short, we need a unit for counting. Similarly, if we were shown a road and asked "how long?", we would demand that our inquisitor specify a unit of measurement. Let us say our unit is the meter and we subsequently discover the road is 100 meters long. Attaching such a number to the road does not preclude further divisions of the road, e.g., into centimeters, only that if we do so, we are no longer considering the meter *qua* indivisible, i.e., as our unit of measure.

Indeed, a certain relativism pervades a unit of measurement's choice; however, the choice need not be arbitrary. Thus, Aristotle advises that when a certain measure is such that additions and subtractions go unnoticed, while a second measure is such that units would not go unnoticed, the second measure is preferred (*Metaphys.* X

1, 1053a3-6). In general, we take the smallest measure; for by means of it we can be more exact since differences in measurement are less likely to evade our notice. For instance, we do not use the kilometer as our indivisible unit for measuring a person's height, since then both Jack and the giant would have been of equal stature, one kilometer high (if we round up). With regard to motion we are fortunate that Aristotle specifies a preferred unit of measurement (1053a8-9). Such a unit must be a motion that is simple (*haplêi*) and the quickest (*taxistêi*). The motion of the heavens is uniform (*homalên*) and judged to be quickest (*taxistên*) and thus best suited to the role of measuring all other motions (Ibid).

Let us flesh out Aristotle's suggestion. Since the heavens move perpetually and smoothly and not sporadically, they provide a constant measure. Consequently, assuming, as the Greeks did, that the heavens circle the earth, we could take some point in the heavens, say the sun, and use its diurnal motion to measure other motions. For instance, the motion of someone's travelling from New York to California could be measured in terms of the number of times the sun crosses the eastern horizon. Or if we needed smaller units of measurement, we could break up this "natural" unit, and use the motion of the sun's shadow cast by a gnomon on a sundial. However we decide to divide the motion of the heavens, it provides us with a constant motion by which all other motions can be measured.

One final feature about magnitudes: they all possess what might be termed a number or countable aspect. The point is of interest since Aristotle ultimately defines time as the number (*arithmos*) of motion according to before and after (219b1-2). Number, for Aristotle, and most Greek and Hellenistic mathematicians before and after him, is a collection of units.[37] Thus, since continuous quantities can be divided into parts and one part can be taken as a unit, we can view these parts as a set of units. Hence magnitudes have a numerable aspect or number insofar as they can be divided into parts that can be counted. As an aside one (1), in the strict sense, is not a number since it is not a set; rather it is the principle of number (*archê arithmou*, *Metaphys.* X 1, 1052b23-4). Yet there is a sense in which one (1) is a number; for a number can also be that by which we count (*hôi arithmoumen*) (*Phys.* IV 11, 219b7). By the phrase "that by which we count" I take Aristotle to mean "that by which number is known".[38] That by which number is known, however, is the unit and thus in a special sense the unit, or one, is a number.

I conclude with a summary. Aristotle hypothesizes both the

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[37] *Metaphys.* X 1, 1053a30; VII 9, 1085a22; *Phys.* II 7, 207b7; also cf. Heath's commentary on *The Elements* (vol. 2, 280) for similar earlier and later definitions of ἀριθμός.

[38] The traditional reading of ᾧ ἀριθμοῦμεν [cf. Simplicius, 718, 6, 763, 2-6; Philoponus, 723, 28; Ross (1936), 593; Mignucci (1987), 197-8] is that it refers to abstract numbers (Simplicius' μοναδικὸς ἀριθμός and Philoponus' ἀριθμῶν ἀριθμός); yet there is little evidence that such an interpretation is demanded. First, Aristotle's mathematics is firmly grounded in concrete objects, where abstract numbers are most likely an adjectival use derived from a plurality which expresses how many instances of a given x there are. Thus, it is not be means of abstract numbers that we can count objects; rather we have abstract numbers because we can count objects. Second, within the context of the *Physics'* passage (*Phys.* IV 11, 219b7), there is a constant paralleling of time and the now and thus a certain symmetry and elegance suggest we read time as the countable number of motion and the now as the number by which we count, i.e., the unit. In one place Aristotle explicitly calls the now the unit of number, μονὰς ἀριθμοῦ (220a4). (Cf. W. Wieland (1962), 318-19 for an explication of the theory that the number by which we count is just the unit.)

existence and definition of physics' primary subject, motion. Motion, which is the imperfect actuality of what is in potency insofar as it is in potency, involves two termini, the prior actuality and the final potentiality and the interval in between these two. This interval is a quantity that follows upon spatial magnitude and is thus one of physics' derivative subjects. Since a *per se* 2 relation holds between spatial magnitude and motion, and the former is continuous and infinitely divisible, so is the latter. Furthermore, all continuous quantities are measurable, where "measurable" means that some unit can be picked out and by means of that unit a number can be assigned to that which is being measured. In the case of motion, the natural unit of measurement is based upon the rotation of the heavens. Consequently, since motion can be measured it must possess a numerable aspect or number. We are now ready to turn to Aristotle's preliminary discussion of time.

CHAPTER 4

APORIAI AND *ENDOXA*: CONDITIONING THE PROBLEM SPACE SURROUNDING TIME

We are finally in a position to consider Aristotle's theory of time. Aristotle does not impetuously run into a discussion of the nature of time, but rather begins with a survey of the terrain. The survey includes various arguments that seemingly call into question whether time is real and also a list of earlier opinions concerning the nature of time. I have argued in the chapter on Aristotelian science that Aristotle uses the opinions and problems associated with a subject to condition his own discussion of that subject. That is to say, the *endoxa* and *aporiai* together provide tentative definitions of the subject and likewise they draw our attention to various characteristics and attributes of the subject. Furthermore, the puzzles indicate questions and problems an adequate account of the subject must answer, while also weeding out certain unacceptable accounts of the subject. Moreover, a knowledge of the opinions of our predecessors helps us avoid the pitfalls that they suffered and guides us where they seem correct. Thus let us see what is to be learned from Aristotle's preliminary discussion of the problems and opinions surrounding the subject of time.

A. Aristotle's Use of Dialectics in the Puzzles and Opinions Concerning Time. When reading *Physics* IV 10 we should pay particular attention to Aristotle's use of dialectic. I have argued that dialectical methods neither establish nor justify scientific knowledge. Instead they nudge our investigation in one direction or another; that is, they suggest possible definitions of key terms or eliminate various unworthy candidates from consideration. This understanding of the *aporia* and *endoxa* in turn suggests a new reading of the puzzles. For many commentators Aristotle presents the riddles of *Physics* IV 10 as primarily an attack upon the reality of time; as such, the puzzles may be viewed as *destructive* of any theory of time.[1] I maintain, in contrast, that the puzzles are primarily *constructive*. They are intended to offer vying conceptions of time and to illuminate the difficulties surrounding the properties or attributes of these conceptions of time and then, only secondarily, do they call into question the reality of time.[2] For instance, I argue that Aristotle's primary intent in *Physics* IV 10 is to dispose

[1] Cf. R. Sorabji, *Time, Creation and the Continuum* (Ithaca: Cornell UP, 1983): 7-10; F. Miller "Aristotle on the Reality of Time" in *Archiv für Geschichte der Philosophie* 56 (1974): 132-155; J. Annas, "Aristotle, Number and Time" in *The Philosophical Quarterly* 25 (April 1975): 97-113 (especially 100-101).

[2] Norman Kretzmann has a similar reading of the *aporiai* in his article "Time Exists--But Hardly, or Obscurely (*Physics* IV, 10; 217b29-218a33)" in *The Aristotelian Society*, Supplementary Volume L (1976) 91-114. Kretzmann's thesis, however, is more radical than my own in that he attempts to make all of the *aporiai* attacks on a dynamic theory of time (see below for a discussion of a dynamic theory of time). In the end I do not think that Kretzmann can sustain his argument and even he seems sceptical as to how the final puzzle applies to a dynamic theory of time (108).

of a particular temporal theory, viz., a dynamic theory of time, rather than to undermine the reality of time absolutely. By a "dynamic theory of time" I mean a position that views time as something flowing or in flux. More will be said in the sequel. Furthermore, I point out how the *aporia* and *endoxa* indicate several common opinions or features associated with the notion of time. An adequate account of time must either include these features or explain why time does not require them. Also, and as one might expect, the *aporiai* delineate certain difficulties for any temporal theory and thus whatever Aristotle's account he must redress the problems mentioned. Thus according to my reading of *Physics* IV 10 we see Aristotle eliminate one unacceptable temporal theory and define the problem space associated with the theory of time, i.e., make clear the issues and problems associated with a theory of time.

B. The Aporiai. Aristotle begins *Physics* IV 10 with three puzzles which cast doubt on whether time is real.

> [1] Thus, someone may conjecture from the following that either there is no time at all or [it exists] with difficulty and indistinctly. On the one hand, what has been of it no longer is, while what will be is not yet; but both infinite time and the time ever grasped [by us] are composed from these. However, it would seem impossible that what is composed from what is not should have a share in being (217b32-218a3).
> [2] Furthermore, everything divisible into parts, if it is, it is necessary, when it is, that indeed either all of the parts are or some them are. But with respect to time, although it is something divisible into parts, some [of its parts] have been, while some will be, but nothing is. And the now is not a part; for a part both measures the whole and the whole must be composed from the parts, but time does not seem to be composed of nows (218a3-8).

Aristotle then completes the puzzles with the paradox concerning the reality of the now (218a8-30), which we encountered in the introduction (p. 4-5).

Most scholars take the three *aporiai* severally; however, I prefer to see them forming one continuous argument with each progressive stage addressing a possible objection to the preceding step. Thus at each subsequent stage in the argument, we might think of Aristotle considering a criticism to the objection and then developing a response to the criticism, which in turn makes the case against time stronger.

Thus, to appreciate the role of each individual argument within the whole, let us briefly limn the global structure of the argument including the possible objections. The first stage (217b32-218a3) questions the reality of time on the basis that neither the past nor future exists and yet time is composed of these two parts. We can picture a defender of time objecting that the present, or now, exists and thus so does time. The next phase of the argument (218a3-8) observes that the now is not a part of time nor is time thought to be composed of nows. Our defender may then reply that the now need not be a part of time to ensure the reality of time; for if it could be shown that the reality of the now requires the reality of time, then the very fact that there is a now would guarantee that there is time. The final stage (218a8-30) lands the *coup d'état* against time. The now either is something that changes or something that does not change. These two alternatives exhaust the possible modes in which the now can be and thus should both views of the now fail, so would

any theory that linked time with the now; for if time depends on the now, but the now cannot be, then neither can time be. The argument then shows that either of these two possible manners of the now's existence seemingly leads to absurdities and consequently the
is silenced
defender of time lies motionless, apparently slain.

1. The First Stage. Keeping the general framework of the argument in mind, let us turn to its first stage (217b33-218a3). Time can be divided into what has been and what will be. Now what has been no longer is, whereas what will be is not yet. Thus, since time is composed of these two parts and yet neither of the parts is, time itself is not among the things that are. The argument is quick but powerful.

An example of Aristotle's reasoning drives his point home. We may divide time into yesterdays, today and tomorrows. Clearly none of the yesterdays or tomorrows are today. Furthermore, today can be divided into morning, afternoon and evening. During the afternoon, the morning has been and the evening will be, but neither of them are. In more genteel regions the afternoon can be further divided into teatime and the times before or after tea. The same type of divisions can be applied relentlessly to any duration, no matter how small, we care to take.[3] The ultimate result is that any span of time can be cleanly cut into either time that has been or time that will be and thus any present "time" must be a durationless moment.

[3] Cf. the section "The Continuum".

Fred Miller has dubbed the argument the "whittling argument".[4]

We should make three points about the whittling argument, all of which become of interest when we discuss Aristotle's own theory of time. First, the argument relies on the fact that the verb "to be" (Grk. *einai*) is syntactically tensed.[5] Thus, when something exists, we say that "it is". In contrast On the other hand, we do not immediately say something exists, if "it was" or if "it will be", rather we are only prone to ascribe to it existence if it also is right now. Consequently, the common opinion concerning either the past or the future is that they do not exist, since they are not *right now.* Such a view seems at work in the second deduction of the *Parmenides* (151e6-152a3), a text that undoubtedly influenced Aristotle's own opinions.[6] For Plato maintains that we say something "is" in contrast to saying it "was" or "will be", only when it partakes of present time.[7]

Second, Aristotle makes a tacit assumption concerning the nature of time, viz., time is divisible into parts. The parts come in the form of past and future. Curiously, Plato affirms this division in the *Parmenides*, but denies it in the *Timaeus* (37e1-4). We have just mentioned one passage in the *Parmenides*, which suggests this division and we can add to it Plato's comments in the same text

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4 Miller (1974), 133.

5 Ibid, 132-155.

6 Cf. G.E.L. Owen's "Tithenai ta Phainomena" especially section 2.

7 151e7-152a3 Τὸ δὲ εἶναι ἄλλο τί ἐστιν ἢ μέθεξις οὐσίας μετὰ χρόνου τοῦ παρόντος, ὥσπερ τὸ ἦν μετὰ τοῦ παρεληλυθότος καὶ αὖ τὸ ἔσται μετὰ τοῦ μέλλοντος οὐσίας ἐστὶ κοινωνία.

at 141d7-e3. On the other hand, Timaeus tells us (37e1-4) that the parts of time are day, night, months and years, whereas "what was and will be" are only the species or forms of time that have come to be (*chronou gegonota eidê*). Most likely Plato's considered opinion is that the past and future are not time's parts. Still the fact that the young Aristotle of the *Parmenides* (not our Aristotle) so readily agreed to accept past and future as time's parts testifies to what must have been the common opinion.

Finally, On the basis of time's divisibility and that it is divided into past and future, we can infer another attribute about time. Before and after must belong to time; for that which has been was "before" the present and that which will be is "after" the present. The first *aporia*, although it tells us nothing definite about the nature of time, has drawn our attention to several features inherent in a common conception of time.

2. The Second Stage. The second phase (218a3-8) runs along the same lines as the first, yet adds a refinement. Aristotle reiterates that time is something divisible, and if a divisible thing is to be, all, or at least some, of its parts must also be, but none of time's parts are. The refinement comes in the form of a response to an imagined objection. For one might complain that although neither past nor present is, the now is and the now is a part of time. Aristotle dismisses the objection. The now is *not* a part of time.

Aristotle provides two arguments for his dismissal. First, a part is capable of measuring the whole, but the first *aporia* has shown that the now must be durationless, i.e., it has no magnitude. For if the now is assumed to have a duration, we can apply the whittling argument, cleaving the extended now into its past and future parts. In our preceding chapter, however, we saw that for Aristotle a measure must be of a kind with that which it measures.[8] Consequently, a durationless now could not measure time, which is a duration. Aristotle's objection can be visualized if we imagine how many footsteps it would take to cover a mile, if each footstep traversed absolutely no distance.

The second objection is much like the first. A whole is composed of its parts. Therefore, if the now were a part of time, time would, or at least could, be composed of nows. Once again, we saw above that what has a magnitude cannot be composed of indivisibles.[9] Time, insofar as it spans a duration, is a magnitude, whereas the now, insofar as it is durationless, is without magnitude. Consequently, time cannot be composed of nows and thus the now is not a part of time. An attempted defense of the reality of time falters.

Once again, the *aporia* introduces an interesting feature related to a common conception of time. Aristotle makes explicit mention of the now and certain of its characteristics. First, we are told that the now divides time into past and future. Second, Aristotle makes clear that the now is indivisible, although the argument is undeveloped. Fortunately, he develops the thesis at

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[8] Cf. section "Further Aspects of Motion".

[9] Cf. section "The Continuum".

Physics VI 3. Given the relevance of this thesis to the current puzzle, we may digress briefly to consider it.

3. Aristotle on the Extended Now. One might think that Aristotle would be sympathetic to the notion of an extended and divisible now; for if the now were extended, Aristotle would have a ready made response to both of the puzzles mentioned.[10] The extended now would be a duration of time, which both measures and makes up time. Contrary to what one might expect, Aristotle at *Physics* VI 3 explicitly denies that the now is divisible. Aristotle's argument for a durationless or indivisible now can roughly be divided into two stages. The first move (234a5-11) shows that an extended now must be at least potentially divisible. The second move (234a11-24) draws out various characteristics that follow from the notion of a divisible now. All these characteristics, however, are incongruous with what one might think of as the common notion of a now that divides the past (or that which has been) from the future (or that which will be).

We can reconstruct Aristotle's argument for the divisibility of the extended now as follows (234a5-11). If the now were extended, then it would have two different extremes, i.e., the endpoints of the extended now, which divide the present from the past and the future

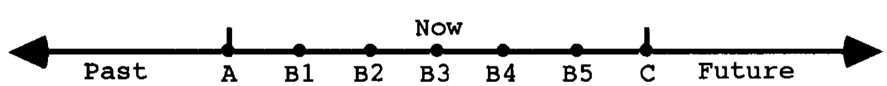
[10] Cf. D. Bolotin, "Aristotle's Discussion of Time: an Overview" in *Ancient Philosophy* XVII (Spring 1997): 47-62; and Julia Annas (1975), especially §III. Bolotin argues that Aristotle does affirm that the now is extended, despite Aristotle's own denial of this thesis at *Physics* VI 3. Annas, although denying Aristotle accepted such a thesis, indicates how a doctrine of an extended now would have been more consonant with his own overall theory of time as a number of motion.

from the present. These endpoints could not be immediately next to one another; for insofar as they are points, they are dimensionless and, as we saw in our last chapter, no two dimensionless points can be immediately adjacent. Thus, on this hypothesis, there would be an interval between the endpoints, which is nothing other than the extended now. Moreover, this interval would be a magnitude and consequently continuous. With respect to the continuous, however, there is always something of the same kind as the extremes between its two extremes (234a6-9). For example, between two points there is a line, in which there is an infinite array of points all of the same kind with the two extreme points. Therefore, assuming that the now is extended, one is likewise compelled to acknowledge that within the extended now there would be divisions of the same kind as the two extremes. To this point Aristotle's argument only precludes that the now is an *atomic* unit of time, not that the now cannot be extended. That is to say that if, *per hypothesis*, the now is extended the now must still be something divisible (at least potentially). The mere divisibility of an extended now, however, does not entail a contradiction in the notion of an extended now. The only way that the divisibility of an extended now could imply a contradiction is if one already assumed that the now must be indivisible; however, in this case the argument would beg the question.[11]

[11] Bolotin [(1997), 57-58] and M. Inwood ["Aristotle on the Reality of Time" in *Aristotle's* Physics*: A collection of Essays*, ed. L. Judson (Oxford: Clarendon Press, 1991), 151-178 (especially 162)] both accuse Aristotle of just this fallacy, claiming that Aristotle's argument only works if one assumes the now is indivisible. In the sequel I shall attempt a reconstruction that avoids this accusation.

Aristotle next derives a list of three characteristics from the notion of a divisible now, which flout our temporal intuitions. For instance, (1) what has been and what will be are marked off in virtue of the extended now's limits (234a11-14). Moreover, points of division of the same kind as the now's limits are found within the now itself. Consequently, the extended now, in virtue of the divisions within it, can be divided into what has been and what will be. At the same time, (2) the extended now does not mark off past and present times in virtue of itself, but rather in virtue of its limits (234a14-16). Furthermore, (3) something of the now will have been and something of it will be; and the same thing is not always what has been and what will be (234a16-19).

A diagram will hopefully clarify these points.



Consider the extended now, AC. At the limit A the extended now AC has not been, but will be, whereas at the limit C, AC has been. The flavor of Aristotle's argument is difficult to capture in English. Translators tend to understand *ti tou gegontos* and *ti tou mellontos* (234a12ff.) as "something of the past" and "something of the future" respectively; however, these phrases can also mean "of what has been" and "what will be".[12] Hence, Aristotle's formulation does not

[12] Cf. Hardie and Gaye's translation of the *Physics* in the Revised Oxford Translation (Princeton: Princeton UP, 1984); Apostle's translation (Grinnell: The Peripatetic Press, 1980); and Ross' analysis of this passage (406). The language of "what has been" and "what will be" is also at work in the first two puzzles concerning the reality of time which we have seen.

assert, as Michael Inwood would have us believe, that AC, i.e., the present, is absolutely past or absolutely future; but rather, Aristotle is only claiming that part of AC, i.e., the extended now, will have been and part of it will be.[13] Thus the division A divides both the future and present from the past, and similarly C divides both the past and present from the future; nevertheless, at A, C neither is nor has been but only will be, and likewise at C, A neither is nor will be but only has been. Therefore, within the present there will be what has been and what will be. This characteristic of an extended now, I believe, is not inherently contradictory, although it is peculiar and seems foreign to what one might think of as the now.

The second peculiar characteristic of the extended now, AC, is that it is not in virtue of what it is to be AC that the past and future are marked off; rather it is in virtue of A that the past is marked off from what will be and in virtue of C that the future is marked of from what has been. Since what it is to be A is other than what it is to be AC and it is A that marks off the past, AC can only be said to mark off the past in virtue of something other than itself, viz. A. The same can be said for the future and C.

Michael Inwood, following W.D. Ross, has understood Aristotle's argument differently.[14] They maintain that AC is called a "now" only insofar as AC includes the actual *per se* now B. In other words, on

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[13] Cf. M. Inwood, (1991), 161-62.

[14] Ross (1936), 645; Inwood (1991), 161-62.

any view something of itself (i.e., *per se*) cleanly divides what has been from what will be. Insofar as this thing "cleanly" divides time it is analogous to an indivisible point. Thus on our diagram this dividing point correspond with the points A, B_1, B_2 etc. and not the whole of AC. Ross and Inwood claim that Aristotle assumes that what divides time into what has been and what will be *per se* just is the now. Given their understanding, it is no wonder that Inwood complains that the "argument seems to beg the question by assuming that since the extended now can be divided at any of infinitely many points, there is some point [B] which is strictly and primarily the present and that it is in virtue of including [B] that [AC] is regarded as secondarily and loosely the present."[15] On my reading, although Aristotle does assume that there is something *per se* which cleanly divides what has been from what will be, he does not make the additional assumption that this thing is necessarily the now. In fact, it is by not making the latter assumption that the argument has bite. My intuition, and I would believe that of many others, is that it is the now that cleanly divides what has been from what will be. Aristotle merely observes that we have to set aside that intuition if we posit an extended now.

Finally, not only would the now have the curious trait of being divided into what has been and what will be, but it would not always be the same parts that have been or will be. For instance (see diagram above), if AB2 has been, while B1B3 will be, then B1B2 cannot

[15] Inwood (1991), 162.

be the same in AB2 and B1B3; for in the first case B1B2 has been, while in the latter it will be. One might complain that even within B1B3, B1B2 has been and it is only B2B3 that will be. Such a concession only confirms that within the extended now itself there is a division into what has been and what will be and this division is never the same. Given our assumption that the now is what divides what has been from what will be, it becomes difficult to avoid the conclusion that the division within the now is the primary now and the extended now is only a derivative now.

Aristotle's intention in all of these arguments, I believe, was not so much to deduce contradictions from the notion of an extended now as to observe that the notion of an extended now is contrary to what we commonly recognize as the now. Thus to the extent that the extended now is incongruous with what people think and say about the now, the natural philosopher should prefer the notion of an unextended, indivisible now.

4. The Third Stage. Returning to the argument of IV 10, we recall that the *aporiai* have forced the defender of time to appeal to the present or the now, but the now was shown to be indivisible and thus time cannot simply be a composition of nows.[16] Still if one could show that the mere reality of the now necessitates the reality of time, victory would be at hand. Let us consider two scenarios that could link the reality of time with that of the now.

[16] Cf. my chapter 3 "the Continuum" for why what has magnitude cannot be composed of indivisibles.

The now may be thought of in one of two ways, either as something that changes (*allo kai allo*) or something that does not change (*hen kai tauton*) (218a8-10). Thus picturesquely we can imagine the now either as something flowing, producing time in its wake, or as something that marks off segments of time, somewhat in the way a marker stone can divide one farmer's land from another's. Consider first the notion of a flowing or moving now. On this theory, the now is the temporal analogue of a mobile. Thus just as the moving of the mobile is motion, so the flowing of the now is time. (Or if we feel uncomfortable about reifying the now, we can say the now is a state belonging to a mobile, which identifies *when* the mobile is, just as a place is a state belonging to a mobile, which identifies *where* it is.) Thus given the perpetually changing now, there would be a time associated with it. We might call such a conception the "dynamic theory" or definition of time.

On the other hand, assume that the now is something unmoving that marks off time just as the termini *a quo* and *ad quem* mark off motion. Time on this account is whatever is bounded or limited by two nows. Thus, since the limit cannot exist apart from what it limits, the reality of the now guarantees the reality of the limited, viz. time. We may dub this view the "static theory" or definition of time. Therefore, the defender of time can argue that the now is either something changing or something unchanging; however, since in either case the reality of the now necessitates the reality of time, time is real. Admittedly, this objection and these accounts of time do not explicitly appear in Aristotle's puzzle, but given what follows one may reasonably assume that Aristotle had the objection and accounts in mind.

The third puzzle (218a8-30) is intended to display that the now itself is not real and thus *a fortiori* neither is time. The detractor of time accepts that the now is either changing or unchanging and proceeds to construct a dilemma. The first horn (218a11-21) shows that the now cannot be changing, since there is no moment when it could change. The second horn (218a21-30) points to two difficulties in assuming that the now is the same or unchanging. First, if the now remained the same, it could not perform its function of marking off time, since one needs two different nows to mark off a time. Second, if the now were one, the now of ten thousand years ago would be the same as the present now and the now of ten thousand years hence.

In the first horn Aristotle assumes the following premises:[17] (1) different nows cannot occur simultaneously (i.e., the instant right now cannot have existed with the instant(s) one minute ago or one minute hence) (218a15); (2) prior nows must have ceased to be at some time or moment (218a14); finally (3) nows, like points, are neither successive nor contiguous to one another (thus between any two points/nows there are an infinite number of other points/nows) (218a18-19). Assume that the now is perpetually changing or flowing.

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[17] Aristotle's version of the argument appears indebted to a platonic version found in the *Parmenides* (156c1-157b5), although it would be difficult to reconstruct Aristotle's argument merely from Plato's premises.

If the now perpetually changes, the prior now must have ceased to be at some moment (from 2). However, the prior now could not have ceased to be while it was (for it was existing) (218a16-17); on the other hand, it could not have ceased to be in the immediately adjacent now, for there is no immediately adjacent now (from 3). Furthermore, if it were to cease to be in any now other than itself, it would have been simultaneous with the infinite number of nows that occur between any two nows (from 3), but it is impossible for one now to be simultaneous with any other now, let alone an infinite number of nows (from 1). Therefore, the now is not perpetually changing.

The second horn involves two diverse arguments. The first concerns the now as a limit and the second concern simultaneity (*to hama kata chronon*). In the first attack (218a21-25), Aristotle takes for granted the following: (1) no determinant divisible thing has a single endpoint (218a22-23). For example, the line AB is cut off, or made determinate, by its endpoints, A and B; for if there had been only one endpoint, A, then there would have existed a line extending infinitely from A, but not a determinate, divisible line). (2) A determinate, divisible time can be delimited. (3) The now is an extreme, or endpoint, (*peras*) of time (218a24-25); i.e., the now marks of the end of what has been and the beginning of what will be. Assume that the now is always one and the same. If the now were one and the same, it could not cut off a determinate, divisible time; for there must be two determinations to cut off a determinate, divisible thing (from 1). Therefore, either the now is not an extreme (or endpoint) of time or a determinate, divisible time cannot be delimited. Both options are false (from 2 and 3), therefore, the now is not always one and the same.

The second (218a25-30) attack involves the notion of simultaneity. Aristotle defines being together with respect to time (*to hama kata chronon*), i.e., simultaneous, (in contrast either to being before or after) as to be in one and the same now (218a25-27).[18] Given the assumption that the now does not flow, but remains one and the same, then what was before and after would have to be in one and the same now. Consequently, what has happened ten thousand years ago would be simultaneous with what is happening today. In fact, Aristotle continues, nothing could even be before or after (218a29-30). Aristotle's unstated argument is undoubtedly that to be before is to occur in an earlier distinct now, while to be after is to occur in a later distinct now, neither of which are possible if there were only one and the same now.

C. Possible Responses to the Dilemma of the Now. A response to Aristotle's dilemma of the now could take one of two forms. One could either grasp the dilemma by the horns and show that one of the horns does not lead to an unacceptable consequence, or one could pass between the horns, by showing that there is some third conception of the now which was not considered. We shall see in part II how Avicenna attempts to pass between the horns. To my knowledge Avicenna was the only philosopher in the ancient and medieval world

[18] τὸ ἅμα εἶναι κατὰ χρόνον καὶ μήτε πρότερον μήτε ὕστερον τὸ ἐν τῷ αὐτῷ εἶναι καὶ ἑνὶ [τῷ] νῦν ἐστιν.

who explicitly used this strategy to solve the puzzle. Thus for the nonce we may consider only ways of grasping the horns.

A response to the first horn (viz., when is the instant of change) would involve showing when the now could change. The problem, we recall, involves specifying the moment at which the now has changed; for it seems impossible that it either changes when it is or at some subsequent time after it is. Richard Sorabji thinks he has a third alternative.[19] We must first distinguish between the present and perfect tense. Thus using the perfect tense, we can say the present now *has* ceased, although we can never use the present tense to say it *is* ceasing. Therefore, in response to the question "when *has* the now ceased?" Sorabji can answer for Aristotle, what had been the present now *has ceased* (perfect tense) to be at any subsequent now, even though at no instant *is* it *ceasing* (present tense) to be.

Inwood has criticized Sorabji's view on the grounds that it appears to reduce to saying the now ceases when it is.[20] For instance, should we ask when does it cease to be 6:00, on Sorabji's advice we can say that it *has* ceased to be 6:00 at 6:00:01 or 6:00:0001 or 6:00:00001 or 6:00:000001 and so on indefinitely; however the limit of this series just is 6:00. Thus it appears 6:00 ceases to be 6:00 at 6:00. Sorabji would rightly complain that the question and response were framed using the illicit present tense.

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[19] Richard Sorabji, *Time, Creation, and the Continuum* (Ithaca: Cornell UP, 1983), 10-12.

[20] Inwood (1991), 163-64.

The motivation for this restriction, Sorabji tells us, is that certain things "can exist at one time and fail to exist at another, without ever being in process (present tense) of coming into existence or ceasing to exist."[21] Sorabji's point, which he takes from Aristotle, is that some things do not come to be or cease to be through a process or gradually; but rather they come to be or cease to be all at once.[22] Therefore since the now is not among the things which cease to be gradually, we cannot ask when *is* it *ceasing*.

Sorabji's point is certainly correct in the Greek, where the present tense indicates progressive/repeated aspect (captured by the English "it *is ceasing*"), but Greek has more than merely progressive/repeated and completed aspect, there is also simple aspect (captured by the English "it *ceases*" or "it ceased"). Although Greek does not have a tense that is both present in time and simple in aspect (as does the English simple present, "it ceases"), it does have a tense that is in past time with simple aspect, viz. the aorist. Thus a perfectly good question in Greek would be "6:00 *ceased* when?" 6:00 certainly *has ceased* to be at 6:00:01, but that is not when it *ceased* to be? If Sorabji's answer is Aristotle's preferred one, then it still fails to answer when the now ceased.

Fortunately, I do not think that Aristotle needs to answer the question of the ceasing now, if we anticipate his later comments in

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[21] Sorabji (1983), 11.

[22] Cf. *Metaphys.* III (B) 5, 1002a28-b11.

the *endoxa* and his stance with regard to the nature of time.[23] As I mentioned initially, the two horns of the dilemma represent different (and I might add, mutually exclusive) conceptions of the nature of time, either a dynamic or static theory of time. Since in the *endoxa* Aristotle undermines the dynamic theory of time and in subsequent passages employs a version of the dilemma of the ceasing now to his own advantage, we can ignore the problems involving a changing now that are associated with that theory.[24] In other words, we can understand Aristotle to have conceded the point of the argument and thus to disavow the notion of a changing now associated with the argument. Consequently, Aristotle's theory of time need merely address the questions raised when we assume that the now remains one and the same. The problems prompted by the two arguments in the second horn, we recall, are: how could something that remains one and the same be the limits for a determinate time, and how could there be one and the same now without all the diverse epochs being simultaneous. We can only hint at his solution now. Aristotle distinguishes between "that which at any time is the now" (*ho pote on*), which is always the same, and the now's being (*einai*), which can be differently characterized.

D. Summary of Characteristics and Issues Concerning Time Raised

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[23] Ἔνδοξα can mean either the common opinions or the opinions of the learned, i.e., the theories surrounding some subject. In the former sense of *endoxa* (i.e., common opinions) the various premises mentioned in the *aporiai* may be considered *endoxa*. I have chosen, however, following the usages established by G.E.L Owen in *Tithenai ta Phainomena* (*passim*), to use *endoxa* to refer to the theories of the learned.

[24] Cf. *Physics* VI 4, 234b10-20; VI 5, 235b6-236b19; VIII 8, 262a17-263a3.

by the Aporiai. Before we turn to the *endoxa* we should briefly catalogue the characteristics we have gleaned from the *aporiai* concerning time, i.e., the common assumptions and commitments we have (or at least Aristotle's contemporaries would have had) concerning what counts as an adequate theory of time, and the issues associated with these characteristics. Among these features are the divisibility of time. Time is assumed to be divisible into past and future, and as such we can image time as spanning a duration. Simply put, we can think of time as a type of magnitude. Moreover, a point not explicitly made by Aristotle, but certainly implied, is that different parts of time, and even the now, can be designated as before and after. These two points should give us reason to pause. Motion, we saw, could be treated like a magnitude and likewise possesses a before and after. Thus we have a presumption to suspect a possible relation between time and motion, although what that relation might be is still not clear. As an aside, if we could show that time either was motion or belonged to motion *per se*, then the first two puzzles would reduce to "is motion real?," a question that we can answer.

Returning to our catalogue, time is divided into past and future at the now and the now is indivisible. Thus given this understanding of time, we should expect a thorough account of time to provide an analysis of time's divisibility. Concerning the now more specifically, our survey suggests two ways of characterizing it, either as something dynamic or static. A dynamic or static theory of time is likewise associated with these two characterizations of the now. The preferability of which theory or definition of time we adopt stands or falls with which notion of the now we opt for. Finally, as a general remark about Aristotle's methodology, the dialectic arguments of the *aporiai* not only have had the negative effect of casting doubt upon the reality of time, but also they have had the positive effect of bringing to the fore certain issues and characteristics concerning one's commitments about time.

E. Endoxa. The *endoxa* are a list of the views of Aristotle's predecessors to which he appeals in order to solve the *aporiai* and develop his own view. As offering a possible solution to the *aporiai*, the traditional accounts provide little solace, complains Aristotle (218a32). Three earlier theories of the nature of time are mentioned. (1) Time is the outermost heavenly sphere (the sphere of the fixed stars) (218b1-5). (2) Time is the revolution of this outermost sphere (218b5-9). (3) Time is simply motion or a kind of change (218b9-20).

One might erroneously think that time is the outermost sphere on the basis of the following syllogism, Aristotle begins. All things are in time, but all things are in the sphere of the whole; therefore, time just is the sphere of the whole (218b6-7). Simplicius attributes the view to certain Pythagoreans, who misunderstood Archytus' saying that "time was an interval in the nature of the whole."[25] The view is too ludicrous to spend time

[25] *In Phys.* 700, 21-2; trans. J.O. Urmson (1992). The only reference I have

refuting, chides Aristotle, and promptly turns to the other theories. We might briefly note that the inference is fallacious since the subject, which is distributed in the conclusion, is not distributed in the premises. The fallacy is more obvious in the following inference, which is of the same logical form. A y chromosome belongs to all male humans; likewise a y chromosome belongs to all male horses; therefore, all male humans are male horses. Time is not the sphere of the fixed stars.

Position (2), viz., that time is the revolution of the sphere of the fixed stars, deserves more of Aristotle's consideration (218b1-5). Aristotle offers two objections. First, if time is nothing but the revolution of the heavenly sphere, then if there is no revolution there is no time; however, a part of the revolution is not the revolution itself, and yet a part of the revolution is a time. Second, if there should be more than one heavenly sphere, then there would be as many distinct times as there are heavens, but all of these times would be simultaneous with one another; however, to be simultaneous is to be at the same time. Hence, the contradiction would follow that there are many times in a single time, where "time" is one and the same thing in both cases. Since the conclusion is impossible, the initial premise must have been false.[26] Time then is not the revolution of the outermost sphere.

The theory that motion is time most interests Aristotle, but

found for Archytus is to a mathematician (ca. 430-365 BC), who very likely wrote an *Elements of Arithmetic* (Heath (1981), vol. 1, 90). Aristotle apparently wrote a book on him in which he deals with Pythagoras (cf. fragment 207 R^3; Damascius, *Dubitationes et solutiones* 306).

like its predecessors Aristotle finds the theory unacceptable. Aristotle offers two counter arguments (218b9-20). First, movement only exists *in* the thing that moves and *where* the thing that moves happens to be; however, time is present everywhere and in all things. Therefore, time and movement are not the same. Next, movement is always fast or slow, but time is neither fast nor slow. Therefore, time is not a movement. A sub-argument is offered for the premise that time is neither fast nor slow (218b17-18). Fast and slow are defined by time; e.g., fast is what moves much in a short time, whereas slow is what moves little in a long time. Now if time were a certain amount or kind of motion, then it would be either fast or slow, and thus defined by time, but time cannot be defined by itself.[27] Therefore, time is neither fast or slow. These two critiques satisfy Aristotle that time is not a motion.

Two points should be raised about this last theory and Aristotle's response. First, who is the author and exactly what was intended by identifying time and motion? And second, what are the implication of his attack on this theory?

1. Authorship of the Theory "Time is Motion". What is the theory "time is motion"? It cannot be that time simply is *any* motion; for then there would be as many times as there are motions. If this is what Aristotle understood, we would expect him to raise an objection to the theory similar to the one he leveled against equating time with the rotation of the heaven. For in this supposed

[26] The proof is weak. The conclusion could just as easily be, "therefore, there is not more than one heavenly sphere." In fact, Aristotle flatly denies

theory one does not even have to imagine multiple heavens, since we encounter countless different motions every day. Thus, time, on this theory, must be a certain type of motion. But what motion? Perhaps, time is the motion of the outermost sphere. This suggestion is different from the one positing time as the revolution of the outermost sphere. In the objection to theory (2) Aristotle had protested that a part of a revolution is not the revolution; however, a part of the revolution of the heavenly sphere would still be the motion of the heavenly sphere, which is just time on this reformulation. Be that as it may, this interpretation still falls prey to the multiple-heavens objection, because there would be as many times as there are movements of these supposed heavens and all of them would be occurring at the same time. It seems then that time would have to be the motion not only of a certain thing, but of some unique thing. Of course our outermost sphere is unique, but it seems arbitrary that we should pick our heavenly sphere rather than a supposed heavenly sphere of some other purported world. In fact, it seems equally arbitrary that we should pick the outermost sphere rather than the Sun or the moon. But what if we said that time is the motion of the all, i.e., everything that exists *in toto*, and that we employ the planets and Sun as instruments to measure this motion? The suggestion is not that time is all the individual motions taken separately, but rather that it is all these motions considered as a single, unitary movement. For instance, when a animal moves from point A to point B, there is the single local movement, which is the result of countless internal movements (synapses firing, muscles contracting, the burning of calories, etc.); thus the movement might be like that of a "single visible living creature".[28]

So characterized, the theory resembles the one Plato described at *Timaeus* 37C-39E. The father of the cosmos, Timaeus tells us, wanted to make the universe as much like the eternal paradigm as possible; however, since it is impossible that that which is generated should be eternal, he made a certain *moving* likeness of eternity, an everlasting likeness moving according to number.[29] Concerning the paradigm to which the demiurge looked, it contained all things; for otherwise it would be incomplete and what is incomplete is not fully good.[30] To move according to number is just to move in countable units, such as days, months or years. These countable units are enumerated by the movement of the heavenly spheres; the complete rotation of the outermost sphere constitutes a day, a cycle of the moon a month and that of the Sun a year. The theory that begins to emerge is that time is the motion of all things continuing without end, which moves according to certain numerable units.[31]

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[28] Cf. *Timaeus* 30D3, ζῷον ἓν ὁρατόν.

[29] εἰκὼ δ' ἐπενόει κινητόν τινα αἰῶνος ποιῆσαι, καὶ διακοσμῶν ἅμα οὐρανὸν ποιεῖ μένοντος αἰνῶς ἐν ἑνὶ κατ' ἀριθμὸν ἰοῦσαν αἰώνιον εἰκόνα, τοῦτον ὃν δὴ χρόνον ὠνομάκαμεν (37D5).

[30] 30C.

[31] One way to imagine Plato's thought is to compare it to the different ways one might answer a math problem. Two students are presented with the same problem. The first sees the problem and immediately recognizes the solution. The other has to move through a series of steps, (perhaps first determining what is being asked, then, what formulae are necessary to solve the question, then determining the various figures and plugging them into the formulae, then

2. Reevaluation and implications of Aristotle's Criticism. If this presentation of the theory that time is motion is correct, then at least one of Aristotle's objections fails. The motion of the all would be equally present everywhere and with all things, insofar as any motion whatsoever belongs to the motion of the all, but Aristotle's critique was just that if time were motion, then it could not be present equally everywhere and with all things, whereas time is.

Aristotle's second objection, though, still has bite. For some sort of rate of motion would exist for this motion of the all; however, time does not have a rate of motion, but rather defines the rate of motion. What would it mean to say that the motion of the whole is faster or slower, i.e., possesses some rate of displacement? What would it be faster or slower than? Can the motion of the whole be faster or slower than one of its parts? But that would be equivalent to saying, for instance, "I am tanning faster than I am running." Nor can this rate be equal to the motion of its parts; for the different motions that compose the whole vary. For example, the rate of motion of the whole would be equal to the rate of motion of Achilles and the rate of motion of the Tortoise. But it is impossible that simultaneously $A > B$ and $A = C = B$. We are left at a loss as to how to understand the rate of motion of the all if that

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undertaking the discursive steps in the demonstration and only then arriving at the conclusion). The first student saw all these steps in a single act, whereas the second student had to move through each successive step. The eternal paradigm contains all the activities of the world in a single act; whereas the world itself undergoes each of these acts successively.

very motion is time. Thus to the extent that we believe that all motion occurs at some rate of slowness and fastness, i.e., some velocity, identifying time with motion is unsatisfying.

The most notable implication of Aristotle's critique is the absolute denial that time is a type of motion. In other words time does not pass or flow. It is wholly unlike Bergson's *durée* or Hericlitus' flux. For to say that time flows is to say that past time is being displaced by "new" time at a certain rate; but this rate must itself be defined by time, i.e., time tells how fast or slow the displacement is taking place. We have returned to Aristotle's second objection. Whatever interpretation we suggest for Aristotle's own theory of time, it must avoid making time a type of flux, otherwise we hurl Aristotle upon the rocks of his own objection. Not to be too blunt, but Aristotelian time must be static! On the other hand, none of Aristotle's arguments preclude time's being related to motion, merely that it cannot simply be motion. For instance, we might think of an analogue with space. In locomotion the mobile traverses a certain distance and as such this distance is related to motion; but clearly the distance is not itself a type of motion, despite its relationship to motion.

F. Summary. The *aporiai*, which begin *Physics* IV 10, have the appearance of only being concerned with denying the reality of time. It is under this guise that most commentators have understood them. Aristotle, I maintain, intends these riddles to play a larger role in his overall theory. These puzzles, in conjunction with a discussion of various earlier temporal theories, define the scope of the discussion and make clear what a satisfactory theory of the subject must explain. They indicate difficulties, issues, even characteristics that must be addressed by a successful theory of time. Consequently, Aristotle is only vaguely bothered by the conclusion of these arguments, i.e., that time is not real. His major concern is to show *how time is real*, not *that time is real*. For if Aristotle's purpose were to prove the reality of time, we should expect explicit solutions to the *aporiai* and a demonstration with the expressed conclusion "time is real", both of which are lacking in Aristotle subsequent account of time.

To anticipate Aristotle's explicit treatment of time in chapter 11, we shall see that he begins with an account of the relation between time and motion (suggested by the *endoxa*). He next introduces the notion of before and after and their affinity to motion and time (*aporia* 1). He then turns to the divisibility of time by a durationless temporal point, i.e., the now (*aporia* 2). Finally he concludes with an extended discussion of the nature of the "now", which explicitly addresses *aporia* 3. Far from discounting the reality of time, the puzzles of *Physics* IV 10 have set the agenda of the next chapter, Aristotle's own account of time. Still we should not overestimate the results of Aristotle's use of dialectical techniques, i.e., *aporiai* and *endoxa*. They have provided us with no deeper insight into the nature or "essence" of time. We know what time is not and what attributes we think should belong to time;

however, to have scientific knowledge of time we must know *why* time has these attributes. We have this type of knowledge concerning time only when we know the essence of time. Such is the subject of inquiry for both Aristotle's next chapter and our own.

CHAPTER 5

ARISTOTLE ON TIME: DEMONSTRATIONS CONCERNING TIME AND A CLARIFICATION OF THE NATURE OF THE NOW

In Aristotle's account of time all the sundry topics that have occupied us begin to merge together. Aristotle exploits to great advantage his theory of science to show both that time is and explain what time is, and perhaps more importantly to demonstrate that a relation between time and motion exists and the reason why this relation holds. His demonstrations draw heavily on the nature of motion and anticipate at numerous points his claims concerning the continuum. Furthermore, the definitions he assumes and the problems he addresses in his account of time find their sources in the *aporiai* and *endoxa* of his preceding chapter. On almost all fronts, Aristotle's discussion of time represents a paradigm of Aristotelian scientific methodology.

A. A Recapitulation of the Syllogistic Structure of Scientific Discovery. A brief pause to recall some of the more germane points concerning the nature of a scientific syllogism would behoove us. I maintained that the demonstration, far from being simply the end in itself of science, was also a means by which more complicated scientific questions could be reduced to more tractable points of query. In this guise the demonstration provided a powerful analytic tool for undertaking scientific investigation and discovery.

The schema of a demonstration, I suggested, begins with a primitive subject, i.e., the subject genus of the science. For instance, in the case of physics the subject genus is motion. The scientist next inquires into the various derivative subjects that the primitive subject entails, i.e., what other subjects follow necessarily or *per se* from the science's primary subject genus. For example, an interval is associated with any motion; for every motion involves a terminus *a quo* and a terminus *ad quem* and what exists between these two. The scientist, following the syllogistic schema, then seeks out the *per se* predicates of the derivative subjects. In our example the physicist would consider the necessary features of the interval. For instance, an interval simply is what is bounded by two termini, or an interval is continuous, or again, the interval, in the case of motion, always involves a spatial magnitude. In the final stage the scientist lays-down (i.e., hypothesizes) the meaning or (to put the point more strongly) the definition of yet some third subject of scientific inquiry. This hypothesized definition would not be presented *de novo*, but would be hit upon after considering various *aporiai* and *endoxa* concerning the subject. For example the physicist may hypothesize that time is whatever is bounded or limited by two nows.[1] A demonstration occurs when the definition's *definiens* corresponds with one of the *per se* predicates found when considering the primary subject's derivative subjects.

We can thus summarize the content of a demonstration in the following schematic form (see footnote 62 of Chapter 2 for a discussion of the logical structure and copulae employed in demonstration):

(1) the primary subject (logical predicate) *follows upon* the derivative subject (logical subject) (according to *per se* 2 predication);
(2) the derivative subject (logical predicate) *entails* certain features (logical subject) (these features are constitutive of the derivative subject's essence and thus it entails them according to *per se* 1 predication)
//(3) the primary subject *follows upon* certain features (*per se* 2 predication)
(4) a third subject (logical subject) $\text{is}_{\text{defn.}}$ one of the features mentioned in (2) and (3) (logical predicate) (*per se* 1 predication)
//(5) the primary subject *belongs to* the third subject.

However, since the primary subject is assumed to exist, the third subject likewise must exist. From this deduction the scientist not only ascertains that the third subject exists, but also why it exists. For the derivative subject provides a necessary link between the third subject and the primary subject insofar as the derivative subject plays the role of a middle term syllogistically joining the extreme terms through various *per se* relations. Just such a schema, I contend, is driving Aristotle's own inquiry into the nature of time. We are now in a position to return to Aristotle's text and

[1] Recall our discussion of the two possible definitions of time at play within the *aporiai*, viz. the dynamic and static accounts of time.

more fully appreciate his account of time.

B. Deducing Whether *Time is. Physics* IV 10 ended with a strong statement concerning the relation of time and motion: time is *not* motion. On the other hand, Aristotle is quick to add, time does not exist without change or motion; for we never perceive time separate from change.[2]

> For whenever we ourselves do not change with respect to intellect, or we do not notice things changing, it does not seem to us that time has elapsed, just as those in Sardinia, who are fabled to sleep among the heroes, do not [think time has elapsed] when they are awakened; for they join the earlier now with the later and make them one, removing the interval because they do not perceive it. Thus, just as if the now were not other but one and the same, in the same way the interval also does not seem to be time since its [i.e., the now's] being other escapes [our] notice (*Physics* IV 11, 218b21-29).

1. An objection. On first blush the argument seems merely an assertion that since we are only aware of time when there is motion, time must be related to motion. But this assertion appears to be more a claim about us than about the nature of time. Apparently Aristotle has confused a psychological fact for an ontological one. Put differently, what justifies the following inference?

(1) We never recognize the existence of time without change.
(2) Therefore, time never exists without change.

(1) is an observation about us and our perception of time, whereas (2) is a claim about the world and makes no reference to us. At

[2] I am following Aristotle here and not distinguishing between "motion" (κίνησις) and "change" (μεταβολήν). Later (*Physics* V 1, 225a34-225b9) Aristotle distinguishes between the two. "Motion" strictly speaking is always from a subject to a subject and includes change of place, quality and quantity, whereas "change" entails not only change from subject to subject, but also includes change from non-subject to subject, i.e., generation or substantial change.

least immediately, the move from (1) to (2) seems unfounded; however, I do not think that the argument is this simple minded. Although the argument is very contracted, it can be expanded into a compelling proof *that* time is and *that* an intimate relation between time and motion holds. In section C we shall consider *why* time belongs to motion. For now let us look at the demonstration that time is and that time belongs to motion.

2. Time's Nominal Definition. To answer the objection we must lay down a tentative definition of time. Clearly we cannot hypothesize a definition in the strict sense of definition, since strictly speaking definitions give the essence of a thing and there are only essences of things which are real. Consequently, to assume the definition of a thing is to assume that it is real and thus to beg the scientific question "whether it is" (*ei esti*). We treated this apparent paradox in the chapter on Aristotelian science.[3] Aristotle distinguished between "what something means"--a nominal definition--and "what something is"--the essence or definition in the strict sense. The nominal definition merely gives some characteristic by which we would recognize the object under scrutiny should it exist. For example, the nominal definition of a "tragelaphos" is a creature that is both goat and stag. This description is not the essence of a tragelaphos, but rather only the means by which the scientist could identify a tragelaphos, should one exist. Only if the natural philosopher discovered that tragelaphoi

[3] Cf. Chapter 2, G.1, "A Dilemma Concerning Definitions and Demonstrations".

existed, would she be justified to inquire into their essence or definition.

In the same way, for the scientist to inquire into the reality of time she must lay down a nominal definition, i.e., some account such that if she discovers something that does fit the account, she can claim that time exists. In the *aporiai* and *endoxa* we encountered two descriptions of time, viz. a dynamic account and a static account of time. The dynamic account described time as the motion of a flowing now, whereas the static account described it as that which is found between two different nows. Both accounts were troubled by puzzles involving the possible reality of the now. Still the accounts of time suggested by the *aporia* about the now provided nominal definitions of time. That is to say that they gave us a place to begin investigating whether time is real.

Of the two temporal descriptions Aristotle proffered strong philosophical grounds for discounting the dynamic theory of time. One of these reasons was that if time were a type of motion, then it would be in some particular mobile, but time is everywhere and thus not in a particular mobile (218b10-13). Furthermore, if time were a motion, it would move at a certain velocity, but time does not move at a certain velocity; rather time defines velocity (218b13-18). Time for Aristotle simply is not dynamic. Consequently, if time is real, it must be static, i.e., it would not be a flow or type of motion.

Indeed, Aristotle introduces the static account of time when he discusses the fabled heroes of Sardinia (218b25-27). They did not perceive any time while they slept, because they were unaware of the interval between the moment of their falling asleep and the moment of their waking up. The point that Aristotle wants us to draw from this story is that we recognize time when we recognize the extension, or interval, between two nows. Thus it should come as no surprise when Aristotle writes: "Time seems to be what is bounded by the now; let [this] be hypothesized" (219a29-30).[4] The definition laid down is nothing other than the static account of time intimated in the *aporia* and adopted at the very beginning of chapter 11.

One may still feel that even as a nominal definition of time this account fails, since it defines one temporal notion, time, in terms of another unanalyzed temporal notion, the now. Once again a science only requires that a nominal definition be sufficient to let the scientist identify the subject under inquiry. Thus it suffices for the scientist's purpose merely that he have a "rough and ready" idea of what is meant by "now". The now, I suggest, is (or is at least related to) our immediate experience. Thus the past is what has been experienced, but not what is immediately being experienced, while the future is what will be experienced, but again is not immediately being experienced. Although Aristotle does not make this point explicitly, it explains nicely Aristotle's introduction of "what we perceive" at the beginning of chapter 11. The now on a first pass, I contend, should be identified with immediate

[4] τό γὰρ ὁριζόμενον τῷ νῦν χρόνος εἶναι δοκεῖ· καὶ ὑποκείσθω, 219a29-30.

perceptions and experiences.[5]

3. A Digressio *Concerning the Relation of the Now and Our Immediate Experiences.* Although I say more on the nature of the now in the sequel, I must briefly remark about the now's relation to our immediate experiences. That a relationship holds between the now and our immediate experiences has been observed by a number of philosophers in our century and raises the issue of our consciousness of the present. For Aristotle the now in the "strict" sense is a temporal point, or what might be called the "punctiform present". Contemporary psychologists and philosophers alike have observed that humans are simply physiologically incapable of perceiving a temporal point (or even very short durations of time below a certain experimentally determined threshold), but rather human perception always involves some duration of time. William James has christened this minimum duration of time necessary for perception the "specious present", since it is not the "real" now, i.e., temporal instant, which for James, as well as Aristotle, was the now in the strict, philosophical sense.[6]

One may think that since James' "discovery" of the specious present was based on psychological experiments that were not available to Aristotle, Aristotle would be ignorant of the specious

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[5] Cf. A. Grünbaum's "The Status of Temporal Becoming" [in *The Philosophy of Time*, ed. R. Gale (London: MacMillan, 1968): 322-354] where he describes "the present or now as an attribute of events which is encountered in *perceptual* awareness." Also see his *Philosophical Problems of Space and Time* [New York: Alfred A. Knopf, 1963], ch. 10 "Is There a "Flow" of Time or Temporal Becoming" (pp.314-329).

[6] Cf. William James' *Principles of Psychology*, vol. 1, ch. 15

present. Furthermore, since Aristotle had arguments showing that the now was a temporal point, one might again assume that Aristotle was ignorant of the specious present. One would also be wrong in this assumption. Aristotle, despite his lack of experimental data, had philosophical reasons for positing that our perception of the present must always involve some duration or time, even if the present properly understood is punctiform or a temporal point.

Aristotle does not specifically give an argument that our immediately perceived experiences must involve a duration, but rather more generally he argues that every object of perception has a magnitude. The argument, which is given in terms of spatial magnitudes and points, is found at the end of *Sense and Sensibilia* (449a20-b5). It runs as follows: in an interval of spatial magnitude there is an extreme, after which an object is no longer perceptible but before which the object is perceptible (449a25-27). If any perceptible object were also indivisible, then if that object were placed in this extreme whence imperceptibility ends and perceptibility begins, then the indivisible perceptible object would both have to be perceptible and imperceptible at the same time, which is impossible (449a30-31). Since the assumption of a perceptible indivisible leads to an absurdity it must be rejected and consequently, concludes Aristotle, all perceptibles possess a magnitude.

We can construct an analogous argument for the now or the present. The now is an extremity between the past (no part of the future being on this side of it) and future (no part of the past being on that side of it) (from *Physic* VI 3). If we were to perceive the now, strictly understood, where past ends and future begins, we would perceive (not remember or divine) the past and the future together; but this is impossible. Therefore the perceived now, or our immediately present experiences, are not of a punctiform present, but rather of a specious present, i.e., an extended now.

Two points are to be made. First, Aristotle's argument *does not* show that the now is extended, but only that our immediate perceptions involve a duration of time. The now in the strict philosophical sense for Aristotle is still dimensionless. Second, although we cannot directly perceive the now *qua* punctiform present, we can still be aware of the now, whereby "aware" I mean that our perception of the present inalienably involves or includes the temporally dimensionless present. Thus, for example, according to Aristotle's argument above we cannot directly perceive the dimensionless points that are the termini of a line segment; nevertheless, we certainly are aware of these extremities; for we cannot perceive a line segment without in some way being aware of its two termini. Indeed, it is on account of being aware of these extremities that we perceive the line as a segment and not as an infinite line. Similarly, any immediate perception involves the now in the strict sense, i.e., a durationless instant. Furthermore, conceptual analysis of the strict sense of the now, such as the one offered at *Physics* VI 3, indicates that any extended present is only called present by its possession of the now in the strict sense, i.e., the punctiform present.

In short, Aristotle would have been sympathetic to a doctrine of a specious present, albeit for reasons far different from those provided by James and other twentieth-century philosophers and psychologists. Nevertheless, even though we are only conscious of a specious present, that is not to say that our immediate perceptions or experiences do not include a punctiform present of which we are aware. This last point is important for what follows; for as I interpret Aristotle, one's being aware of two different immediate perceptions and the interval between them, is for one to be aware of two distinct nows and the interval between them and thus of time itself.

4. The Proof that Time Is. The grounds for a scientific deduction of time's necessary link with motion, and consequently a proof for the reality of time, have been laid. Recall the analysis of the essence of motion. Whenever we perceive motion, there necessarily is some prior state of which we had immediate experience, i.e., the terminus *a quo*; there is also some posterior state of which we have immediate experience, i.e., the terminus *ad quem*; and finally there is the interval between these two. The now, I suggested, is roughly equivalent to that of which we have immediate experience. Hence the initial state of the mobile marks off a prior now *qua* perception of a prior state, and the final state of the mobile marks off a posterior now *qua* perception of a posterior state. Moreover, our awareness of the interval *qua* experience of the motion in between these two states is of an interval bounded at either extreme by a prior and posterior now, i.e., our immediate perceptions of the motion's termini *a quo* and *ad quem*. Time though is what is bounded by the now. Therefore if we are aware of motion, there must be time. That the natural philosopher inquires into motion and takes it to be real is assumed by the science of physics. Consequently time is real.

Formally the syllogism looks like this:

(1) Our perception of motion (pred.) *follows upon* the experience of a prior state and posterior state of a mobile and the interval between them (subj.). (*per se 2* predication holds between the terms; for the subject term makes clear the essence of the predicate term);
(2) a prior and posterior now, and an interval in between them, is essentially the same as the experience of a prior state and a posterior state of a mobile and the interval between them (*per se* 1 predication from the nominal definition of the now);
//(3) our perception of motion (pred.) *follows upon* there being a prior and posterior now and the interval in between them (subj.);
(4) Time is the interval between the now (nominal definition of time)
//(5) our perception of motion *follows upon* there being time.

Not only has the syllogism demonstrated the reality of time, but also it has provided an explanation of how Aristotle moves from a psychological fact about ourselves (viz., whenever we perceive motion, we perceive time) to an ontological claim about the world (viz. whenever there is motion, there is time). For us to perceive motion we must be aware of prior and posterior states and the interval in between them; however, we are aware of these states because they are ontological facts about the nature of motion. Furthermore, we are aware of time only if we perceive an interval bounded by two nows. Since such a state exists when we perceive motion, and motion has its ontological basis in reality, so must time. Stated in its simplest terms: we perceive time and motion together because time and motion really are together. Time, then, belongs to motion.

If one feels that this demonstration provides no real explanation about the relationship between time and motion, she would not be far from the truth. This demonstration is intended only to show *that* a relationship holds. As such, it moves from what is better known to us (i.e., our immediate perceptions) to what is better known by nature (i.e., the nature of time and motion). Still the demonstration has shown that time belongs to motion, and consequently, since motion is real, time must also be real. The next section answers the scientific question *why* time belongs to motion.

C. The Reason Why *Time Belongs to Motion.* Aristotle has proven that time is real because it belongs to motion; for since motion is real, so must time be real. In fact, the middle term of the syllogism, viz., "the interval between the prior and posterior nows," provides the reason why time belongs to motion. And indeed immediately next in the text Aristotle explains how this middle term links the two extremes.

> Since the mobile is moved from something to something and all magnitude is continuous the motion follows upon (*akolouthei*) the magnitude (219a10-12); for on account of the magnitude being continuous the motion is also continuous, while on account of the motion [being continuous] the time [is continuous] (219a12-13); for the time always seems to have passed just as much as the motion [has passed] (219a13-14). Now the before and after are primarily in place. [They] are in [place] by means of position (219a14-16), but since the before and after are in magnitude, it is also necessary that they be

> in motion in proportion to them [in magnitude] (219a16-18). But indeed the before and after are also in time because the one of them [i.e., time] always follows upon (*akoluthein*) the other [i.e., motion] (219a18-19). The before and after in the motion are, on the one hand, that which the motion is at any time (*ho men pote on kinîsis*),[7] however their being is different and not motion (219a19-21). Now indeed we know time whenever we mark off the motion by marking off before and after; and we say then that time has elapsed whenever we grasp a perception of the before and after in the motion. So we mark them off by understanding they are other and other and that a certain interval is different from them; for whenever we recognize that the extremes are other than the middle and the soul says that the nows are two--on the one hand before and on the other after--then we also say that there is time; for what is marked off by the now seems to be time; let this be laid down (219a21-30).

In broad strokes, this passage has two stages. The first is 219a10-18, where Aristotle observes that a certain relationship holds between spatial magnitude and motion, such that particular features belonging to spatial magnitude likewise belong to motion. The mapping technique mentioned in our chapter 3 best explains the relationship between spatial magnitude and motion. We should also note that the use of *akolouthei* suggests that the relationship is causally explanatory according to *per se* 2 predication. The second stage is found at 219a18-19, where Aristotle, using the mapping technique, indicates how distinctions within spatial magnitude mark off befores and afters in the motion. Perceptions or experiences of different states of the mobile (i.e., an awareness of the mobile in different spatial locations) and also the interval between these perceptions follow upon the different befores and afters in the motion. Time, Aristotle hypothesizes, just is the interval extending

[7] See §F.2 in this chapter for a discussion of the locution ὅ ποτε ὄν.

between two nows, but, as we have seen, the now can be identified with, or at least closely related to, our immediate perceptions or experiences. Once again, Aristotle's use of *akolouthei* to describe the relationship between motion and time intimates that the relationship is causally explanatory according to *per se* 2 predication.

Let us now consider the argument in detail. First, as a note, Aristotle has cast his entire discussion in terms of locomotion. Thus one may fear that Aristotle's account of time is limited to locomotion and not necessarily applicable to other types of motions, such as alteration, augmentation and the like. Such a restraint, however, does not limit his account of time to locomotion only. For as we saw in chapter 3 locomotion is the primary type of motion and all other forms of motion (taken in the strict sense, i.e., excluding substantial change) are impossible without there being locomotion.[8] Consequently, to show that time belongs to locomotion is to show that time belongs to all motion; for all motion in some way entails locomotion.

Concerning locomotion, 219a10-12 tells us that all motion is from something to something. Aristotle's observation in this passage, I take it, is that locomotion requires or follows upon there being some distance or spatial magnitude which is traversed; for

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[8] Cf. chapter 3, section D, "The Relation of Motion to Spatial Magnitude". The general argument there was that increase and decrease (motion in respect of quantity) are not possible without alteration (motion in respect of quality); but alteration requires the agent to draw near in order to actualize the potential; however "to draw near" is locomotion (VIII 7, 260a26-b14).

locomotion just is motion from one spatial location to another. Hence distance, or spatial magnitude, is ontologically prior to motion. Furthermore, since spatial magnitude makes clear the essence of locomotion, locomotion *follows upon* spatial magnitude; a *per se* 2 relation hold between the two.

219a12-18 foreshadow the "mapping technique" developed at *Physics* VI 1.[9] By anticipating this technique Aristotle can infer that if the spatial magnitude is continuous, then so is the motion (219a12-13). Furthermore, 219a13-14 provides a presumption (which awaits full explication at 219a21-30) that time is a magnitude which follows upon motion as motion follows upon spatial magnitude. Thus Aristotle concludes that time likewise is continuous. The mapping technique, which Aristotle briefly limns at 219a14-18 and develops fully at *Physics* VI 1, explains why divisions marked off in a spatial magnitude also mark off potential or imaginary divisions in the motion. These divisions in the motion, according to the mapping technique, in turn mark off potential or imaginary divisions in the magnitude following upon the motion, i.e., time. For to be continuous and thus potentially divisible at any position on the magnitude belongs to the nature of spatial magnitude. Consequently, when a mobile traverses a spatial magnitude, analogous divisions can

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[9] Cf. chapter 3, section E, "The Continuum". His general strategy at *Physics* VI 1 (231a21-232a22), where he discusses the continuum, is first to demonstrate that spatial magnitude cannot be composed of indivisible units or points; and second to show how one can map motion or the time of a motion on to spatial magnitude in a one to one correspondence. Thus for any point in the magnitude (whether actual, potential or imaginary) there will be a corresponding point in the motion or time, and vice versa.

be marked off in the motion insofar as the mobile is (or was) at some before position and then at some after position.

We should be careful to note the emphasis of text 219a14, viz., that the before and after are primarily in place (*topos*) and they are in place on account of position (*thesis*). The divisions in the motion follow upon the mobile's occupying different places or positions along the spatial magnitude and they are the results of corresponding divisions belonging primarily to the spatial magnitude. For example, if I were to travel direct from Washington D.C. to New York City, I could mark off divisions in the train's motion as it passed through Philadelphia, Newark, etc.. Although the divisions or points are primarily in the spatial magnitude, there would also be corresponding points or divisions in the motion, which follow upon the mobile's being at certain places on the spatial magnitude. Consequently, the points in the motion can be ordered as either before or after by reference to the actuality and potentiality of the mobile; and the actuality and potentiality of the mobile are themselves explained in terms of the location of the mobile on its trek across the spatial magnitude.[10] Simply stated, certain

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[10] Conceptually this point is one of the most difficult; for although we might grant there is an essential ordering of before and after in motion, no such *essential* ordering exists in spatial magnitude, but rather there is only a relative ordering. From my vantage point one tree is before another, but from my neighbor's the ordering of the trees is reversed. Aristotle's move is to observe that the essential ordering in the motion is due to the proportionality of motion to spatial magnitude. What is potential in the motion corresponds with what is before in the spatial magnitude (relative to the direction of the motion), and what is after corresponds with what is actual. The mobile will be in whatever state of actuality it is in due to its location in the spatial magnitude. Aristotle's point becomes graphic if we once again consider my trip from D.C. to New York. I cannot have actually passed through Newark without first having

divisions exist principally in spatial magnitude, where these divisions correspond with different spatial locations in the spatial magnitude. These spatial divisions in turn can mark off divisions within motion, where the divisions in motion correspond with different actualities and potentialities, viz., actually being spatially located here or potentially being spatially located there. Motion thus follows upon spatial magnitude and consequently certain features belonging to spatial magnitude can be "mapped on to" motion.

219a19-19, and again at 219a21-30, presents a similar scenario for time. Time, we have hypothesized, and Aristotle explicitly asserts at 219a29-30, is that which extends between two nows. Furthermore, we have observed that the now corresponds with our experiences of various states. Let us consider these various states of a mobile. We only recognize that there are two distinct states, when we have an experience of some one thing as F and then another experience of it as not-F. For example, we experience a ball first in one spatial location, F, and then not at F, but in another location, G. Such an experience, however, is just to recognize a ball in one state of actuality and then in a different state of actuality, but we have seen that to recognize these differences is just to recognize the ball as having distinct spatial positions--one

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actually passed through Philadelphia; thus my potentially passing through Newark requires that I actually have passed through Philadelphia. I can only actually be at New York because I actually passed through the various locations along the way; for if I could actually be in New York without actually having passed through these location, there in fact would not be a one to one correspondence between the motion and distance; the two would not be proportionate. The ordering of the location in the spatial magnitude determines, or is explanatory of, the ordering in the motion.

spatially before and the other spatially after. Therefore, when we see the ball roll across the floor, we are aware of the ball's change in position. First it is at one place on the floor and then it is at a different place. These different positions indicate different states of the moving ball and consequently the different positions mark off distinct befores and afters within the motion according to the different positions through which the ball passes. The befores and afters belong to the motion as potential divisions within the motion, but they are substantively different from the motion itself. Or in Aristotle's terse vocabulary: "the before and after in the motion are ... that which the motion is at any time [i.e., the motion's states]; however the being belonging to [the before and after] is different and not motion" (text 7). Consequently, we can mark off temporal befores and afters by marking off distinct states of potentiality and actuality in the motion, which are themselves marked off by distinct spatial positions of the mobile during its traversal of a spatial magnitude. Once again we must note that whatever divisions we mark off in either time, motion or spatial magnitude ultimately are referred back to positional divisions within the spatial magnitude.

Aristotle next summarizes the points made above and then makes explicit the middle term explaining why time belongs to motion.

> Therefore, it seems that no time has elapsed whenever (1) we perceive the now as one, or (2) [we do not perceive the now] as the before and after in the motion or (3) [we do not perceive the now] as the same thing [belonging to] some before and after because [in these cases] neither is there motion. But whenever [there is] before and after, then we say that there is time;

> for this is time the number of motion according to before and after (219a30-219b2).

The beginning of this passage delineates three conditions which must be met for time to have elapsed: (1) we cannot grasp the now as one; (2) we must be aware of the now in relation to a before and after in a motion; and (3) the before and after must have been marked off by the same element (219a30-33).

Condition (1) captures the intuition that no time passes in an instant. Time is the extension between the now; hence if the now is taken as one, there will be nothing which corresponds with time. Although we shall speak more fully about the manner in which the now cannot be one below, a brief comment should be made here concerning the different ways of using "one" (*hen*). At *Metaphysics* V 6 Aristotle distinguishes between being one *per accidens* and being one *per se*. A thing is one *per accidens* when one of the parts in the account is an accident of the other (1015b24-25). Aristotle gives the example of the musical Coriscus, but we could just as easily consider Coriscus in the market as an instance of something being accidentally one; for in both cases an accident (musical or being in the market) is predicated of some subject. On the other hand, a thing is one *per se* in at least one way, if the account that states what it is to be one thing is not different from the account that makes clear what it is to be some other thing (1016a32-34). Aristotle gives the example of something that either increases or diminishes. The example is not particularly illuminating; however, I take him to mean that if we were to consider, for example, a straight line that we extended from one meter to two meters, the line is one *per se* since the account that states the essence of the one meter line is the same as the essence of the two meter line, viz., a breadthless length that lies evenly with the points on itself. Thus returning to condition (1), when we grasp the now as one in *both* the *per accidens* and *per se* senses of one, only then does it seem that there is no time. Consequently, to know the now as not one, regardless of whether we are aware of it as not one in either the *per se* or *per accidens* senses, is sufficient for there to be time. To be more exact, we need merely be aware of the now as not one *per accidens*, even though it may still be one *per se*, for us to perceive time. We shall return to this point in the sequel.

Condition (2) specifies what type of before and after are necessary for there to be time; for there are many ways one thing can be before or after another. At *Metaphysics* V 11 Aristotle presents us with a lengthy list. One thing can be before another in place, time, movement, power, arrangement and the like. Thus the mere awareness of a before/after relation does not guarantee that time has elapsed. For example, I can know that 30th Street Station is before Suburban Station, but surely no time is involved due to this mere spatially before and after relation. Thus in order to say that some time has elapsed we must grasp the before and after in some motion.[11]

[11] Once again, the before and after in the motion are ontologically dependent upon the before and after in spatial magnitude; nevertheless, the before and after in spatial magnitude are not sufficient to account for time.

Condition (3) restates (1), but with an added caveat: that by which we mark the before and after in motion must be one and the same. This point becomes clear if we imagine a possible criticism. Consider two trains, one leaving from New York to Philadelphia and the other from Philadelphia to New York, both leaving promptly at 8:00 am. Now the New York train's departure marks off one endpoint of a motion and the Philadelphia train's departure marks off an endpoint for a different motion; consequently we have two distinct endpoints. Yet no time has passed, since both trains leave sharply at 8:00 am. Another example is that of a somewhat contrived relay race, where runner A stops immediately upon passing the baton to runner B and runner B only begins running the instant she receives the baton. The moment the baton passes hands would mark off the end of A's motion, but the beginning of B's motion. Certainly A's ceasing to run is distinct from B's beginning to run, yet no time has elapsed. In both instances the alleged criticism has emerged because we considered two distinct motions; however, if we limit ourselves to one motion, or "the same thing in relation to a before and after" (219a32), we guarantee that whenever we are aware of two distinct nows, we perceive time.

219a33-b1 provides the reason why (or the causal explanation why) time belongs to motion, viz., time and motion are causally linked through the before and after. Conditions 1-3 present the requirements for there to be time, i.e., there must be different befores and afters. 219a33 observes that the same conditions are required, if there is to be motion; motion, thus, *follows upon* before and after; for these are required if there is motion. 219a33-b1 then points out that before and after *belong to* time as elements defining its very essence; for time had been laid down as the interval between nows, where Aristotle cashes out "nows" in term of befores and afters belonging to motion. Consequently, time belongs to motion according to before and after, where before and after indicate the middle term that links the two extremes.

This demonstration of the reason why time belongs to motion is succinctly captured by Aristotle's canonical definition of time as the *arithmos* of motion according to before and after. *Arithmos* here designates the interval or extension between the before and after. This point must be explained. Literally, *arithmos* means number or even quantity, but in a more loose sense it also means the numerical aspects, where a "numerical aspect" is that through which a thing is enumerated or measured. This latter sense, I believe, is what Aristotle wants us to understand by *arithmos*. This reading finds support first in the text. For we are told that *arithmos* can be taken in two ways: either (a) what is counted or countable, or (b) that by which we count (219b6-7). Time, Aristotle continues, is an *arithmos* in the former sense, i.e., as what is countable (219b7-8). Furthermore, taking *arithmos* as numerable aspect corresponds well with Aristotle's own formal definition of *arithmos* as a collection of units or indivisibles or ones (*Metaphys.* X 1, 1053a30; *Metaphys.* XIII 9, 1085b22; and *Phys.* III 7, 207b7). The unit in turn is defined as that which is posited as indivisible for the purposes of counting in the category of quantity (*Metaphys.* XIV 2, 1089b35).[12] Thus an *arithmos* for Aristotle would be a set or group of indivisibles all of which possess the capacity of being numbered. In our chapter 3, however, we observed that the indivisible of the mathematician need not be actually indivisible, but merely something posited as indivisible for the sake of counting. For example, on a continuous length some segment can be posited as indivisible such that the rest is subsequently measured by that length, just as one meter can be posited as an indivisible unit by which a hundred meter road is measured. Moreover, we saw in the same chapter that motion could be divided by positing divisions in the magnitude of the motion. Consequently, a measure or number (*arithmos*) belongs to motion on account of its continuous quantity. Motion can be treated as a continuous quantity, however, because it entails an interval between a state of potentiality and a state of actuality, viz., between a before and after. Therefore, a numerable aspect belongs to motion on account of before and after. Time, Aristotle now observes, just is that numerable aspect belonging to motion on account of before and after.

D. Summary and Formalization of Aristotle's Demonstration of the Relation between Time and Motion. We saw earlier the underlying demonstration that time is and that time belongs to motion. We have

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[12] Cf. the appendix "Aristotle's theory of Mathematics", § 3. "Aristotle's Theory of Number"; also cf. J. Klein, *Greek Mathematical Thought and the Origin of Algebra* (New York: Dover Publication, Inc., 1992), 106ff..

just finished exploring the explanation for this relation. Let us now consider the syllogistic structure that underlies and directed Aristotle's inquiry into the relation of time and motion. As an initial caveat, I am *not* suggesting that the syllogistic structure of Aristotle's discussion, which I shall limn, is what Aristotle actually intended to say, but in a more rigorous manner. Aristotle's actual account is sufficiently rigorous. Rather, my reconstruction testifies to an underlying schema that would have directed Aristotle's research respecting time. The structure of the underlying argument is this:

(1) motion (pred.) *follows upon* continuous quantity;
(2) but a continuous quantity (pred.) *belongs to* an extension between some before point and some after point;
(3)// therefore, motion (pred.) follows upon an extension between some before point and some after point;
(4) but time (subj.) $\text{is}_{\text{defn.}}$ what extends between some before point and some after point (pred.);
(5)// therefore time (subj.) belongs to motion (pred.).

We can extend this conclusion and get something closer to Aristotle's own account if we note that:

(3.5) the extension between some before point and some after point is_{defn} the *arithmos* or numerable aspect of a continuous quantity;
(4) but time (subj.) $\text{is}_{\text{defn.}}$ what extends between some before point and some after point (pred.);
(5´)// consequently, time is the *arithmos* or numerable aspect of a continuous quantity, viz., motion.

The first premise in any scientific deduction begins by stating upon what the predicate of the ultimate conclusion follows. Since the subject term makes clear what it is to be the predicate term the two are related according to *per se* 2 predication. The ultimate conclusion in our case is: time (subj.) belongs to motion (pred.) on account of some middle term. Thus, from the mere logical structure of the syllogism Aristotle would know that premise (1) must be of the form: motion (pred.) *follows upon* x (according to *per se* 2 predication). Aristotle's analysis of motion revealed that it in fact followed upon magnitude, or continuous quantity, according to *per se* 2 predications; for magnitude makes clear the essence of motion. Thus he arrives at premise (1).

The second premise in a demonstration considers the attributes or predicates that belong to the subject term of the first premise. These attributes state the essence of the new predicate term and thus hold according to *per se* 1 predication. Thus, having learned that motion follows upon continuous quantity, Aristotle would recognize, from a purely logical point of view, that the next premise is of the form: a continuous quantity *belongs to* y (according to *per se* 1 predication). To be the extension between some before point and some after point defines a continuous quantity. Thus premise (2) has been obtained.

To this point we have worked our way down logically from the predicate of our ultimate conclusion, which in this case was motion. We obtain premise (4) by working our way up from the subject term of our ultimate conclusion, viz., time. The premise must have the logical structure: time *is hypothesized* (i.e., set down) as z. The premise, since it is a definition, involves *per se* 1 predication. Aristotle ultimately hypothesizes that time is what is found between the now; however, it is a short step from "what is found between the now" to "the extension between some before point and some after point". Aristotle himself did not explicitly make the link, although I suggested above how one could move from the now to points which are before and after. This absence is not so much a demerit in Aristotle's argumentation as a testimonial that Aristotle's mode of presentation is not syllogistic even though the motivating reasoning underlying it is.

Premise (3.5) in our extended argument was already suggested by (2). It merely observes that with respect to continuous quantities "*arithmos*" (or "numerable aspect") is understood in terms of "the extension between some before point and some after point." Thus it does not substantively change the structure of the argument.

We now conclude syllogistically that time belongs to motion, or, in the more completed form, time is the numerable aspect of motion. Moreover, all the terms of each premise are related to one another according to one of the forms of *per se* predication mentioned at *Posterior Analytics* I 4, and thus the relation of time to motion has been demonstrated. Finally, the appendage of "according to before and after" at the end of Aristotle's formal definition of time makes clear the middle term by which time is linked to motion.[13]

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[13] As a provocative aside we notice that all the elements necessary for a demonstration of the relation between time and motion are present in Aristotle's definition of time as the number of motion according to (*kata*) before and after. In fact in the *Posterior Analytics* Aristotle had given as one account of definition that it is a syllogism of what something is (*ti esti*) differing only in mood (i.e., arrangement of the premises) from that of a demonstration [93b38-94a10, 94a12-13]. Such a definition states the reason why, usually indicating it with the Greek preposition *dia* (because of) or *kata* (on account of). The

E. Is Aristotle's Account of Time Circular? Richard Sorabji and others have complained that Aristotle's definition, and in fact his entire account of time, is circular.[14] Sorabji commends Aristotle's herculean attempt to explain the "before and after" in time's definition" in terms of spatial before and after. Yet in the end, bemoans Sorabji, Aristotle's defence is "regrettably unsound. For we distinguish two positions as before and after (as opposed, say, to here and there), only if we have in mind an imagined movement such that the moving objects is temporally before at the position we call 'before' and temporally after at the position we can 'after'."[15]

There is certainly some truth in Sorabji's observation that Aristotle's definition must in one sense entail the notion of a temporal before and after. For if the before and after in time were not temporal befores and afters, we would be hard pressed to say how time arises from, say, heres and theres. Still, the question is not whether Aristotle employs temporal notions of before and after in his definition of time; but rather, whether he can give an explanation of before and after in non-temporal terms. For if the temporal notions of before and after can be accounted for in a non-temporal vocabulary, the charge of circularity is avoided, since Aristotle's definition of time would not ultimately be grounded in unanalyzed temporal terms.

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definition of time has just this arrangement.

[14] Sorabji, *Time, Creation, and the Continuum* (Ithaca: Cornell UP, 1983), 86; also cf. Denis Corish, "Aristotle's Attempted Derivation of Temporal Order from That of Movement and Space" in *Phronesis* XXI (1976): 241-51

[15] *Time, Creation, and the Continuum* (Ithaca: Cornell UP, 1983), 86.

Aristotle has provided us with the necessary explanation of temporal before and after in non-temporal terms. When we recognize motion, although we are clearly aware of a temporal before and after, as Sorabji claims, we are aware of them because we remember the mobile in a state of potency and then in a state of actuality. In other words, the temporal before and after *follow upon* the mobile's states of potency and actuality. The potency and actuality of the mobile make clear what it is for a temporal before and after to be. Consequently, the temporal notions of before and after are ultimately explained in non-temporal terms of actuality and potentiality. Furthermore, the notions of actuality and potentiality are cashed out in spatial terms. For all motion entails some locomotion, and all locomotion requires a spatial magnitude over which it traverses. Thus whenever there is motion, i.e., a reduction of potency to actuality, a mobile traverses a spatial magnitude and consequently at any state of the mobile, it is spatially located either here or there. That is to say that the state of potency or actuality of the mobile *follows upon* its spatial situation. In a nutshell, temporal befores and afters follow upon the potentiality and actuality of a mobile, which in their turn follow upon the spatial befores and afters of the mobile. Therefore, even if time is the numerable aspect of motion according to *temporal* befores and afters, the definition is not circular since Aristotle can, and indeed does, give a non-temporal account of these temporal befores and afters.

F. Aristotle's Theory of the Now. Aristotle's discussion of time has relied heavily on the notion of the now and yet Aristotle has only made passing remarks concerning it. Let us attempt to fill in the lacunae. For only in grasping the nature of the now can we hope to resolve the paradoxes surrounding the now and thus render Aristotle's account of time viable.

After distinguishing between the two senses of *arithmos*, i.e., as what is counted and that by which we count, Aristotle begins addressing the difficulties that arose in the preceding chapter concerning the nature of the now.

> Just as motion is always other and other (*allê kai allê*), so also is time (219b9-10), whereas all simultaneous (*hama*) time is the same (219b10); for the now which at any time is is the same, while its being is different, and it is the now which marks off time *qua* before and after. So the now is thus the same, but thus not the same; for *qua* in the other and other it is different (and this belongs to its being the now), while the now which at any time is is the same (219b-15). For as was said, the motion follows upon the magnitude, whereas as the time [follows upon] this [i.e., the motion], just as we asserted (219b15-16). Indeed similarly the mobile (*to pheromenon*, i.e., what is being moved locally) [follows upon] the point (*stigmê*), by which [i.e., by means of the point] we know the motion and the before and after in it [i.e., the motion] (219b16-18). This which at any time is is the same (for the point is either a stone or something else of this sort) (219b18-19),[16] but it is different in account, just as the sophists assume Coriscus in the Lyceum is different from Coriscus in the market. Indeed this being in one place then another is different (219b19-22). But the now follows upon the mobile (*to pheromenon*), just as time [follows upon] motion; for we know the before and after in the motion by means of the mobile, but the now is the before and after *qua* numerable (219b22-26). Hence, in these that which at any time is is the same (for the before and after are in the motion), whereas, the being is different (for the now is the before and after *qua* numerable). And this is known best; for the motion is known

[16] I am following a suggestion made by G.E.L. Owen (fn. 32 in "Aristotle on Time" in ***Articles on Aristotle: 3. Metaphysics***). He amends 219b19 from Ross' "ἣ στιγμὴ γὰρ ἢ λίθος ἤ τι ἄλλο τοιοῦτόν ἐστι" to "ή στιγμὴ γὰρ ἢ λίθος ἤ τι ἄλλο τοιοῦτόν ἐστι".

> because of what is moved (*kinoumenon*) and locomotion (*phora*) because of the mobile (*pheromenon*); for the mobile is a this, while the motion is not. Therefore on the one hand the now is thus the same, but on the other it is thus not the same; for [the same is true of] the mobile (219b26-33).

The vocabulary of 219b9-15, especially *allê kai allê* and *hama*, harken us back to the paradoxes concerning the now in *Physics* IV 10. There the questions were: first, when would the now change if it were other and other (*allê kai allê*) (218a11-21)? And second if the now were one and the same, would not all time be simultaneous (*hama*) (218a25-30)? 219b10-15 presents Aristotle's solution to the paradoxes in a nutshell: the now has a bipolar nature. Therefore, in one sense the now is different, and thus explains away the problem of simultaneity, but in another sense the now remains the same, and thus there is no question of when the now changes.

The dual nature of the now comes from the fact that, although the now itself is not other and other (*allo kai allo*) it is in what is other and other (*en allô$_i$ kai allô$_i$*) (219b13-14). Consequently, certain features belong to the now accidentally insofar as it is in the other and other, where the other and other is motion. The now's nature becomes clearer if we consider the relation between the point, the mobile and the now. An analysis of this relation is similar to that given for magnitude, motion and time, as 219b15-16 confirm. Thus just as motion *follows upon* magnitude and time *follows upon* motion, so we shall see, the mobile *follows upon* the point and the now *follows upon* the mobile.

1. The Dual Nature of the Now: the Mobile. We must begin by contextualizing the term "point" (*stigmê*). When Aristotle speaks of the "point" at 219b16-18, we should understand him to mean the so called "before" and "after" within spatial magnitude, but these befores and afters were just the various locations in the spatial magnitude. I take this contextualization to be the intention of 219b18-19, where we are told the point is a stone or some other spatially located object. Thus Aristotle is not using "point" necessarily to indicate a mathematical point, but rather the different places in the distance through which the locomotion takes place. Of course if we sufficiently mathematize Aristotle's account such that we indicate the spatial magnitude by a mathematical line, the various places in the magnitude are represented by mathematical points. The account, however, does not demand that we take "point" in this strict sense.

Returning to the relation of the point, the mobile and the now, we are told that the relation is similar to the one that holds between magnitude, motion and time (219b15-18). Motion, we recall, required spatial magnitude as that *through* which motion takes place and as such it is prior to motion. Similarly, the mobile, which is able to be moved by definition, must be in a place; for, as Aristotle observes in his account of place, although everything that *is* need not be in place, every thing that *is able to moved* must be in a place (208a29-30; 212b29). Hence, in order for there to be a mobile, there must be the place in which it is, or which it occupies. Therefore, 219b16-18 tells us that the mobile *follows upon* some spatial point.

Consequently, place or spatial location is prior to the mobile. Thus we see a similar structure between the way motion requires spatial magnitude and the way the mobile requires place or a point. Spatial magnitude is that *through* which motion occurs; the point is that *in* which the mobile is. In both cases the latter requires the former.

Furthermore, 219b22-26 observes that a certain magnitude follows upon motion, and similarly certain potential divisions follow upon the mobile insofar as the mobile is at various places in the magnitude over which it is carried along. The now, however, is understood as that which divides past time from future time.[17] Hence the now belongs to the mobile in exactly the same way that time belongs to motion. For a certain magnitude according to before and after follows upon motion, and time just is a magnitude according to before and after. Likewise, a certain division into before and after follows upon the mobile, and the now just is a division into before and after.

The now's relationship to the mobile ultimately gives rise to its bipolar nature, as 219b19-33 attempts to make clear. "Mobile" is a single term designating a compound notion, viz., a moving object.[18] Hence, a mobile has certain characteristics that belong to it insofar as it is an object and other characteristics insofar as it is moving.

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[17] The criticism that one temporal notion is defined in terms of another temporal notion, i.e., the now in terms of future and past time, is avoided in the way suggested above; for we explain past and future time in terms of actuality and potentiality, where potentiality corresponds to the future and actuality to the past. Potentiality and actuality are in turn clarified in relation to spatial befores and afters relative to a motion.

[18] Cf. *Metaphys.* VII 4-5.

Its most obvious characteristic *qua* object is that it remains one and the same through the motion. This is the point of 219b19-22. Coriscus at the Lyceum and Coriscus at the market is the one and the same person; he does not become a different person when he changes locations. On the other hand, there is a sense in which Coriscus in the market and Coriscus at the Lyceum are different; for the way that he is described is different and even the way he is, at least accidentally, is different (for when he *is* at the market, he *is not* at the Lyceum). These differences are accidental ones belonging to the object due to location; however, the object is in different locations because it is moving. Therefore, the mobile *qua* object remains one and the same, while *qua* moving, it is different. We can analyze the mobile along these lines since it is a single term designating a compound concept, i.e., a moving object.

The "now" likewise designates a compound notion, viz., the extremity or division between past and future *belonging to* motion.[19] The now *qua* extremity belongs to the mobile *qua* object. For insofar as the mobile is an object, it must be in a place, or at a point, and thus it divides the motion into actual and potential (and consequently, past and future), which is what it is to be a now.

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[19] Aristotle actually uses the locution "in motion" for my "belonging to motion". I have chosen my phraseology since it captures Aristotle's intent while avoiding the confusion inherent in the English phrase "in motion". When we say something is "in motion" we normally mean that it is moving. This understanding of "in motion" is not what Aristotle has in mind. For x to be *in motion*, according to Aristotle, means whenever x is, there must also be motion (*Phys.* IV 12, 221a25). Since the now requires the mobile and the mobile is undergoing a motion, anytime there is a now there is motion; and hence the now is *in motion*, although not moving.

Therefore, the now, insofar as it belongs to the mobile *qua* object, remains one and the same, viz., an extremity or division between past and future. On the other hand, the now *qua* belonging to motion, i.e., as what is in the other and other, is related to the mobile *qua* moving. Thus insofar as the mobile is at various locations there are different conceptual divisions in the motion; however, by means of these divisions in the motion we can describe the now in different ways. These different ways of describing the now indicate accidental differences in the now. So, for example, the hands on my watch are mobiles. Thus in one sense they remain the same during their circuit around the face of my watch; they never cease to be watch hands. In another sense they do change; for when they are in one position I can characterize them as 12:00:00, and then a different position as 12:00:01, and so forth.

2. The Dual Nature of the Now: ho pote on. The same point about the dual nature of the now is made through Aristotle's use of the *ho pote on* locution, which I have translated "that which at any time is." If we look at Aristotle's employment of *ho pote on* in other scientific texts, we see that it indicates something which is essentially x, while accidentally not-x. For instance, in the *Parts of Animals* Aristotle exploits the phrase *ho pote on* in reference to blood (649a15-28). We are told that blood is a complex notion such as "boiling water" or "white man"; for blood is a "hot nutritive-fluid".[20] That a hot nutritive-fluid must be hot is evident. On the

[20] The phrase "hot nutritive fluid" is not Aristotle's, but it does correctly

other hand, *that which at any time* is the blood, i.e., the nutritive-fluid, is not hot *per se*; for it belongs *per se* to a fluid to be cold. Consequently, the blood is actually hot (even though accidentally) on account of some external influence, whereas it is potentially (even though essentially) cold on account of being a fluid. Similarly with the now. For the now is essentially a link (*sunecheia*) or extremity (*peras*) of time connecting the past and the future, and in this sense it is unchanging; for it always is that which at any time *is* as opposed to that which has been or will be.[21] On the other hand, since the now is *in* that which is other and other, i.e., motion, or more specifically the mobile, the now is accidentally other and other insofar as the mobile changes.

3. Solution to the Paradoxes Surrounding the Now. Having distinguished the bipolar nature of the now, we can easily reconstruct Aristotle's solution to the dilemma of the now. The dilemma argued that if the now were real, it must either change or remain the same; however, since both options appeared untenable, the now apparently could not be real. We have seen that what it is to be the now never changes, although the way we characterize the now does change. Let me reiterate: for Aristotle the now itself does not change. Indeed he virtually argues as much at *Physics* VI 3-4. For in VI 3 Aristotle argues that the now in the proper sense is

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capture his conception of blood articulated in the *Parts of Animals* (II 2-4).

[21] Cf. Sarah Waterlow, "Aristotle's Now" in *The Philosophical Quarterly* 34 (April 1984): 104-128 (especially, 120); David Bostock, "Aristotle's Account of Time" in *Phronesis* XXV (1980): 148-169 (especially, 158).

indivisible.[22] VI 4, then continues: "every changing thing necessarily is divisible" (234b10).[23] Thus we can conclude: the now is not a changing thing. Therefore, let us set aside the first horn of the dilemma concerning the now; for it is a red herring.

On the other hand, although what it is to be the now does not change, they way we characterize it does change according to accidental differences belonging to the now, and these accidental differences follow upon different spatial locations of a mobile. Thus the now is accidentally different; however, we observed above that accidental differences are sufficient to mark off time. Consequently, since the now can be characterized differently according to various accidental differences, the now can function as two different termini marking off time, even though essentially it remains one and the same. For the now always is the present, marking off what has been from what will be. Similarly, although the now of 10, 000 years ago and the now of 10, 000 years hence are essentially one and the same now, they are characterized differently, since the universe, i.e., a certain mobile, will be in different states of actuality and potentiality. Consequently in a very real sense the "two nows" are different, just as Coriscus is different when he is the market places versus at the Lyceum, albeit not essentially different.

Moreover, in the chapter on the *aporiai* and *endoxa* I suggested

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[22] 233b33-234b9, i.e., the now which marks off what has been from what will be.

[23] Τὸ δὲ μεταβάλλον ἅπαν ἀνάγκη διαιρετὸν εἶναι.

that the other puzzles surrounding the reality of time either stood or fell with the reality of the now. Thus if time is inextricably linked with the now, and if the now is real, then time is real. But in Aristotle's temporal theory the reality of time is inextricably linked with the reality of the now; for time is what extends between the now differently characterized. Furthermore, having set aside the dilemma of the now, it seems obvious that the now must be among the things that are (*ta onta*); for it is what *is* as compared to what has been or will be. If my reading of the *aporiai* and account of Aristotle's theory of time is correct, then Aristotle has provided us with a means of answering *all* of the puzzles posed and not just one.[24]

G. Numbering Time. The remainder of chapter 11 explains more specifically the relation between time and the now. Thus Aristotle begins this section with an explicit statement of this relationship.

> If there were no time, there would be no now, and if there were no now, there would be no time; for just as the mobile and locomotion (*phora*) are together (*hama*), also in this way are the number of the mobile and [the number] of the locomotion [together]; for time is the number of locomotion, while the now is as the mobile, i.e., the unit of number (219b33-220a4).

When we considered the *aporiai* it was suggested that the reality of time stood or fell with the reality of the now. We now understand why this is so. Time is related to the now as motion is related to

[24] Cf. R. Sorabji who maintains that "with one exception, Aristotle does not follow his statement of the paradoxes with a statement of solutions" (1983, 9). The "one exception" to which Sorabji refers is the dilemma of the now.

the mobile. In the chapter on physics and motion, however, we saw how close the relation of the mobile and motion is; for there is no motion over and above the mobile. Motion just is the imperfect actuality of the mobile reduced from potentiality to actuality. Similarly, time just is the interval between the now *qua* before and after. Furthermore, that time is related to the now as motion is related to the mobile is not due to a mere analogy or similarity as some philosophers would have it.[25] The now *follows upon* the mobile and time *follows upon* motion according to *per se* 2 predication. Thus a principled reason exists why the two pairs are related in the way that they are and the predicates hold of them in the way that they do.

Moreover, since time stands to motion as the now stands to the mobile, and time belongs to motion as a number, so too the now belongs to the mobile as a number. Number, we must remember, is said in two ways: as that which is countable, i.e., a collection of units, and as that by which we count, i.e., the unit (219b6-8). Time is number *qua* countable or the countable aspect. The now is a number *qua* that by which one counts.

This doctrine certainly lends itself to confusion; for should time be a number and a number is a collection of units and the now the unit, then would not a continuous extension, time, be composed of a collection of extensionless units? Such a view flies in the face

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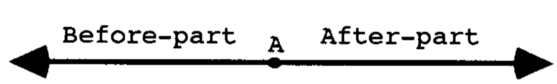
[25] Cf. W.D. Ross, *Aristotle's* Physics*: A Revised Text with Introduction and Commentary* (Oxford: Clarendon Press, 1998), 599; Edward Hussey, *Aristotle's* Physics*: Books III and IV* (Oxford: Clarendon Press, 1983), pp. 153-156.

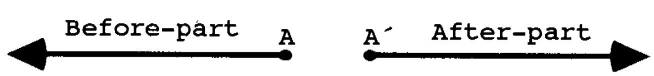
of the *aporiai* and Aristotle's teaching presented in book VI of the *Physics*.

The answer lies in the manner by which the now makes motion numerable. The now does *not* make motion numerable by offering a part or portion by which motion can be measured in the way a meter provides a standard for measuring a spatial length. Thus we read: "time is a number ... not as the parts [of a line], because ... it is evident that neither the now is a portion of time nor is the division [a portion] of the motion, just as the point is not [a portion] of the line, but two lines are portions of one [line]" (220a14-21).

The now, nevertheless, does mark off (*horidzei*) a segment or portion of the motion by indicating a before and after state in the motion corresponding to a state of actuality and potentiality of the mobile (219b11-12; 220a10-11). This segment marked off by the now can in turn be used as a standard by which to measure and thus count other motions. Aristotle is quick to warn us off an erroneous way of envisioning the now as marking off a number in motion (220a12-14). One may imagine that insofar as the now marks off time, the now divides time into two--a before part and an after part--in much the same way that a mid-point divides a line into two. Graphically the point may be represented as such:



Therefore, according to this erroneous understanding, since it is by means of the now that the magnitude of motion has been divided into two parts--the before part and the after part--and a number in the strict sense is a collection of two or more things or units (220a27), the now is a number by which we count. Such a position fails, Aristotle tells us; for "whenever someone takes what is possessed of unity as two, it must be fixed [or appointed] (*histasthai*), if the same point is to be a beginning and end" (220a12-13).[26] In other words, if a point is actually to divide some magnitude into two magnitudes, an end point has to be fixed or appointed to one of the magnitudes and a different point has to be fixed or appointed to the other magnitude. Although Aristotle does not provide the reason why the points must be different here, we can fairly easily reconstruct a reason. For if a magnitude is actually divided at some point A, then the magnitude can be actually separated at A; however, in that case one and the same point would actually have to be two points, which is absurd.[27] Once again let us turn to a diagram:



We see that in order for A to be the actual end point of the before part, it must belong only to the end part, whereas if A were the actual beginning point of the after part, A must belong only to the after part, otherwise two things actually divisible would be inseparable and hence indivisible.

Clearly the now must mark off time and make time numerable in a

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[26] The same point is made again at 220a17-18.

[27] Cf. *Metaphys*. XIII 2, 1076b4-11.

way different from either of the suggestion thus far mentioned. According to Aristotle the now numbers time insofar as the now is an accidental extremity (*peras*) of time (220a20-21). We may state this same point differently: insofar as the now belongs to what is always other and other (although the now itself is not other and other) it conceptually (though not actually) divides motion by indicating states of imperfect actuality belonging to the mobile.

This point is dense and demands explication. First, the now belongs to the mobile, i.e., the now belongs to what is other and other according to a *per se 2* relationship. Moreover, a mobile is a compound term indicating a moving body. Hence insofar as the mobile is a body it is in some state of actuality; nevertheless, insofar as the mobile is moving, the mobile's actuality is imperfect, i.e., it is ordered to some further actuality. For example, insofar as a direct train between Washington D.C. and New York city passes through Philadelphia, the train is in Philadelphia according to imperfect actuality, whereas when the train terminates its journey in New York, it is in New York according to complete actuality. At any state of imperfect actuality the mobile may be said to be *that which it is at that time*, i.e., the actuality which it is, in contrast to that which it had been (i.e., its prior actuality) or that which it will be (i.e., it posterior actuality or present potential). Furthermore, these states of actuality are primarily indicated by the various places in a spatial magnitude which the mobile occupies. With respect to the now's relation to the mobile, the now belongs to the mobile essentially as *that which at any time is*, i.e., as the mobile's state of imperfect actuality, and in this capacity the now never changes. On the other hand, since the mobile is changing or moving, the now is also accidentally changing or moving, in the same way that the Washington Monument is accidentally moving insofar as the earth is spinning and tracing out its elliptical orbit. On account of the accidental differences of the now, the now can mark off the mobile's motion according to different states of the mobile's imperfect actuality. For the purposes of counting, we can take these "marking offs" as extremities that conceptually divide the motion into numerable portions, which is nothing other than time. Therefore, insofar as the now marks off motion it is truly said to be that by which motion is numerable, and thus the now truly can be called a number.[28]

I have used the phrase "conceptually" instead of "potentially"

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[28] The position which I am putting forward, viz. that ᾧ ἀριθμοῦμεν [i.e. that by which we count] is the unit runs contrary to the traditional interpretation, which sees ᾧ ἀριθμοῦμεν indicating abstract numbers (cf. Ross (1998), 598; Hussey (1983), 151, 163; Mario Mignucci, "Aristotle's Arithmetic" in *Mathematics and Metaphysics in Aristotle* (Bern: Paul Haupt, 1987), 197-198. On the other hand Wolfgan Wieland in his *Die aristotelische Physik* ((Göttingen: Vandenoeck & Ruprecht, 1962), 318-319) has argued that ᾧ ἀριθμοῦμεν simply refers to the unit; "das (inhaltlich bestimmte) Einheitsmaß [ist das], *womit* wir zälen... (319)." Mignucci has criticized Wieland on the grounds that at *Metaphysics* X 1, 1053a24-30 and XIV 1, 1088a6-8 Aristotle either explicitly or implicitly denies that the unit is a number (Mignucci, 197, fn. 51). Number in the strict sense is a collection or set of units and thus since a unit (or one) cannot be itself a collection of units (or ones), it is not a number. *Pace* Mignucci, Aristotle seems to recognize a less than strict sense of the term ἀριθμός; for at the beginning of *Physics* IV 12 (the chapter immediately after his developed discussion of time) Aristotle asserts that the smallest number in the strict sense (ἁπλῶς) is two, but precedes to speak of the smallest number accruing to magnitudes as either one or two. I take Aristotle's "waffling" to indicate that he realizes in the strict, traditional sense of number, one is not a number; nevertheless, there is at least some sense in calling one, or the unit, a number, especially if it is through the unit that we can count or number the set.

advisedly. For although Aristotle does say later in book IV that the now divides time potentially (*to nun to men tou chronou diairesis kata dunamin*) (222a17-18), it does so only because the point (and by implication the now) is not one in thought (*tê$_i$ noêsei*) (222a16-17).[29] Furthermore, if one takes the now to be a potential division within time, in the strict sense of "potential", a certain discomfort arises, since what is potential, when the right conditions obtain, can become actual; however, the now can never actually be a division within time for the reasons sketched above.

H. Conclusion. 1. A Concrete Example of Time as a "Number of Motion". Let us consider a brief example that explains in practical terms how Aristotle envisions time as a numerable aspect of motion marked off, and thus made numerable, by the now. We recall from our chapter 3 that magnitudes possess a number insofar as the mathematician or measurer lays it down that some determinant magnitude is to be taken as an indivisible unit of measurement.[30] Clearly, this indivisible unit of magnitude is a mathematical fiction; for magnitude is continuous and hence potentially infinitely divisible. Still, for the purposes of counting we can take some determinant magnitude as indivisible. For example, if we want to know how long a road is, we may posit the meter as our ultimate unit of counting, i.e., we do not take into account any lengths smaller than a meter. The measurer in turn uses this unit to mark off

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[29] IV 13, 222a16-18.

[30] Cf. § D, "Further Aspects of Motion".

portions or parts of a greater magnitude. The collection of units (or portions of the magnitude) constitutes the magnitude's number. Although a degree of relativity pervades the choose of the unit, Aristotle remarks that we should always choose the unit that is least likely to go unnoticed and thus easiest to count (*Metaphys.* X 1, 1053a5-7; XIII 3, 1078a12-13). With respect to motion the unit should belong to a motion that is the simplest (*haplêi*), i.e., the most uniform (*homalên*), and the quickest (1053a8-13). The motion of the heavens, by which we mean the motion of the heavenly bodies, meets this bill (Ibid). The measurer or time keeper now takes the motion of one of the heavenly bodies, for instance the sun, and marks off conceptual divisions within the sun's motion according to different positions of the sun during its travels. For instance, we can mark off one conceptual division in the sun's motion when it crests the horizon in the east and a second when the sun crests it again. Call the extension between these two conceptual divisions a day. This extension or magnitude, which we call a day, can in turn be used to measure other motions and thus to assign them a number.[31]

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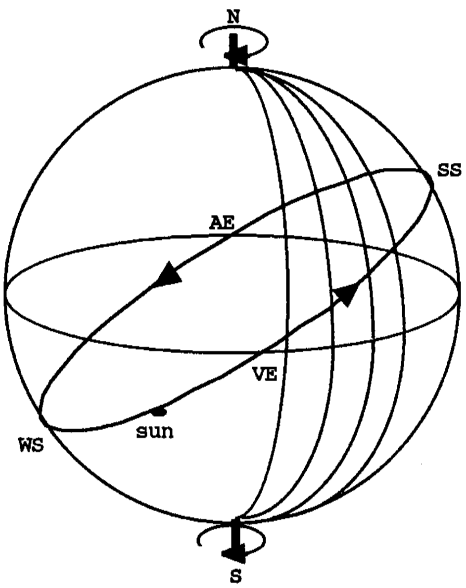
[31] The use of the cresting of the sun provides a practical point of reference for time keeping. With respect to more exact sciences, such as astronomy, high noon, i.e., the sun's maximal elevation on the meridian, was used, and the interval between two maximal elevations of the sun is called the solar day. In fact, the sun's motion was not the preferred motion for astronomers, since its apparent motion was irregular when compared to the fixed stars. That is to say that if throughout the year we compare the various solar days with a sidereal day determined by one of the fixed stars, we notice an irregularity between the two times, which varies by almost a minute at different seasons of the year (cf. footnote, p.9 of T. Kuhn's *The Copernican Revolution* (Cambridge: Harvard UP, 1957)). In other words, if we assume that the time required for the stars to complete one diurnal circle is invariable and regular (23 hours, 56 minutes, 4.09 seconds), then throughout the year we observe that the time the sun takes to go from high noon to high noon varies and is irregular. This irregularity was noted

at least by the time of Ptolemy. Whether it was noticed in Aristotle's time is uncertain. In practical, day-to-day, concerns the discrepancy between the apparent solar day and time reckoned by the stars is of little importance, although it was significant for astronomers, who wanted to explain the motion of the heavens strictly in terms of regular circular motion. (The following is adapted from Kuhn's *The Copernican Revolution*, technical appendix "Correcting Solar Time" and W.M. Smart's *Text-Book on Spherical Astronomy* (Cambridge: At the University Press, 1960).)



There are two sources for the irregularity in the solar day; however, to appreciate them we must make some brief comments about the sun's apparent motion. Roughly every 24 hours, the sun appears to circle the earth moving in a western direction. This is the sun's diurnal motion. Along with the diurnal motion, the sun also appears to circle the earth once every year, but in an eastward direction. Consequently, every day the sun appears to have moved 1° further to the east than it was the previous day. This is the sun's annual motion. Now let us consider the causes for the sun's apparent irregular motion.

The first source is due to variations in solar speed. It is an observed fact that during the summer months the sun moves more slowly in its annual eastward motion than during the winter months. (The sun takes nearly six extra day to move from the vernal equinox to the autumnal equinox than from the autumnal equinox to the vernal equinox.) Since the sun moves more slowly towards the east in the summer months, it moves more rapidly in its westward diurnal motion. (Think of two passengers on a westward moving train. If one passenger runs to the east within the train, while the other causally strolls eastward, the net western velocity of the one who strolls is greater than the one who runs.) Since the sun moves more rapidly in its westward diurnal motion during the summer months, it takes less time in the summer for the sun to go from high noon to high noon, i.e., regain its highest elevation. Therefore, the apparent solar day should be shortest during the summer months and longest during the winter. (Note, the longest solar day is *not* the same longest amount of day light.) Thus variations in solar speed is one explanation of the irregularity of the solar day.

A second cause is due to the angle of the ecliptic or path which the sun apparently travels during its annual eastward motion. If the ecliptic were parallel with the celestial equator (imagine our equator extending out into space so as to divide the entire celestial sphere into north and south), then there would be no problem; however, the ecliptic is at a 23 1/2° angle to the celestial equator. Now imagine the celestial sphere as a globe with lines of longitude marked down it. At, or near, the solstices, the sun moves with respect to the stars nearly due east, instead of either to the southeast or northeast and consequently the sun has a greater net eastward motion when it is near the solstices. Moreover, during the solstices the sun moves through lines of longitude that are more closely together than at any other time of the year. The results of these two effects, viz., the sun's nearly due east motion and its

For instance, the magnitude of a trip from New York to California can be marked off into six solar units or days. On the other hand, if we need a smaller unit of time, we can posit some smaller division within the solar unit according to the various positions of the sun as indicated, for instance, by a sun dial.

2. Two Possible Objections. I complete this chapter with a response to two possible objections. One might want to complain that in our example of marking off a day by the sun's motion, the first cresting and the second cresting of the sun would be in the same position and thus we cannot distinguish the two crestings according to spatial difference, but only according to temporal differences. Hence, the objection goes, Aristotle cannot make spatial magnitude primary and consequently his account of time collapses. The objections fails since the sun is in fact at a different position with respect to the fixed stars after each rotation of the earth (or for Aristotle after each rotation of the outermost heavenly sphere). Throughout the year the relative position of the sun against the fixed stars changes by a little less than a degree each day. Moreover, the sun's relative position against the fixed stars changes

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passing through lines of longitude that are close to one another, is that at the solstices the eastward motion of the sun is a bit more than 1°. consequently, the sun crosses slightly more than 361° during its western diurnal motion. In contrast, at the equinoxes the sun's motion is either to the northeast or southeast, rather than nearly due east. Furthermore, the lines of longitude are at their maximal separation. The result of these two effects is that at the equinoxes the sun's eastward motion is a bit less than 1° and consequently, the sun crosses less than 361° to regain its maximal elevation. Based solely in this phenomenon the solar day should be longer at the solstices and shortest at the equinox.

The end result of these two phenomena was that the sun's motion appeared to be irregular and thus did not provide the best means for keeping astronomical time.

each year by 50.26 seconds due to the precession of the equinoxes.[32] In short, the sun's position relative to the fixed stars always is different and thus the objection fails.

The second objection is that if time is the measure of motion and it belongs to all motions, then since there are distinct motions, there must be distinct times. To such a criticism, Ibn Sînâ, Thomas Aquinas and other commentators felt forced to make time the measure of one particular motion, viz., the motion of the heavenly sphere. Certain scholastics following Augustine levelled a critique against this suggestion.[33] Assume that the outermost heavenly sphere were to stop, while a rock was in mid-fall. What would happen to the rock? Would it cease falling in mid-fall? Such a response, although adopted by some scholastics, is extremely counter intuitive.[34] On the other hand, if the rock continued its motion, then the rock's motion would be timeless; for time is *ex hypothesi* the measure of the motion of the heavens on this view, yet we are supposing that this motion has stopped.

Aristotle's response to the objection that a unique time must be associated with each particular motion, I believe, would be

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[32] The same point (albeit with a different intent) was made by Duns Scotus and Oresme, who both argued that heavenly bodies do not return to identical positions (or at least most likely do not return to identical positions) (cf. John Murdoch's "*Mathesis in Philosophiam Scholasticam Introducta:* The Rise and Development of the Application of Mathematics in Fourteenth Century Philosophy and Theology" in *Actes du Quatrième Congrès International de Philosophie Médiévale* (2 Sept. 1967), 232).

[33] Cf. Augustine's *Confessions*, XI, 23 (29).

[34] Cf. Pierre Duhem's *Medieval Cosmology: Theories of Infinity, Place, Time, Void, and the Plurality of Worlds*, ed. and trans. Roger Ariew (Chicago: Chicago UP, 1985), 295-363.

different.[35] Time is a number or measure of a temporal magnitude; however, numbers or measures do not belong to one particular and determinant magnitude, but rather they number or measure all magnitudes of the requisite type. Consider spatial magnitude. There are several spatial magnitudes; for example, the road outside my house, the length of the University of Pennsylvania campus, and the distance between 30th Street Station and the Penn campus. All of these magnitudes are distinct magnitudes to which a definite number or measure belongs. For instance, the road in front of my house is one kilometer, the Penn campus is one kilometer and between 30th Street Station and Penn is one kilometer. These facts do not entail that the spatial measurements require some one, unique spatial magnitude, which is the absolute measure of spatial magnitude and all other spatial magnitudes are known through it. All that is required is that we set one magnitude and then let this magnitude measure all other magnitudes. Just as the measure of a spatial magnitude does not demand some particular and determinant spatial magnitude of which it is the measure, neither does time, which is the measure of motion, demand some particular and determinant motion, of which it is the measure. Any suitable motion (i.e., any uniform motion) can give us a temporal unit, by which we subsequently measure all other motions.

The core of Aristotle's temporal theory is complete.[36] He has

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[35] I am taking my response from a comment of Aristotle's at 220a23-24 and again more explicitly at IV 14, 224a2-17.

[36] *Physics* IV 12-14 take up a series of important secondary topics surrounding an account of time. The central issue for Aristotle in these chapters is to reconcile his own account of time with our temporal vocabulary and intuitions,

shown that there is time, since time necessarily belongs to motion and the reality of motion is a given. Moreover, Aristotle has provided a reasoned account of why time necessarily belongs to motion; for a certain extension belongs to motion as the interval between the motion's two termini and this extension just is time. Aristotle completed his account of time, and we ours, with a discussion of the way in which motion is numerable and the relation of this numerable aspect to time and the now.

We should note that Aristotle's conception of time is static; time is a magnitude or measure that follows upon motion. In this sense, Aristotle's theory of time is thoroughly opposed to Plato's dynamic notion of time as a *moving* image of eternity. Despite the mutually exclusive nature of these two temporal theories, Aristotle's language does allow for misinterpretation. Indeed, much of the history of later Hellenistic commentators on this topic was an attempt to reconcile Plato and Aristotle's doctrines of time. Ibn Sînâ was a beneficiary of this tradition and it is to him and his dynamic interpretation of Aristotle's temporal theory that we now turn.

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e.g., how do we reconcile time's static nature with our intuition that time flows or changes? Aristotle's general solution to this and several other questions is to observe that we are attributing to time features that in reality only belong to change or motion.

CHAPTER 6

HISTORICAL DEVELOPMENTS AND BACKGROUND TO IBN SÎNÂ'S TEMPORAL THEORY

Approximately 1300 years passed between the time Aristotle wrote and Ibn Sînâ flourished. One might expect numerous changes in both the problems surrounding the notion of time and the way Aristotle's theory evolved, and in this one would not be mistaken. The differences Ibn Sînâ would have confronted are most apparent in three areas. First, the Aristotelian commentary tradition, especially in its Neoplatonic variety, which grew up around the *Physics*. Second, the fully developed atomistic physics of the *mutakallimûn*, or Islamic theologians. Third, the "Neoplatonizing" thought of Abû Bakr ar-Râzî (the Latin Rhazes) with his conception of time as a self-subsisting co-eternal, which exists independent of motion. Therefore, to appreciate the context in which Ibn Sînâ was thinking and writing, we must consider the thought and impact of these developments.

A. The Greek Aristotelian Commentary Tradition. Almost immediately after Aristotle's death, his works and philosophy were eclipsed by those of Aristotle's master, Plato, and the new philosophy of the Stoa. Indeed, Aristotle's flame may have completely faded had the Alexandrian librarian, Andronicus of Rhodes, not rekindled it, when he reissued Aristotle's works around 30 BC. Aristotle received another boost in the third century AD, when commentators and philosophers such as Alexander of Aphrodisias (c. 200 AD) and Plotinus (204-270 AD) began engaging his thought and once again made Peripatetic philosophy a thing with which to be reckoned. To engage all the fates and furies that confronted Aristotle's *Physics* would be an herculean task, which is neither feasible nor necessary. We need merely consider certain changes in emphasis and orientation respecting Aristotle's theory of time which would have influenced Ibn Sînâ.

Among the Greek commentators on the *Physics* whose works were translated and studied by the Arabs we find Alexander of Aphrodisias, Porphyry (c. 232-305), Themistius (c. 320-390 AD) and John Philoponus (c. 490-570). The thought of Plotinus was partially known to the Arabs in the guise of the *Theologia Aristotelis*, which in fact was a paraphrase of *Enneads* IV-VI; however, since Plotinus' direct response to Aristotle's discussion of time comes in *Ennead* III, we need not consider him. Nor do we need to take into account the comments and modifications of Aristotle's temporal theory by the great Neoplatonic commentator Simplicius, since his commentary on the *Physics* was unknown in the Arab world. Among those Greek thinkers who were known to the Arabs, I shall not mention the works of either Porphyry or Themistius; for Porphyry's work is an extremely brief synopsis and

Themistius' is only a slightly longer paraphrase. I do not want to suggest either that these works may not be of philosophical interest or that they could not have influenced Ibn Sînâ's own account of time, but there are richer (and more obvious) sources in the works of Alexander and Philoponus.

1. Alexander of Aphrodisias. We know that Alexander wrote a commentary on Aristotle's *Physics*, even though it is no longer extant. Moreover, an-Nadîm, a tenth-century bibliophile who kept a record of every book he either came across or heard about, catalogued what of Alexander's *Physics* commentary was extant in Arabic. Thus we read: "as to the fourth book [of the *Physics*, Alexander] commented on it in three books of which are extant the first and second books and part of the third up to the discourse on time."[1] *Physics* IV indeed lends itself to a tripartite division; thus it seems likely that Alexander's first book would have been on place, the second book on the void and the third book on time. We are also told, however, that only part of the third book was translated viz., the part "up to the discourse on time." This phrase could imply that the division I suggest is wrong and that the Arabs were ignorant of Alexander's commentary on time; however, this reading is not the only one. The phrase "up to the discourse on time" could mean "up to and including" Alexander's commentary on Aristotle's formal account of time (i.e., *Physics* IV 10-11 (and perhaps 12)), but excluding his discussion of

[1] In F.E. Peters, *Aristotelis Arabus: The Oriental Translation and Commentaries on the Aristotelian* Corpus, (Leiden: E.J. Brill, 1968), 30.

the subsidiary issues, such as Greek temporal vocabulary and certain applications of Aristotle's theory of time (i.e., IV (12) 13-14). I contend that the phrase "up to the discourse on time" should be taken in this latter sense; however, since the commentary is no longer extant, even in Arabic, this point is mere speculation.

Despite the loss of Alexander's *Physics* commentary we are not bereft of Alexander's thought about the nature of time; for we possess an Arabic and Latin translation of his *De tempore*, a smaller treatise on time.[2] R.W. Sharples in a translation of and commentary on the Latin version of the text argues that the work is too short to be Alexander's commentary on the section concerning time from the *Physics*, nor does its order suggest it is an epitome of the *Physics'* discussion on time; rather, Sharples suggests that the work is one of the short discussions collected in Alexander's *Quaestiones*.[3] I do not propose to give an analysis or summary of this treatise but merely to mention three points of interest: Alexander's emphasis on the merely potential divisibility of time, his modification of Aristotle's definition of time and his addition of the language of a "flowing now" to Aristotle's theory of time.

Alexander goes to great lengths to emphasize the continuity of

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[2] The Arabic can be found in *Commentaires sur Aristote Perdus en Grec et Autres Épîtres*, ed. A. Badawî (Beirut: Dar el-Mashreq, 1971), 19-24; the Latin in G. Théry, "Autour du décret de 1210: II, Alexandre d'Aphrodise, Aperçu sur l'influence de sa noétique," *Bibliothèque Thomiste* 7 (1926): 92-97; an English translation of the Latin can be found in R.W. Sharples, "Alexander of Aphrodisias, *On Time*," *Phronesis* 27 (1982) 58-81. (All translations are my own and from the Arabic, cited as *De tempore*; bracketed numbers refer to Sharples' translation from the Latin text).

[3] "Alexander of Aphrodisias, *On Time*," 67-68.

time and that time is only divisible potentially, not actually. Indeed, Aristotle is clear that time is continuous because it follows on motion, which is continuous (219a12-13). Furthermore Aristotle remarks that time is made continuous by the now and yet divided at the now (220a5);[4] and he mentions in passing that the now is only a potential division in time as opposed to an actual division (222a14).[5] Although these issues appear in Aristotle, Alexander truly brings them to the fore. Time, Alexander argues at *De tempore* 21.13-17 [13], is a continuum and can only exist divided in potency, never in actuality. For if some period of time, call it AC, where actually divided, say at B, then all the instants in the period AB would have ceased to be at B, whereas all the instants in the period BC would have begun to come to be at B. Hence, the same instant, B, would have simultaneously had to have come to be and to have ceased to be. To avoid this conclusion one would have to posit some interval between AB and BC, which itself would not be time, an absurd conclusion. Thus according to Alexander time is only divisible "in potency and the imaginative faculty (*wahm*), not in existence and act."[6] He sums up his position well at the end of the treatise when he says:

> Time in itself is one and is only made many for us in the imaginative faculty (*wahm*) according to what we measure or imagine (*natawahhamu*). Likewise we say that "was" and "is" only are according to our imagination (*tawahhuminâ*). As for

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[4] συνεχής τε δὴ ὁ χρόνος τῷ νῦν, καὶ διῄπηται κατὰ τὸ νῦν.

[5] διαιρεῖ δὲ δυνάμει.

[6] *De tempore*, 21.6-7 [11].

> [time] in itself, it is one, everlasting, continuous according to a single state.[7]

Once again Alexander does not make any points that are not alluded to in Aristotle, but rather what is of importance in Alexander's account is how he makes these points central to Aristotle's theory of time. As we shall see, issues concerning the continuity and divisibility of time play a prominent role in Ibn Sînâ's account of time.

A second point of interest is a modification Alexander makes to Aristotle's definition of time. Time for Aristotle is the number of motion with respect to before and after (219b1-2). In contrast Alexander makes time the number of the motion of the celestial sphere.[8] Alexander's proof runs as follows: the motion of the celestial sphere is swifter than (and therefore less than) any other motion; all measures must be less than what they measure; therefore the motion of the heavens is the measure of all other motions. He proves the minor by observing that pluralities and intervals are measured by the unit, e.g., ten bushels are measured by a single bushel and a hundred miles by a single mile. Likewise swifter

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[7] Ibid, 24.7-9 [28]; the nouns I have translated, "imaginative faculty," "imagination" and the verb "to imagine" are most likely translating the Greek ἐπίνοια ("thought, power of thought, inventiveness") and its cognates, which appears in both Philoponus (733.3-4) and Simplicius (749.10) in much the same context as we find them in *De tempore*. The Arabic root is *wahama*, to imagine, which Ibn Sînâ ultimately uses to designate the estimative faculty (*wahm*) in distinction from the imaginative faculty (*mutakhayyilah*). At the time Alexander was writing, however, this distinction within the internal powers of the soul had not been made. Thus given the evidence in Simplicius and Philoponus we can feel relatively confident that ἐπίνοια is being translated.

[8] *De tempore*, 21.1-2 [10] "Time only becomes the number of the motion of the celestial sphere and no other motions because no motion is swifter than it; 22.12-14 [19] "[Time] is the number of a regular motion possessing an unvarying ritual (ṭaqs), indeed according to one thing always, viz., the motion of the celestial spheres."

velocities measure slower ones, since there are less unit times in the swifter velocities.[9] Once he has the premise that the motion of the heavens is the measure of all other motions, he can plug in the definition of time, viz., time is the measure of motion, and then conclude that time is the measure of the movement of the heavenly sphere. Although Aristotle intimates that our notion of time comes from the measurements of the motion of the heavens, Alexander comes down firmly on this point, maintaining that the very essence of time is to measure the motion of the heavens.

Two points should be noted about Alexander's emendation: one philosophical and interpretative, the other historical. Concerning the former, although Aristotle indicated that the motion of the outermost celestial sphere was the preferable motion for measuring all other motions, he nowhere asserted that time is in fact the number of this sphere.[10] In fact, we have seen that Aristotle had arguments for denying that time was the motion of any one particular motion.[11] Another argument for this thesis is found at *Physics* at IV 14 (222b30-223a15), where Aristotle asserts that fastness and slowness belong to all changes; however, fastness and slowness is understood in terms of time. Consequently, a certain rate of change

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[9] *De tempore*, 21.1-5 [10]; Alexander's *Physics* commentary *apud* Simplicius 768.31-769-19.

[10] IV 14, 223b18-23; in fact, all Aristotle says is that continuous circular locomotion is the best known and thus best measure of other motions and it was on account of continuous circular motion being the best measure that some thought that the motion of the sphere was time--a position which Aristotle has already refuted (IV 10, 218b1-5).

[11] Cf. Section H.2, "Two Possible Objections" of chapter 5.

belongs to every change and associated with this rate of change is a time.[12] As we have seen time for Aristotle is akin to a mathematical object insofar as it is a number; but the mathematician merely posits, especially when dealing with what is continuous, a preferred unit of counting. There are no ontological features about reality that necessitate that one unit of counting be privileged over another; it is a matter of convention and suitability. The motion of the outermost celestial sphere happens to be the most useful motion for us to count or measure other motions, but insofar as all other motions can be counted, they too can be used as a measure for numbering other motions.

The second point concerns how the tradition adopted Alexander's suggestion. Alexander's argument that the essence of time was the number of the motion of the celestial sphere was based on the nature of a measure. The commentary tradition adopts Alexander's suggestion that time is the number of the motion of the celestial sphere, but puts it to a different philosophical use.[13] Future commentators employ Alexander's suggestion to answer the following philosophical problem. If time belongs to every motion, then there would be as many times as there are motions; however, there is not a plurality of times corresponding with the various motions, but rather there is a single time in which all

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[12] 222b30-223a15.

[13] The tradition does not unanimously accept linking time with the number of the motion of the outermost sphere. Simplicius (*In Phys.*, 768.35-769.6), in fact, denies that time is exclusively linked to the motion of the outermost celestial sphere, arguing along the same line that I have.

(simultaneous) motions are found. Future commentators answer that if time is the measure of a unique motion, then indeed there would only be a single time. They go on to identify this single motion, following Alexander's lead, with the motion of the outermost heavenly sphere.[14] We have discussed this puzzle in the account of Aristotle's theory of time and I let my comments there suffice.

Alexander's most notable divergence from Aristotle's theory of time, as I have explained it, is his claim that time is created by the flow of a changing now. "The now when it flows (*sâl*) makes time."[15] This reference and one more in the same paragraph are the only places in *De tempore* where Alexander explicitly states that time is, or at least is created by, the flow of the now. Yet this notion, so opposed to the historical Aristotle, grabbed the imagination of numerous later generations of commentators and interpreters of Aristotle.[16]

As I have argued, Aristotle accepted the validity of the

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[14] Ibn Sînâ, *ash-Shifā': aṭ-Ṭabīʿiyāt*, 149.14-150.10; Aquinas, *In phys.* L.IV, l.xvii, 573-574. Also see P. Duhem's discussion of the history of the Absolute clock in the section on time in *Medieval Cosmology: Theories of Infinity, Place, Time, Void, and the Plurality of Worlds* (trans. R. Ariew, (Chicago: University of Chicago Press, 1985): 229-366).

[15] *De tempore*, 21.13 [13]; 21.17 [13].

[16] In what exists of Alexander's *Physics* commentary in Simplicius I have found no clear reference to time as the flow of a changing now. (In Simplicius' commentary (749.25) we read the phrase "the flow of time" within the context of a discussion of Alexander's interpretation of Aristotle, but it is not clear whether this represents Alexander's position or Simplicius' interpretation of Alexander.) This is not to say that Alexander did not make this point in his larger work, only that we cannot be certain to what extent he "pushed" this interpretation. Judging from his account in *De tempore* we may reckon that this thesis did not play an important part for Alexander's overall understanding of Aristotle's temporal theory.

paradox of a changing now and thus maintained that the now cannot change. Since Alexander believes that the now does change he is forced to explain the paradox. The only hint of his solution is his claim that "it is not the case that generation (*kawn*) belongs to time, but only that generation belongs to the now, and its generation is in the imagination (*wahm*; Grk. *epinoia*)."[17] At least one reading of this remark is that Alexander only considered the now an object of the intellect and thus any change in it would only take place within the intellect; for example, if the soul were to characterize the now differently, we might say the now changed.[18] Thus our awareness of a change, or flow, in our characterization of the now found in the soul would be the cause of our awareness of time. Such a reading would not be too different from the one we attributed to Aristotle, with the exception that it has introduced the term "flow" into an otherwise static account of time. Whatever the proper way to interpret Alexander, he introduced a piece of dynamic vocabulary into an understanding of Aristotle that would have a profound effect.

2. John Philoponus. Philoponus was a Christian Neoplatonist. A key element of the Neoplatonic program was to reconcile the great philosophical traditions of Antiquity, most notably the thought of Plato and Aristotle. In this respect, Philoponus' commentary on Aristotle's theory of time is no exception. He affects the

[17] *De tempore*, 22.18 [20].

[18] In at least one place Alexander states that the now belongs to time in just the same way division belongs to time, viz. in imagination and in potency (*De tempore*, 21.14-16).

reconciliation between Plato and Aristotle's theories of time by exploiting the dynamic vocabulary, viz., "flow", introduced by Alexander mentioned above. He makes time the measure of motion produced by the flow of a changing now. Thus Philoponus retains Aristotle's position that time is a measure of motion and yet likewise incorporates Plato's view that time is a *moving* image of eternity; for the now, like eternity, is what is, but unlike eternity the now can only be by constantly changing.

To appreciate Philoponus' contribution (or the Neoplatonists' in general) to the interpretation of Aristotle's temporal theory, we must again briefly consider Plato's theory of time. I limit my discussion of Plato's temporal theory to comments he makes in a small, but well known, passage from the *Timaeus* (37C8-D7). Plato tells us there that the Father, who had begotten, took thought to form the world more like its paradigm. Since the living creature, which is the paradigm of the world, is eternal the Father attempted to form the all in the same way insofar as it was in his power. Now the nature of the living creature is to be eternal; however, it is impossible to confer eternity upon that which is generated. Thus the Father made the all a certain moving (*kinêton*) image or shadow (*eikô*) of eternity; and simultaneous with the ordering of the heavens he made an everlasting moving (*iousan*) image, abiding an eternity in unity according to number. Truly, concludes Timaeus, this is that which we call time.

Setting aside the mythological nature of the account, Plato attempts to explain time in terms of the eternal, becoming in terms of being. Such a move is not surprising, since for Plato all real explanations must appeal to the unchanging, eternal Forms. Thus I gloss Plato's temporal account as follows. The paradigm of our universe is eternal; that is to say, it has all of its being completely and simultaneously. It is this quality of the ever complete and simultaneous possession of being that the creator cannot confer upon the universe. For that which comes to be cannot always be, since the distinctions of "has been", "is", and "will be" belong to it. Although the creator cannot communicate complete and simultaneous being on the universe, it can bestow successive being, i.e., becoming, on the universe. I call this "successive being" since for the universe "that which is" is imperfect or constantly changing (as opposed to the more complete and perfect being of the paradigm); for that which is at any moment passes away into non-being, while that which will be becomes that which is. Thus the universe does not have being as the paradigm does, but rather, the universe has its being as a mere shadow or wraith (another translation of *eikôn*) of the paradigm. "That which is" is the immediately present and it is the coming into being and passing away, i.e., the motion or flow, of that which the universe presently is that is time. Finally, this motion can be marked off according to number (*kat' arithmon*) insofar as it is divisible into days, weeks and years according to the circuits of the planets and heavenly spheres.

Philoponus affects his reconciliation of Plato and Aristotle's temporal theories by assimilating what I have ascribed to Plato as "that which is coming to be" with Aristotle's now or the before and after in motion. Following Aristotle closely, Philoponus reiterates that the before and after are primarily in place and they are primarily in place on account of the position of the parts (719.13-14).[19] He continues, with an important aside, that analogous to the way that there is a motion across a spatial magnitude, so there is the before and after across motion (719.15-16).[20] The before and after in motion cannot be from the position of the parts of motion; for one part of motion does not remain when another comes to be, but rather, the before and after in motion are in flux (*en hrusei*) (719.20). Returning to Aristotle's solution, Philoponus continues, the before and after in magnitude are proportionate to the before and after in motion because the motion comes across a before part of the magnitude, so that we call it "before", and then over a second part, so that we call it "second". Although Philoponus gives Aristotle's explanation of how the before and after in motion are proportionate to the before and after in magnitude, his aside concerning the flowing before and after is Plato's; for he has now introduced that there belongs to motion a moving or flowing of the before and after.

Of course if Philoponus merely meant by this claim that what we consider before and after changes, then his position would not be

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[19] κατὰ τὴν τῶν μορίων ἐστι θέσιν.

[20] ἐπί τῆς κινήσεώς ἐστι τὸ πρότερον καὶ τὸ ὕστερον ἀνάλογον τῇ κινήσει.

far from Aristotle's; however, we shall see that what he intends is that something, analogous to a point, belongs to motion and through this "point's" flow it generates befores and afters and consequently time. At 721.16-17 and 22, we are told that the before and after are boundaries (*horidzontes*) in motion by which we recognize time and that time is bounded by the now. In this respect Philoponus is following Aristotle; the before and after are equated with the now that marks off the boundaries of time.[21] Philoponus, however continues at 725.13-14 that the now is the generator of time.[22] And it generate time by its flow.

> The now is the efficient cause (*poiêtikon aition*) of time; for the flow of this generates time. Therefore, just as the point (*sêmeion*) is related to magnitude and the mobile is related to motion, in the same way also is the now related to time. Thus a point, one and the same in being, generates magnitude; for the line is not generated by placing a plurality of points (*stigmôn*) side by side, but by a flow of a single [point]. And again the mobile, one in being, generates motion. Clearly it follows that the now, one in being, generates time. Time is not generated by placing a plurality of nows side by side; nor is [time] continuous from the nows, but rather from the flow of a single [now]; for by the same now being grasped as before and after does time have its being (727.21-29).

Philoponus has assimilated Aristotle's' static conception of time to Plato's dynamic. The now, which for Aristotle indicated the terminus or boundary of time, has been converted into Plato's moving present, generating time through its flow.

Both Aristotle and Philoponus argue via analogy: as the point is to the line, so the now is to the time. However, Philoponus

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[21] Cf. *Physics*, IV 11, 219a25-30.

[22] τὸ νῦν ἐστι τὸ γεννητικὸν τοῦ χρόνου.

understands the relation between the point and the line differently, I believe, than Aristotle would have. For Philoponus the point through its flow generates the line and thus likewise the flow of the now generates time.[23] For Aristotle a moving point does not make a line, although certain commentators have ascribed to Aristotle this view based on an erroneous understanding of a passage in the *De anima*.[24] The passage under consideration, *De anima* I 4, concerns Xenocrates' theory that the soul is a number that moves itself. Aristotle first argues that it is impossible for a unit (*monad*) to move, which would include both the point and the now; for only that which has parts and differences can move, but a unit has none.[25] He then presents a second argument against Xenocrates showing that even assuming the position that a line is made by the motion of a point, his theory of the soul is incoherent.[26] For if the soul were a self-moving unit, and the movement of the unit were to make a line, the movement of the soul's unit would be a line, which is gibberish. My point is that for Aristotle a line is not that which is generated by a moving point, since a point cannot move. Thus Philoponus has

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[23] The exact origin of the conception of a line being made by the flow of a point is not clear. Aristotle disapprovingly mentions at *De anima* I 4 that certain members of the academy, most likely Xenocrates, claimed that a moving point (κινηθεῖσαν στιγμήν) makes a line. (I shall say more about this passage in the body.) On the other hand, Proclus approvingly mentions ῥύσις σημείου, or the flow of a point, in his commentary on Euclid's *Elements*, as an alternative definition for a line (97.8-13).

[24] Thomas Heath, *Mathematics in Aristotle*, (Bristol: Thoemmes Press, 1998), 90; *De anima* I 4, 409a4.

[25] The same point is made at *Physics* VI 4, 234b10-20.

[26] Aristotle rather defines the line as that which is continuous in one dimension (*Metaph.* V 13, 1020a11-12, μεγέθους δὲ τὸ μὲν ἐφ' ἓν συνεχὲς μῆκος).

introduced a new conception of the relation between point and line (and subsequently between the now and time) into his commentary on Aristotle. Consequently, Philoponus opens the way for a new (Neoplatonic) interpretation of Aristotle's temporal theory and it is this interpretation that medieval Arab philosophers (and Latin philosophers) inherit. What is missing in Philoponus' account is an adequate answer to the paradox of a changing now. As we shall see, Ibn Sînâ advances the dynamic theory of time by providing just such a necessary solution.

B. The Arabic Milieu. The Greek commentary tradition was not the only influence on Ibn Sînâ. Influences also came from the Arabic side. The two must prominent sources would have first been *Kalâm*, or Islamic systematic theology, especially in the atomistic physics employed by Islamic theologians, or *mutakallimûn* (sing. *mutakallim*);[27] and a second influential Arabic source would have been the nonconformist thought of Abū Bakr Muḥammad ibn Zakariyyā' ar-Rāzī (the Latin Rhazes; 864-ca.925 or 933). Their influence on Ibn Sînâ, however, was not a positive one, but rather a negative one, insofar as Ibn Sînâ took as one of his tasks a refutation of both the physical theory of the *mutakallimûn* and ar-Râzî's absolute, self-subsisting time. Consequently, we must say something about both of

[27] To refer to the *kalâm*'s theory of time, space, bodies etc. as "physics" is something of a misnomer; for our word "physics" and the Arabic طبيعيات both come from the root meaning "nature". Yet the *mutakallimûn* were viciously opposed to the reality of natures, which they rightly understood to imply causal influences. Nevertheless, insofar as the theory of the *mutakallimûn* was concerned with issues and problems related to what historically has been linked with the science of physics, we can loosely call their theory a "physical theory".

these views.

1. Atomism and the Physics of Kalâm.[28] The cardinal tenet of *Kalâm* physics is that everything other than God is constituted of atoms and accidents; this includes time and space or spatial magnitude (*masâfa*).[29] Although the *mutakallimûn* posited the reality of a void, the spatial magnitude of this void was composed of discrete spatial units. Furthermore, since the spatial magnitude is discrete so time must be discrete. For the *mutakallimûn*, Maimonides tells us, were aware of Aristotle's "mapping argument," which showed that if either motion, distance or time were continuous, then all the others must likewise be continuous; and by the same token, if one of these were discrete, then so must the rest.[30] "Therefore they supposed that distance is not continuous, but composed of parts at which divisibility comes to an end, and that likewise the division of time ends with the instants (*'ânât*) that are not divisible."[31] Consequently, they explained the motion of an object in terms of its coming to be with each new moment (*waqt*) in one of a successive

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[28] For a discussion of *Kalâm* and its atomistic or occasionalist physics see H.A. Wolfson, *The Philosophy of Kalâm* (Cambridge: Harvard UP, 1976); M. Fakhry, *Islamic Occasionalism* (London: Allen & Unwin, 1958); Alnoor Dhanani, *The Physical Theory of Kalâm: Atoms, Space, and Void in Basrian Mu^ctazilî Cosmology* (Leiden: E.J. Brill, 1994).

[29] My account of the *Kalâm* atomic theory is taken from Moses Maimonides *The Guide of the Perplexed* (trans. S. Pines (Chicago: University of Chicago Press, 1963), I.73. It is a curiosity of history that this Jewish Aristotelian provides us with the best connected description of the atomistic theory of the *mutakallimûn*.

[30] *The Guide of the Perplexed*, bk. I, ch. 73, prop. 3.

[31] Ibid.

series of immediately adjacent spatial points.[32] Thus if we think of a motion during the period of time composed of the moments 1, 2, 3, 4 and 5 along a spatial magnitude A, B, C, D and E, at time unit 1, the motion is at A; and time unit 2, it is at B and so forth. As one point of clarification, when Ibn Sînâ discusses this atomic temporal theory, he is clear that he does not understand the theory to be positing time units (or for that matter spatial units) that are atoms in their own right, i.e., time atoms or space atoms, but rather that these "units" are accidents which befall atoms. Thus an aggregate moves because Allah recreates the atoms that comprise the composite at each moment bestowing on them a new accident of location at a new accident of time.[33]

The difficulty with this view, whether as presented by Maimonides or Ibn Sînâ, is that it apparently disallows differences in velocity. For if two mobiles could only traverse one space unit in one time unit and these units are the smallest possible units and thus equal, the same distance would always be traversed in the same period of time. This difficulty was overcome by introducing intervallic rests. That is to say, a slower moving object remains at a spatial location for a number of time units, while a faster moving object continues coming to be at each successive spatial units during these time units. Thus imagine two people, A and B, crossing a distance of one kilometer and A crossing this distance faster than B.

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[32] Ibn Sînâ says that time for the atomists was composed of *awqât* (sing. *waqt*; *Shifâ'* 151.4-1), where a *waqt* possess a certain length or temporal span.

[33] *Shifâ'* 148.9-12.

The distance for the atomists is composed of x number of spatial units, which are the smallest units of spatial magnitude. Thus, if in every case in which A went from one spatial unit to the next, B were likewise to go from one spatial unit to the next, A and B would traverse the kilometer together and A would not be faster than B; for B would be keeping apace with A. But we assumed A did traverse the distance faster than B. Consequently, for every case of A's going from one spatial unit to the next there is not a corresponding case of B's going to the next spatial unit. Hence during some of the cases in which A went from one spatial unit to the next, B remained at a spatial unit and "rested". Thus, A is faster than B in proportion to the number of rests in between B's going from one spatial unit to the next. Although much more can be said about the physical theory of the *Kalâm*, I let these comments suffice as an introduction to Ibn Sînâ's thought.[34]

2. ar-Râzî's Absolute Time.[35] What we know of the thought of Abû Bakr ar-Râzî is limited.[36] His philosophy was repugnant to nearly all Islamic thinkers and thus slowly fell into oblivion. What little we have from the pen of Râzî has been collected together by Paul Kraus in the *Opera philosophica* (Cairo, 1939). We are fortunate

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[34] I refer the reader to S. Pines' classic work *Beiträge zur islamischen Atomenlehre* (Berlin, 1936) and the more recent work by Alnoor Dhanani, *The Physical Theory of Kalâm* (Leiden: E.J. Brill, 1994) for a more thorough discussion of Islamic atomism.

[35] One can find a brief account of the life and philosophy of Abû Bakr ar-Râzî in M. Fakhry's *A History of Islamic Philosophy*, 2d ed. (New York: Columbia UP, 1983): 97-106.

[36] In what follows I either refer to him as Abû Bakr ar-Râzî or use the Latinate Rhazes.

that Abū Ḥatim ar-Rāzī (a Muslim theologian and competent philosopher) kept a record of a debate between himself and Abū Bakr ar-Rāzī (the Rāzī with whom we are concerned) in which an account of the later's "five co-eternals", including his account of absolute time, is preserved.[37] I let a translation of this debate stand for a discussion of Rhazes' view of absolute time.[38]

I [Abū Ḥatim ar-Rāzī] demanded of him [Abū Bakr ar-Rāzī] at another session, saying to him "Tell me, is it not the case that you allege that nothing other than the five co-eternals [i.e., matter, space, time, the Soul and the Creator] is eternal?.

He said: "Yes!"

I said: "However, we know time through the movements of the celestial sphere and the passing of days and nights and the number of the years and months and the elapsing of moments; then are these eternal with time or are they created?."

He said: "It is impossible that these are eternal because all of them are measures (*muqaddirah*) of the motions of the heavenly sphere and numbered by the rising and setting of the sun, but the heavenly sphere and what are in it are created. This is the teaching of Aristotle concerning time; but there might be an other opposed teaching at variance with [Aristotle's].

"Now I say that time is [either] absolute time or determinate (*maḥṣūr*) time. Thus the absolute is the duration (*muddah*) and the everlasting (*dahr*), which is eternal, i.e., it is a non-hesitating movement. On the other hand, the determinate is that which is through the movements of the celestial sphere and the progress of the sun and planets. If you distinguish this and imagine the motion of the everlasting, then you have imagined absolute time and this is endless eternity (*al-'abad as-sarmad*); but if you imagine the motion of the celestial sphere, then you have imagined determinate time."

I said: "Provide me some real meaning which we imagine to belong to absolute time; for when we eliminate the motions of the celestial sphere and the passing of the days and nights and the elapsing of hours from the imagination, time is eliminated from the imagination, since we do not recognize a real meaning belonging to it. Thus produce for me the motion of the everlasting which you mentioned is absolute time."

He said: "do you not see how something of this world comes to

[37] ar-Rāzī is a place name indicating that both men came from Rayy, a suburb of modern day Teheran.

[38] The dialogue is found in *A^clâm al-nubuwwah (The Peaks of Prophecy)*, ed., Salah al-Sawy (Teheran: Imperial Iranian Academy of Philosophy, 1977): 14-16.

an end through time (little, by little, by little)? [The motion of the everlasting] is something which does not come to an end or die. Such is the motion of the everlasting, when you imagine absolute time."

The substance of Abū Bakr ar-Rāzī's comments concerning absolute time ends here. Abū Ḥatim continues with a critique that Abû Bakr has failed to provide the real meaning that belongs to absolute time, i.e., the matter of fact underlying the imagination (*wāqi*[ᶜan] *taḥta al-wahm*). The discussion then turns to the issue of absolute space, which need not concern us. For our purposes we must make one note about Rhazes' absolute time. First, for Rhazes absolute time is eternal, existing independent of any particular motion, such as that of the heavens. Indeed, Rhazes describes absolute time as itself an everlasting motion, and not the motion of any particular thing. However, insofar as absolute time is eternal and has an independent existence, it would be a self-subsisting substance. Therefore, when in the sequel we see Ibn Sînâ critiquing the view that time is something self-subsisting, Abū Bakr ar-Rāzī is undoubtedly his target.

C. Conclusion. We are now in a position to consider Ibn Sînâ's account of time. We have seen the development and modifications of Aristotle's temporal theory at the hands of his Hellenistic commentators--positions Ibn Sînâ would have to contend with in articulating his own understanding of time. Likewise we have seen various competing conceptions of time which existed in the Arabic world, namely, those of the Muslim atomists and Abū Bakr ar-Rāzī.

Ibn Sînâ, like Aristotle before him, dedicates the first chapter of his account of time to laying out the *aporiai* (Arb. *shukūk*) and *endoxa* (Arb. *ārā'*). Among the puzzles Ibn Sînâ mentions, we find the three presented by Aristotle (148.12-149.10), viz., that the parts of time are not real, the now is not a part of time and finally that the now cannot be real. We also see the puzzle associated with the need for a single mobile if there is to be a single time (149.14-150.10)). Finally he presents a puzzle (149.10-14) which seems specifically directed towards the static conception of time espoused by Aristotle. The puzzle simply asks how time can be the extension between two termini (or nows) if one of the termini (or nows) no longer exists.

Among the various opinions about the nature of time we once again find those mentioned by Aristotle, viz., that time is the revolution of the celestial spheres and that time is motion (153.16-154.11). Not surprisingly we also find the opinions of the atomists, who make time a collection of units of time (awqât) (148.10-11, 151.4-11) and Abû Bakr Râzî and his conception of time as an eternal substance (148.12, 151.11-18). Let us now consider Ibn Sînâ's own account of time.

CHAPTER 7

IBN SÎNÂ'S INVESTIGATION INTO AND CONFIRMATION OF THE ESSENCE OF TIME

I
Translation: *Shifâ'*, physics II.11

(155.4-10) So we say: it is clearly obvious that two mobiles could begin and end their motion together and that one of them would traverse a lesser spatial magnitude and the other a greater spatial magnitude, either from the difference in slowness and fastness, or, as some people think, from a dissimilarity in the number of intervalic rests (*ʿadad al-sukūnāt al-mutakhallilah*).[1] Also, two [mobiles] could begin [together] and traverse two equal spatial magnitudes, and yet one of them would come to the end of the spatial magnitude while the other had not yet reached the end. That follows because of the aforementioned differences. In all the cases of the beginning of each motion till its termination there exists a capacity (*imkān*) of traversing that exact same spatial magnitude in that motion determinate in fastness and slowness or determinate in composition in

[1] The "some people" (*qaum*) must refer to the atomists, who would have explained differences in velocity in terms of a greater or lesser number of "rest atoms".

relation to rest.[2] [There is] a capacity of traversing more than that spatial magnitude by [a motion] faster than it or mixing less intermingling rests and also a capacity of traversing less than it by [a motion] slower than the former one or mixing more rests. And indeed that absolutely cannot be disputed.

(155.10-18) Thus between the starting point and termination a well-defined capacity is already established in proportion to the motion and fastness. Now when we postulate half of that spatial magnitude but [still] postulate the same fastness and slowness, then there is another capacity between the beginning of that spatial magnitude and the end point of half of it, in which it is only possible to traverse half [the spatial magnitude] at that fastness and slowness. Likewise, [there is a capacity] between this postulated half-way point now and between the original end point. So, the capacity up to the half-way point and [the capacity] from the half-way point are equal to each other, since each one of them is half of the original postulated capacity and thus the capacity originally postulated is divided.

(156.1-3) At present it does not matter whether you make this mobile something actually moving in place or a part which one assumes belongs to the mobile in position, which resembles the mobile in place. (For [the mobile in position] departs from a contiguous position (*mumāssah*) to a contiguous position by intermediate contiguous positions, or from a parallel position (*muwāzāh*) to a

[2] Reading "*au*" after "*as-surʿata*" with the manuscripts for Zayd's "*wa*".

parallel position by intermediate parallel positions.) Under any circumstances that which is traversed is called spatial magnitude (*masāfah*) and thus no judgment in the course of what we are discussing will differ because of that [i.e., either taking the mobile as something actually moving in place or only moving in position].

(156.3-11) Thus we say: it has proved true that this capacity is something divided and whatever is divided is either a magnitude or possesses a magnitude. Hence this capacity is not lacking a magnitude. So its magnitude must either be the magnitude of spatial magnitude or another magnitude. Now if [this capacity] were the magnitude of spatial magnitude, then things equal in spatial magnitude would be equal in this capacity; however, this is not so. Therefore, it is another magnitude. Again, either it is the magnitude of the mobile or not; however, it is not the magnitude of the mobile, otherwise the greater the mobile is the greater it would be in this magnitude, but that is not so. Therefore, it is not the magnitude of spatial magnitude and it is not the magnitude of the mobile. It is also known that motion itself is not a being (*dhāt*), which is itself the magnitude nor is fastness and slowness that [magnitude]. Because motions, in that they are motions, agree in motivity [lit. "motioness"] and agree in fastness and slowness, but disagree in this magnitude or perhaps the motion disagrees in fastness and slowness, but agrees in this magnitude. So there has been established the existence of a magnitude (which belongs to the capacity of the occurrence of motions between the prior and the posterior requiring well defined spatial magnitudes) which is not the magnitude of the mobile nor the spatial magnitude nor is it motion itself.

(156.11-17) This magnitude cannot be self-subsistent. How would it be self-subsistent when it is something that can diminish (*munaqqaṣ*) along with that of which it is a magnitude and every thing which is diminished and corruptible is either in a substratum or possesses a substratum?[3] Thus this magnitude is related to a substratum, but it is not possible that its first substratum be the matter of the mobile because of what we made clear; for if it were the magnitude of matter without an intermediary, then the matter would become greater or smaller with [the magnitude]. So therefore, it is in a substratum through the intermediary of another disposition (*hay'ah*). Now it is not possible that it be through the intermediary of a fixed disposition (*hay'ah qârrah*) such as whiteness and blackness, otherwise the magnitude of that disposition in the matter occurs in the matter as a permanent, fixed measure. Thus it remains that it is the magnitude of some unfixed disposition (*hay'ah ghayr qârrah*), e.g. motion from place to place or from position to position between which is a spatial magnitude through which positional motion (*tajrī ᶜalayha al-ḥarakah al-waḍᶜīyah*) proceeds. And this [viz. the magnitude of some unfixed disposition] is what we call time.

(156.18-157.4) You know that to be divided into prior and

[3] Excising "*fahuwa*" with M; the Latin reads "Omne autem quod desinit esse et corrumpit est in subjecto aut est causa subjecti." The introduction of "et" does make the text read more smoothly, although it is not necessary.

posterior attends[4] motion; however, the prior belonging to (*min*) [motion] exists in [the motion] because of (*fī*) the prior belonging to (*min*) spatial magnitude and the posterior belonging to [motion] is because of the posterior belonging to spatial magnitude. However, from that it does not follow that the prior belonging to motion is found together with the posterior of [motion], as the before and after in spatial magnitude are found together. Nor is it possible for what is congruent with the prior belonging to motion in spatial magnitude to become posterior nor what is congruent with the posterior belonging to it [to become] prior, as is possible in spatial magnitude. Thus a property belongs to priority and posteriority in motion, which attends them on the part of their belonging to motion, but not on the part of their belonging to spatial magnitude.

(157.4-7) The two are numbered by motion; for motion by means of its parts numbers the prior and the posterior. Hence a number belongs to motion insofar as priority and posteriority belong to [motion] in spatial magnitude. Moreover, a magnitude belongs to [motion] parallel to (*bi-izā'i*) the magnitude in spatial magnitude. Time is this number or magnitude; for time is the number of motion when [motion] is distinguished (*infaṣalat*) into prior and posterior--not by time but rather by spatial magnitude, otherwise the definition

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[4] "*Yulḥiq*" is similar in meaning to Aristotle's ἀκολουθεῖν, having the logical sense of "to follow" and the sense of "connected or "joined with". A.M. Goichon cites Ibn Sînâ as saying that the proper accidents are connected with (*yulḥiqhâ*; suivie) the essence (*Lexique de la Lange Philosophique d'Ibn Sînâ*, 422, 5th ex.). The Latin translating *yulḥiq* is "accidit" (to come; to befall something).

would be circular. This is what some of the logicians supposed, viz., that a circle existed in this definition; because they did not understand [what we have explained] they erred.

(157.7-13) Moreover, this time is essentially a magnitude of what in its essence possess priority and posteriority, of which the prior part does not exist with the posterior, as might be found in the rest of the types of priority and posteriority. This [i.e., time] essentially is some part of it before something and some part of it after something; and the rest of the things are some part of them before and some part after because of it. That follows because the things, in which there are before and after--in the sense that the before pertaining to it is over and the after is not something existing with the before--are only such [i.e., before and after in this sense], not from their essences, but rather because of their existing with two divisions of the divisions of this magnitude. Hence whatever of these [things] is congruent with a part which is before, it is said of it that it is before, and whatever is congruent with a part which is after, it is said of it that it is after. It is also known that these things [i.e., the things in which there are before and after, but not essentially] are subjects of change (*dhawāt at-taghayyur*) in [time]; however, [time] is not something passing away or coming [to be] in [time].

(157.13-18) This thing [i.e., time] is not before and after because of some other thing; for if that were the case, then the before pertaining to [time] would only become the before of [the other things that are said to be before, although not essentially] because of its existence in a before of some other thing. Then that thing, or some other thing to which the regress eventually ends, is essentially before and after[5], i.e., it essentially receives the relation (*iḍāfa*) by which it is before and after. But it is known that that thing [which essentially receives the relation before and after] is that in which the capacity of changes occurs primarily according to the aforementioned manner and [the relation by which something not essentially before and after is before and after] occurs in others because of [that thing]. So that, that thing is a magnitude--the measurer belonging to the aforementioned capacity--measuring by its essence, which is none other than what we have said about it. But we have only made "time" a name for the intention which is essentially a magnitude belonging to the aforementioned capacity in which [this] capacity occurs primarily.

(157.18-158.5) So it is clear from this that this aforementioned magnitude is the very thing which essentially receives the relation before and after. Indeed it itself is divided into before and after. I do not mean by this that time is before not by relation, but rather, I mean that this relation essentially adheres in time and [this relation] adheres in the remaining things because of time. For when something [x] is said to be before, and that thing is not time (so it is like motion, or people[6] etc.), then what it

[5] Excising the "*wa*" before "*qabla*".

[6] The Latin has "quies" (rest), but this is certainly an interpolation rather than a variant reading.

means for [x to be before] is that it exists with something [t] which is in some state, such that there is attached to that state [of t] a "before," when [that state] is compared to the state of the other, if the thing is in [the latter state].[7] That is to say, this adherence belong to [t] essentially.[8]

(158.5-7) Also the priority of what is prior [call it x], is that it has an existence together with the nonexistence of some other thing [y], which was not something existing, while [x] was existing. So [x] is prior to [y] if [y's] privation is considered, but [x] is together with [y] if [y's] existence is considered only. In the state of [x's] being together with [y], then [x] is not prior to [y], but the being of [x] (*dhātuhu*) is fully realized in the two states [i.e., the state of being prior to y and together with y]; there just is not a state of [x's] being prior to [y], when there is a state of [x's] being together with [y]. Thus some sort of priority belonging to [x] might necessarily cease to apply to [x] whenever it is together with [y].

(157.7-13) Hence priority and beforeness are an intention belonging to this being [viz., x], but not essentially [belonging to x] nor [are priority and beforeness] something invariable

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[7]

كان معناه أنه موجود مع شئ هو بحال، تلك الحال يلزمها إذا قيست إلى حال الآخر إن كان الشئ بها قبل لذاته

[8] Reading *"hādhā al-luzūm"* with the Teheran manuscript for Zayd's *"hādhā liluzūm"*. Also, the "it" here is the thing in that state of beforeness, which we shall learn is time.

accompanying the persistence of [x's] being (*dhātihi*).[9] But concerning that intention [i.e., beforeness or priority], it is utterly and essentially impossible that it remain with the other state and also it is impossible concerning it to become together with [the other state]. It is known that this existence does not remain belonging to it with the existence of the other. As for the something to which this intention and thing belong, [to remain] is not impossible for it. For indeed it sometimes exists while it is before and sometimes it exists while it is together and sometimes it exists while it is after, remaining all the while one and the same. As for the thing itself which is essentially before and after, even if by comparison, it cannot remain the same; so that it is after, after it was before. For the intention by which something is after does not come until that by which it is before cease to apply, whereas the something [x] possessing this thing remained with the cessation of the before thing.

(158.13-16) The relation of this thing cannot be either to nonexistence or existence only. For the relation of the existence of something to the nonexistence of a something might be [one of] posteriority just as it might be [one of] priority and likewise with respect to existence; rather, it is a relation to nonexistence joined

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[9] Beforeness and priority are intentions which do belong to concrete things, e.g., my father was existing before me. But this beforeness is not something invariable that belongs to my father so long as he persists; for when I was born, he was no longer existing before me, but was now existing with me. Or to make the same point, if beforeness were something that belonged to my father's essence essentially and invariably, then since it would belong to my father to be essentially before, he would be before his father, which clearly is false.

to another thing, such that when it joins with it, [the relation is one of] priority and if it joins with [something] other than it, it is [one of] posteriority, while nonexistence is the nonexistence in the two states and similarly existence [in the two states is existence]. Likewise, in the same manner as it, it joins with what is related, because what is related is also something conversely related to it and the former judgment belongs to it.

(158.16-159.2) Now this thing is either time or a relation to time. However, if it is time, then that is just what we have been saying it is. If it is a relation to time, then [the relation's] beforeness is because of time and the issue comes back to the fact that the first substratum of this beforeness and afterness is time.[10] Hence before and after essentially befall time, and indeed that which before and after essentially befall is that which we call time. The more so as we had made clear that essentially it is the indicated magnitude of a capacity.

(159.2-8) From which it is correct to say that time is not among the things which exist independently. And how would it be among the things which exist independently, given that it does not possess a fully realized essence, when it is generated and corrupted? Whatever is like this, its existence is related to matter. Thus time is material, but not simply material, but rather something existing in matter through the intermediacy of motion. Hence if there is

[10] I.e., beforeness and afterness are said first of time and only then said of other things.

neither motion nor change, neither is there time. For how would there be time, and not a before and after; and how would there be a before and after when one thing after another does not come to be? For the before and after will not be together, but rather something which is before insofar as it is before will cease to be, because something which is after insofar as it is after will come to be. For if there is not a difference or some sort of change through something ceasing or coming to be, the thing is not after since it was not before, nor will the thing be before since it is not after.

(159.9-16) Thus consequently time does not exist except with the existence of the renewal of a state and it is necessary that it be uninterrupted in that renewal, otherwise time also would not be, since if a thing were all at once, then there was nothing at all until some other thing is all at once, and then one of two things must follow: either (1) between the two things there is the capacity (*imkān*) of the renewal of things, or (2) there is not. If between the two there is the capacity of the renewal of things, then there is a before and after in what is in between the two, but the before and after are only realized by the renewal of things, but we assumed that there is no renewal of things. This is a contradiction. On the other hand, if there is not this capacity between the two, then the two are adjacent; however that adjacency must either be uninterrupted or not. If it is uninterrupted, then what we had posited works out; however, it is impossible and its impossibility will be clarified later. If it is interrupted, then the discussion is where it started. Thus it is necessarily necessary that if there is time, that the renewal of states is either according to adjacency or continuity. Hence if there is not motion, there is not time, since time, as we said, is a magnitude which is continuous, parallel to the continuity of motions and spatial magnitudes; however, there necessarily belongs to it an imaginary division which is called the now.

II
Commentary: *Shifâ'*, physics II.11

Ibn Sînâ's temporal theory is broadly Aristotelian. It makes time the measure or number of motion, as well as exploiting Aristotle's mapping technique between spatial magnitude, motion and time. On the other hand, Ibn Sînâ's theory of time is clearly not Aristotle's theory. Ibn Sînâ provides a version of a proof for the reality of time of which no trace is found in Aristotle. Moreover, the dynamic account of time Ibn Sînâ ultimately endorses is diametrically opposed to Aristotle's own static theory.

Ibn Sînâ's discussion of time moves in two stages. It first offers a proof for the reality of time and then undertakes an analysis of the nature or essence of time. Let us begin with Ibn Sînâ's proof for the reality of time.

A. Spatial Magnitude, Velocity and a Certain "Capacity". Aristotle's account of time lacked an explicit proof for the reality of time, although, as I attempted to show, Aristotle could provide a demonstration of the reality of time and indeed this demonstration underlay and directs Aristotle's discussion of time. Nevertheless, the lack of an explicit proof for the reality of time, especially in the face of the apparently damning critique found in the *aporiai*, created a crisis for subsequent Aristotelians. How could we in fact know that time is real?

Ibn Sînâ offers a needed proof for time's reality (155.4-156.17). In broad outline his argument runs as follows. We observe certain obvious features about motion, e.g., two objects that begin and end together and travel at the same velocity travel the same distance, etc.. Based on such observations a magnitude must be associated with motion, which is neither measured by distance nor velocity. An analysis of this magnitude reveals certain characteristics and essential features, which in turn are identified with time, or at least with what everyone calls time.

1. Two Kinetic Observations. With more precision, the proof begins with a number of undeniable observations about motion. First, two mobiles can begin moving together and then stop together and yet one has traversed a greater distance (155.4-5). For example, we might think of a somewhat contrived auto race. Let two cars begin at the firing of a gun and then end at a second firing of the gun. Clearly one of the cars could cover more distance than the other between the two firings of the gun. One reason the one would cover a greater distance, Ibn Sînâ tells us, is due to differences in fastness and slowness between the two cars, i.e., the difference in the two cars' velocities.

Ibn Sînâ also gives a second possible explanation of this difference, ascribing it to "some people" (*qaum*) (155.5). The suggestion is that the difference between the two could be explained by reference to the difference in the number of rests taken by the two cars. The "some people" here certainly refers to the atomists, whom we have discussed in the previous chapter and I shall let my comments there suffice. At the end of Ibn Sînâ's discussion of the nature of time, he attacks the notion of discrete temporal units; however, at this point he is not begging the question against the atomists. Nevertheless, in what follows I limit myself to the non-atomic explanations of Ibn Sînâ's observations about motion.

A second observation about motion is that two mobiles may begin moving together and both cross the same distance and yet one of them has completed crossing the distance, while the other is still in the process of crossing (155.6). One must merely consider a traditional auto race for an example. Two cars begin together and both traverse the same distance, but one car completes the traversal of the distance while the second car is still completing it. Once again, the explanation for this difference in the two motions of the cars is their difference in velocity.

Ibn Sînâ multiplies similar examples in his smaller encyclopedic work, the *Najât*, but these two are sufficient for our purpose.[11] In all the cases a certain capacity (*imkān*) belongs to the

[11] *Kitâb an-Najât* (Beirut: Dâr al-âfâq al-jadîdah, 1985), 152; there he further observes that two mobiles agreeing in beginning and ending and having the same velocity traverse the same distance. And also, two mobiles agreeing in velocity but not beginning or ending together disagree in the distance travelled.

motion of some mobile across a distance at some velocity (155.7-8). Thus it is possible for two mobiles to traverse the same distance when both are moving at the same velocity, and likewise it is possible for one to travel a greater distance, even though they are traveling at the same rate. For instance, imagine two cars travelling from New York to California and they both begin the trip just as the sun crosses the horizon; further imagine that their speed controls are set so that they both travel at the same velocity. Now let one car stop when the sun is directly over head, while the other one continues until the sun just passes over the horizon. The two cars travelled different spatial magnitudes, even though their velocities were the same. In short, similarities in velocity do not guarantee similarities in distance travelled; there must be some third factor that explains the observed differences.

Again, it is possible for two mobiles to traverse different distances when they travel at different velocity and likewise it is also possible that they travel the same distance, even though they travel at different velocities (155.8-9). Thus return to our cross country trip. Once again let the two cars begin together and one end at noon, the other at dusk; but now let the car that stops at dusk travel at only half the velocity as the car that stops at noon. In this case, despite the differences in velocity the two cars traversed the same distance. On the other hand, if both the cars stop at noon but one travels at twice the velocity of the other, the faster car covers twice the distance. In short, dissimilarities in distance do not entail dissimilarities in velocity. Once again there must be some third factor that explains the differences.

2. The Relation between Spatial Magnitude, Velocity and a Certain "Capacity". This third factor, or what Ibn Sînâ termed "capacity", is the difference in the starting and stopping of the motions or the before and after aspects of the motions (155.10). That is to say, this capacity is the difference between both beginning at dawn and ending at dusk, or both beginning at dawn, but one ending at noon and the other at dusk. For simplicity let us call this capacity, i.e., the difference in starting and stopping, "t". Now if two mobiles have the same velocity and t is also the same, then they both traverse the same spatial magnitude, as is clear from the example of the two cars. On the other hand, if two mobiles traverse the same spatial magnitude, but their velocities are different, there is a proportional difference in t. T is greater for the mobile traveling at the lesser velocity. Thus, concludes Ibn Sînâ, there exists some capacity (or possibility) t, which is proportional to the velocity and distance (155.10).

Ibn Sînâ next attempts to specify the nature of this proportionality. It has been established that two mobiles always and only traverse the same distance at the same velocity if t is the same. We can generalize the point as follows. To explain various kinetic observations we must posit three factors: the distance travelled, the velocity of the motion and t. These three are so related that for any two motions, if two of the factors are the same, then the third factor is also the same. For convenience let us call this observation the principle of *ratio constans*.

We can reconstruct Ibn Sînâ's argument as follows (155.11-18). Imagine a mobile traversing a spatial magnitude ABC at some fixed velocity, v, in which t is determinate. Let this unit of t be designated by 1(t). When the mobile reaches B, the mid-way point, only a portion of 1(t) has occurred, 1(t)/x. Since the mid-way point between AC is B, the distances AB and BC are the same and both can be described as (1/2)AC. Now since AB is the same as BC and the mobile travels at the same velocity across both distances, by the *ratio constans* principle, the t belonging to the motion across AB is the same as the t along BC. Thus the t associated with the traversal of BC is also given by 1(t)/x. Clearly, the sum of the two portions 1(t)/x must equal 1(t), otherwise ABC can be traversed at some fixed velocity, v, in which t is not determinate, which is contrary to the initial assumption. Thus:

$$1(t)/x + 1(t)/x = 1(t).$$

Solving for x we obtain 2. Since half the distance of AC was traversed in 1(t)/x, where x=2, half the distance is traversed in half of the original unit t, i.e., 1(t)/2. In short, distance is directly proportional to t. Consequently, given some motion at a fixed velocity along a determinate distance, for any portion of the distance completed there is a corresponding completed portion of t directly proportional to the distance completed. Or the same point stated slightly different, for any point dividing the distance travelled by a mobile into its completed and uncompleted parts, we can find a corresponding division in t. A similar argument could be given *mutatis mutandis* to show that t is inversely proportional to the velocity.

B. Ibn Sînâ's Proof for the Reality of Time. Before Ibn Sînâ continues he quickly makes a point of clarification (156.1-3). Motion can be of two types:[12] (1) when the mobile actually changes its place, or motion strictly speaking (*mutaḥarrik bilḥaqīqa*) and (2) when the mobile does not change its place, but only the relative position (*mutaḥarrik bilwaḍ*) of its parts, as for example when something spins. The following argument, Ibn Sînâ tells us, is indifferent with respect to which variety of motion one considers. For the two types are significantly alike in the requisite way, viz., they both entail spatial magnitude. Since if you imagine some point on the outer edge of a spinning top, during that point's revolution it marks off a certain spatial magnitude which is equivalent to the circumference of the top.

Having made this caveat, Ibn Sînâ establishes the reality of time (156.3-17). The general structure of his argument is this. The capacity that we encountered above is a type of magnitude. When we consider all the known magnitudes associated with motion, we realize that none of them could be the magnitude in question. Thus the capacity t is neither (1) a spatial magnitude nor (2) the bulk of the

[12] Ibn Sînâ's discussion, like that of Aristotle's, considers only locomotion, or change of place, (and its varieties) and excludes from consideration motion with respect to quantity or quality.

mobile, nor (3) the motion itself, nor (4) the velocity of this motion. Neither is this measure a (5) self-subsisting thing, nor (6) the matter of some self-subsisting thing, nor (7) a fixed or permanent form belonging to a self-subsisting thing. This magnitude t rather is the magnitude of an unfixed disposition, viz., motion, belonging to a mobile, but this is just a description of what we call time. Thus Ibn Sînâ concludes that since a particular magnitude necessarily belongs to motion and this magnitude turns out to be time, given the reality of motion, time must be real. Let us now consider the argument in all of its stages.

In the previous section we saw that t, i.e., a capacity or possibility belonging to motion, was something that was divisible; for it could be divided in proportion to the distance traversed. From the divisibility of this capacity Ibn Sînâ concludes that t is a certain magnitude. Although no explicit argument is given for this inference, we can easily construct one based upon comments made by Aristotle at *Metaphysics* V 13. Aristotle defines quantity there as that which is divisible into constituent elements and a measure as a quantity which is measurable.[13] Consequently, since this capacity is divisible and measurable according to the spatial magnitude over which the mobile moves, it is a quantity and more specifically a measure.[14]

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[13] 1020a7-3; Ποσὸν λέγεται τὸ διαιρετὸν εἰς ἐνυπάρχοντα ὧν [ἑκάτερον ἢ] ἕκαστον ἕν τι καὶ τόδε τι πέφυκεν εἶναι. πλῆθος μὲν οὖν ποσόν τι ἐὰν ἀριθμητὸν ᾖ, μέγεθος δὲ ἂν μετρητὸν ᾖ.

[14] Exactly how this possibility is measured is explained more fully in the sequel; for now it is sufficient to note that since there is a correspondence between the capacity and spatial magnitude and spatial magnitude is measurable,

Hence a magnitude belongs to motion. Of the magnitudes that belong to motion one is spatial magnitude, but the capacity under consideration cannot be spatial magnitude; for then "things equal in spatial magnitude would be equal in this capacity [t]" (156.5). For example, consider two cars that both travel one hundred miles, but one is going at twice the velocity of the other. The starting and stopping of their motions would be different, but we have seen that the differences in starting and stopping just are differences in this capacity. Therefore, the magnitude of this capacity cannot be reduced to spatial magnitude.

Nor can a difference in this capacity be reduced to a difference in the magnitude or bulk of the mobiles. For if this capacity were the bulk of the mobile, then a small mobile and large mobile would always differ in t. This conclusion is false; for take the contraposition of the principle of *ratio constans*, viz., if either spatial magnitude, velocity or this capacity is *not* the same for two motion, then at least one of the others is *not* the same for the two motions. Consequently, if the magnitude of this capacity were the bulk of the mobile, then a motorcycle and a bus (two mobiles clearly differing in bulk) could *not* traverse the same spatial magnitude if they traveled at the same velocity or they could *not* travel at the same velocity if they traverse the same spatial magnitude. Clearly such is not the case and thus this capacity is not the magnitude or bulk of the mobile.

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there is a good presumption for believing it is likewise measurable.

The mobile's motion, or its velocity, cannot be this magnitude either. Consider motion first (156.7-9). Motion is nothing but the reduction of potency to act insofar as a thing is in potency. Take two motions and let them be as dissimilar as you want; insofar as the two are moving, there must be a reduction of potency to act insofar as the mobile is in potency, if there is to be motion. Thus however so dissimilar two motions may be in either their velocities, shape of the mobiles, distance over which they travel or termini at which they begin and end, they can never differ in being motions, when they are moving; however, we have seen that this capacity can differ and often does differ between motions. Therefore, this capacity is not the motion itself.

Nor can this magnitude be the rate of the motion, i.e., its velocity (156.9-10). For two mobiles can either agree (or disagree) in velocity and yet disagree (or agree) in this magnitude. For example, let two cars begin together when the sun peaks in the east and then pace one another so that they have the same velocity; but let one stop when the sun is directly over head, whereas the other continues until the sun just drops below the horizon in the west. The two agree in velocity yet disagree in the magnitude we are investigating. Similarly, let the two cars begin together, yet vary in their velocities; however, they both stop when the sun is over head. In this case both mobiles agree in the magnitude, t, but disagree in velocity. Velocity then is not the capacity we seek.

To this point Ibn Sînâ has asked whether the magnitude of this capacity is some specific thing, e.g., a spatial magnitude, the mobile or the velocity. He now provides a general argument to show that this magnitude could not be any subsistent thing, i.e., a substance, such as the mobile, whose existence is not in another, but is independent (156.11-17). This capacity allows of more and less, or as Ibn Sînâ puts it, "it is something diminished according to its magnitude" (156.12). The proof is that there can be some measure of extent of this capacity and also one half of this capacity. On the other hand, a defining characteristic of a substance is that it does not admit of more and less.[15] One human is neither more an human nor less an human than any other human. Consequently, this magnitude is not a substance, i.e., something self-subsistent. In contrast, insofar as this magnitude diminishes it must be in a substance, i.e., it must be in a substratum or possess a substratum.[16]

Ibn Sînâ quickly rejects certain candidates for what this substratum might be (156.12-14). Unfortunately, his arguments are elliptical and thus we must make explicit what is only implicit. Although the magnitude we are considering is not a self-subsisting thing, it is related to such a thing by being in a substratum. If the magnitude were to belong to its substratum directly, i.e., not through an intermediary, then it must either be the self-subsisting thing's "first form" (i.e., its substantial form) or it's "first substratum" (i.e., its matter). This point, though not made by Ibn

[15] Aristotle, *Categories* 5, 3b33-36.

[16] Cf. Aristotle, *De gen. et corr.*, I 1, 314b27-29.

Sînâ, seems necessary given his ultimate conclusion that the capacity t belongs to its substratum through the intermediacy of motion. Thus to say this capacity belongs to a substratum though an intermediary is to say it does not belong to a substratum through that substratum's "primary" (which can loosely translate *awwal*) constituents, viz., form and matter. The "first form" of a substratum would be its substantial form, but as we have seen neither substances nor substantial forms allow of increase or diminution. Thus this magnitude cannot be the "first form". The "first substratum", on the other hand, is that which first receives a formal determination, viz., a thing's matter. Clearly the substratum of the magnitude we are considering cannot be matter. For if the substratum of this capacity were the matter, it could only be the matter of the mobile; but we noted above that the mobile (or if you will, the mobile's matter) neither increases nor diminishes with an increase or diminution of the magnitude t. Therefore, this magnitude does not belong directly to the substratum either through the substratum's matter or its substantial form, but rather through an intermediary, which itself can allow of increase and decrease without entailing a corresponding increase or decrease in the substratum.

If the magnitude must belong to a substratum, but it can neither belong directly to the matter or be the substantial form of the matter, then the magnitude must belong to the substratum through the intermediacy of some accidental form or disposition (*hay'ah*)

(156.14).[17] This disposition or form can either be fixed (or stable) or not. A disposition is fixed if it can be found belonging to something in an instant or its existence does not have its being through becoming, such as happens with processes. In cases of processes the disposition is unfixed.[18] For example, red is a fixed disposition belonging to an apple, whereas the apple's ripening is unfixed. For in the former case the red endures and can belong to the apple at an instant, whereas in the latter case the apple cannot be ripening at an instant, but rather it is in such and such a state of ripeness at any given instant. If the capacity we are considering belonged to the substratum through the intermediacy of a fixed disposition, then since that disposition is a fixed or relatively permanent feature of the substratum, then this magnitude would likewise be fixed or permanent; however, it is not, since as we have seen the magnitude varies with the motion. Consequently, this capacity must belong to a substratum through the intermediacy of some unfixed disposition belonging to that substratum. Since, as suggested above, unfixed dispositions are processes, e.g., motion from place to place or position to position, this capacity belongs to a substratum insofar as that substratum is in motion.

"Time," concludes Ibn Sînâ, is the name we have traditionally given to this magnitude belonging to motion.

To review, upon considering various instances of motions, Ibn

[17] *Hay'ah* (disposition) seem to be equivalent for Ibn Sînâ to *ṣûrah* (form); cf. 34.9.

[18] Cf. Ibn Sînâ's comment in the next chapter (163.1-3).

Sînâ observes that associated with these motions is a certain magnitude. This magnitude is neither the magnitude of the distance over which the mobile traverses, nor the magnitude of the mobile itself nor the magnitude of the velocity. Moreover, this magnitude must belong to some substratum, but not directly, i.e., as that substratum's substantial form or matter. Hence, the magnitude under question necessarily belongs to a substratum through some accidental form or disposition in the substratum. Such forms in turn can either be fixed or unfixed; however, since this magnitude is not some permanent feature of the mobile, it must belong to the mobile through the intermediacy of some unfixed disposition, viz., motion. This magnitude we call time.

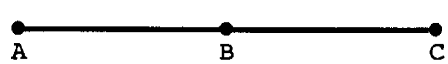
C. Attributes of Motion. Having established that time is real and that it is a magnitude associated with an unfixed disposition, viz., motion, Ibn Sînâ begins an in-depth analysis of motion and the consequent implications of motion's nature on the nature of time (156.18-157.4).

Motion by its nature can be divided into parts that are either prior or posterior to one another; for "the prior belonging to (*min*) [motion] exists in [the motion] because of (*fî*) the prior belonging to (*min*) spatial magnitude and the posterior belonging to [motion] is because of the posterior belonging to spatial magnitude" (156.18-157.1).[19] Thus if we consider some motion, αβγ, along a spatial

[19] The preposition *min*, which I have translated here as "belonging to" is much like the Greek and Latin prepositions "ἐκ" and "ex" respectively. It initially meant "out of" with respect to place, but also came to mean "out of" with respect to some causal point of departure and thus to indicate the source or origin of

magnitude ABC, which begins at A and ends at C, the motion can be divided into prior and posterior parts, e.g., $\alpha\beta$ and $\beta\gamma$, since the spatial magnitude AB is prior to BC with respect to the motion. In other words, the motion itself is divisible insofar as the mobile occupies different positions on the spatial magnitude. The priority and posteriority of the motion's parts are in turn explained by reference to the positional order of the parts along the spatial magnitude. Thus the reason the motion $\alpha\beta$ is prior to $\beta\gamma$ is that in going from A to C one must pass through B prior to arriving at C. There simply cannot be a motion $\alpha\beta\gamma$ where $\alpha\gamma$ is prior to $\gamma\beta$, given the positional ordering of the spatial magnitude ABC. Thus the prior and posterior in spatial magnitude are causally explanatory of the prior and posterior in motion.

Despite similarities between the prior and posterior in motion and spatial magnitude, there are likewise definite differences. Ibn Sînâ distinguishes two. First, that which is prior and posterior in spatial magnitude can exist together in a way that prior and posterior in motion cannot (157.1-2). Thus for example, if I move my finger from A to C across the line ABC, the parts of the line exist together insofar as, if my finger is at A, C still exists and once my finger is at C, A still exists.



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some thing. At *ash-Shifâ": Physics*, 19.11-13 Ibn Sînâ gives an example of ink coming out of (^{c}*an*) vitriol and acid, and further adding that ^{c}*an* and *min* are interchangeable here. The suggestion is that *min* is related to the matter out of which something comes. Thus in our passage, the "material" condition of the prior and posterior in the motion is the prior and posterior in the spatial magnitude.

In contrast, when we consider the motion of my finger over that spatial magnitude, my finger at A does not exist together with my finger at C nor vice versa. Thus A and C exist together, whereas the parts of the motion across AC in no way exist together but must always exist one part prior or posterior to another. We might want to say that the positions in spatial magnitude can exist together *simultaneously*, which is not possible for the prior and posterior belonging to motion, although Ibn Sînâ avoids such blatant temporal terminology.[20]

Second, another feature distinguishing the prior and posterior in motion from that in spatial magnitude is that what is prior in spatial magnitude can become posterior and vice versa, whereas what is prior in a motion can never become what is posterior. Once again, consider a motion, $\alpha\beta\gamma$, along a spatial magnitude ABC, where the motion begins at A and ends at C. On account of the positional ordering of ABC, $\alpha\beta$ is prior to $\beta\gamma$ in the motion $\alpha\beta\gamma$. Now consider a second motion $\gamma\beta\alpha$ along the same spatial magnitude ABC, where the motion begins at C and ends at A. In this case $\gamma\beta$ is prior to $\beta\alpha$, since in the motion $\gamma\beta\alpha$ C is prior to B. Therefore, relative to the motion $\alpha\beta\gamma$, A is prior to B and C, but relative to the motion $\gamma\beta\alpha$, C is prior to B and A. Thus what is prior and posterior can change for

[20] Actually, Ibn Sînâ uses the adverb *ma^{c}an*, which can be translated "simultaneous" but it also has the more general meaning of "together with". I have chosen the more general reading of "together with" since Ibn Sînâ is attempting to explain features about time through an analysis of characteristics belonging to motion. Thus to explain the nature of motion by recourse to temporal notions would undercut Ibn Sînâ's project. Indeed, when Ibn Sînâ has need of the temporal notion of "simultaneity" he employs the locution "*fī zamān wāḥid*" (lit. "at a single time") (cf. *an-Najâh*: the Theology, II.12).

spatial magnitudes. The same is not true of the priority and posteriority that belong to motion. In the motion αβγ, αβ necessarily is prior to βγ, otherwise we are dealing with a different motion, e.g. γβα. In contrast, we are not necessarily dealing with a different spatial magnitude when what is prior and posterior in spatial magnitude changes.

D. Time as the Number of Motion. The priority and posteriority that belong to motion can be assigned a number; for insofar as the motion can be divided into parts that are prior and posterior and those parts can be assigned a number, so can the prior and posterior be assigned a number (157.4-7). Thus if we consider the motion αβγδ, this motion can be divided into the prior and posterior parts αβ, βγ and γδ according as the mobile is located at various positions along the spatial magnitude ABCD; however, since αβ is one part, βγ a second part, and γδ a third, we can assign a number to the whole motion αβγδ, viz. three. For insofar as some motion can be divided up into prior and posterior parts it has distinct successive parts that can be counted. For αβ is distinct from βγ or γδ since it is prior to both of them, βγ is distinct from the other two since it is prior to one and posterior to the other and γδ is posterior to both of the others. The fact that the parts can be so distinguished allows us to number them. Time simply is the number which belongs to the motion insofar as the motion is distinguished into prior and posterior according to a parallel distinction in the spatial magnitude (157.6). Ibn Sînâ says more about how time and motion are numbered in the next chapter (164.13-165.9).

The argument given by Ibn Sînâ is much like the one outlined by Aristotle. An one-to-one relation exists between spatial magnitude and motion, such that divisions found in the spatial magnitude can be mapped on to and distinguished within the motion. Thus since a definite positional ordering belongs to the spatial magnitude a parallel ordering belongs to the motion. This ordering within the motion allows us to distinguish prior from posterior parts in the motion, which can in turn be assigned a certain number. Time is the number of the motion insofar as motion is distinguished into prior and posterior. However, as Ibn Sînâ is quick to remark, the prior and posterior appealed to by the definition are fully explained and distinguished according to distinctions within the spatial order and not the temporal order. Thus Ibn Sînâ's discussion does not appeal to unanalyzed temporal terms to explain time; for the distinction between "prior" and "posterior" are accounted for by appealing to distinctions within spatial magnitude. Hence, Ibn Sînâ tells us, the account of time is not circular.[21]

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[21] It is not certain who the "logicians" are that Ibn Sînâ has in mind. al-Fârâbî was renowned among Arab philosopher as a logician and he likewise commented, glossed and epitomized Aristotle's *Physics*. Yet it seems unlikely that he is the philosopher to whom Ibn Sînâ refers. First, al-Fârâbî was one of the great Arabic philosophers, and although Aristotle does not explicitly say that he is introducing spatial priority and posteriority in order to avoid circularity, the point is obvious upon consideration. Thus short of accusing al-Fârâbî of reading Aristotle superficially, it would seem he would have grasped Aristotle's point. Second, Ibn Sînâ held al-Fârâbî in high esteem and thus if al-Fârâbî is the one who accused Aristotle of defining in a circle, we would expect Ibn Sînâ to treat the objection more seriously. As it stands Ibn Sînâ virtually scoffs at the "logicians". Thus we should look elsewhere for the accused.

Assuming that the accusation of circularity was levelled not in the form of a passing example in a logic treatise, but rather as a commentary on the *Physics*, *E. The Before and After in Time and Time's Essence.* Time is something that must be essentially prior and posterior in the strongest possible sense, i.e., its priority and posteriority cannot be found together as with spatial magnitude; the prior and posterior in time must occur successively, one part of time "existing" after or before another part of it. For although priority and posteriority belong to spatial magnitude, we have seen that this priority and posteriority are not essential to a given spatial magnitude, but only relative to a certain motion over that magnitude. For the prior and posterior of spatial magnitude exist together and moreover one and the same part of a spatial magnitude can be prior or posterior to another part with respect to different motions. On the other hand, time essentially possesses priority and posteriority; for a before time cannot be together with an after time; dawn is not together with dusk. Nor is the priority and posteriority of time relative to some

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we can consult the *Fihrist* for possible candidates. Among these we find: Qudāmah, Thābit ibn Qurrah, Ibn Karnīb, Abū Bishr, Yaḥyā ibn ᶜAdi, Ibn as-Samḥ and although not mentioned we might add as-Sijistāni (who was roughly contemporary with Ibn Sînâ). Yaḥyā's commentary makes no accusation of circularity and in fact emphasizes that priority and posteriority must initially be understood as spatial priority and posteriority [Aṭ-Ṭabīᶜah (The general Egyptian Book Organization), 423-24]. The same can be said for Yaḥyā's student Ibn as-Samḥ [Cf. P. Lettnick, *Aristotle's* Physics *and Its Reception in the Arabic World*, 361]. That neither Yaḥyā ibn ᶜAdi nor Ibn as-Samḥ made the accusation provides some grounds (though by no mean certainty) that Abū Bishr, the teacher of Yaḥyā, did not make the charge and perhaps likewise Ibn Karnīb, who was Abū Bishr's teacher. Thābit ibn Qurrah seems innocent, since, first, he was primarily a mathematician and astronomer and thus the title "logician" seems out of place, but second, and more importantly, his commentary covers only part of *Physics* I and not book IV where the discussion of time is found. For a similar reason we can exclude Qudāmah, who likewise only commented part of the first book. As-Sijistāni defines time as "the number of the motion of the diurnal sphere in respect of before and after", which implies that priority and posteriority are primarily spatial in the definition of time, since the before and after are those of the diurnal sphere [J. Kraemer, *Philosophy in the Renaissance of Islam: Abū Sulaymān al-Sijistānī and His Circle*, 166]. In short, a brief investigation of those thinkers most likely to level a charge of circularity turns up nothing.

other thing such that one part of time is either before or after another on account of this other thing, but rather it is on account of time that we say all other thing are either before or after.

We must consider in some detail Ibn Sînâ's arguments that time is essentially before and after; however, before we do so, let us respond to a potential objection. Although Ibn Sînâ does not consider this question, one may complain that time possesses priority and posteriority because motion is essentially before and after. Thus it is motion that rightly should be called essentially before and after, while time is only so on account of the motion. The objection fails. For although time has its reality through the intermediacy of motion, it does not follow that an intermediate must itself have all the attributes essentially that belong to that of which it is an intermediary. For example, an object is essentially visible through having color, but in order for something to be colored there must be the prior accident of extension or quantity, which as it were plays the role of an intermediary; however, quantity is not essentially colored. Furthermore, although two times are essentially prior and posterior to one another, two motions are not essentially prior or posterior to one another. Consider two motions, αβγ and γβα; let αβγ begin at dawn and γβα begin at noon. The motion αβγ is before γβα, but nothing belongs to αβγ *per se* that entails it must be before γβα; for we can just as easily let γβα begin at dawn and αβγ begin at noon. For example, let a train going from Washington D.C. to New York City leave at dawn and another train going from New York to Washington leave at noon. Nothing forbids us from making the morning train begin in New York and terminate in Washington and the afternoon train leave from Washington and arrive in New York; we just change the train schedule. On the other hand, it is essential that two times be before or after one another. We cannot stipulate that noon today will be before dawn today any more than we can postulate an human that is not an animal. Time, then, is essentially before and after and all other things are before and after on account of time.

Ibn Sînâ offers two arguments that time must possess priority and posteriority essentially, while everything else possesses them on account of time. First at 157.12-13 we are told that all things that come to be before or after, e.g., motions or substances, are subjects of change[22]; for insofar as something comes to be what it was not, there is change. Thus if something that was not before and after came to be before and after, then there must likewise be a change. However, all things that are subject to change, do so in time; for there is some moment when they are not-x, then a different moment when they are x, and since moments cannot be immediately adjacent to one another there must exist an interval between them, which is time. Now if before and after did not essentially belong to time such that before and after had to come to belong to time, then time would be a

[22] We saw above how two motions might be before or after and the same can be said of substances; for the summer lettuce in my garden is before the fall lettuce, or I was before my younger brother (in that I existed in an interval of time before my brother existed). Although all these are cases of one thing being before or after another, before or after do not belong to them essentially.

subject of change; however, if time were a subject of change, time would come to be in time. Thus for time to come to be before and after there would already have to be a time, which is before and after; and this is absurd. Consequently, time must be before and after essentially; for if something is essentially x, then it does not come to be x, but rather it is what it is to be x. For example, fire does not come to be hot, but rather fire is what it is to be hot, although it is on account of fire that other things come to be hot, at least according to Aristotelian physics. Similarly time does not come to be before and after, but rather it is essentially before and after.[23]

Ibn Sînâ's second proof is intended to show that there cannot be some other thing by which time is before and after; thus since priority and posteriority do belong to time they must belong to it essentially (157.13-18). Assume that there is some other thing by which priority and posteriority belong to time. Then things, other than time, that are before and after are such because they are congruent with some interval of time and the interval of time is before or after because it is congruent with some *tertium quid* which is essentially before or after. Now this *tertium quid* cannot be before or after because of some other thing; for if the regress is infinite there is no explanatory principle of one thing's being (temporally) before another. Wherever the regress ends, this thing

[23] One note of clarification, the argument is *not* that the befores and afters in time change; for Ibn Sînâ they do change. Instead, the argument is that the before and after cannot be a property which comes to belong to time--what it is to be time is to be before and after.

must be essentially before and after, since it does not have its priority and posteriority by virtue of another. Furthermore, this *tertium quid* is primarily a certain capacity, or interval, in which change occurs; for all things that are subjects of change entail some moment when they are not-x, then a different moment when they are x and since moments are not immediately adjacent to one another there exists an interval or, as Ibn Sînâ terms it, a "capacity" between the two moments (157.15-16). Also, since the relation of before and after belongs to this *tertium quid* essentially, it is essentially divisible into before and after (157.16-17). We have seen, however, that whatever is divisible is a magnitude. Thus this *tertium quid* is a certain capacity belonging to change or motion and is itself a magnitude; however, we laid it down that we would use the name "time" for that capacity belonging to motion that is a magnitude (157.17-18). Therefore, time is not made before and after by virtue of some third thing, which is essentially before and after, since any thing which might play the role of this *tertium quid* would itself have to be time.

Ibn Sînâ is quick to clarify that when he says that time is not before and after by virtue of another, he is not gainsaying that time is before and after by virtue of some relation belonging to time, viz., the relation of before and after (157.18-158.5). The difference is that the relation of before and after does not belong to time by virtue of another as it does in the case of two motions, one of which is before another; but rather the relation of before and after inheres in time essentially.

F. The Before and After in Other Things. Those things that are not essentially before and after come to be before and after insofar as they are congruent with (or coincide with) something that is essentially before and after, viz., time (158.2-5). We can reconstruct Ibn Sînâ's thought as follows. Time, we have seen, is a certain magnitude or measure belonging to motion. Moreover, this magnitude in turn allows of certain divisions of before and after by which we attribute a number to time. For example, consider the motion of the sun. Certain befores and afters can be posited in this motion according as the sun occupies different spatial locations. Thus we can mark a division when the sun just peaks the horizon in the east and again when it is directly overhead and again when it just passes below the horizon in the west. (Even finer divisions can be posited using the gnomon, astrolabe or sextant.) Time is the interval running between these various divisions, which are ordered such that any given interval is essentially either prior or posterior to any of its fellow intervals. Thus x is before y because x corresponds with, or can be mapped onto, an interval of some ordered system and likewise y can be mapped onto a different interval on this system. Furthermore, a unique number can be assigned to any interval in this ordered system. For example, the interval congruent with x might be assigned 1 and that of y assigned 2. Consequently, since 1 is prior to 2 in the ordered system, x is said to be prior to y. A concrete example will explain. Take two events: my birth and my baptism. These two events are congruent with certain intervals that can be mapped onto a specified ordered system of dating. In the United States we number time using a Gregorian calendar and a division of the day into twenty-four parts. Thus we can assign the number AD-09.11.65:07.32 to my birth and AD-04.10.93:20.45 to my baptism, since AD-09.11.65:07.32 is prior to AD-04.10.93:20.45 on this ordered system, my birth is prior to my baptism.[24]

Ibn Sînâ has just explained how things that are not essentially before and after can be said to be before and after. He now adds that one thing that is not essentially prior to another can be both prior to and then together with (or more loosely, simultaneous with) some other thing and he explains how this occurs (158.5-7). When we say that x is prior to y, we mean that x was something existing but y had not yet come to exist. Thus if x exists and y has not come to exist, then x is prior to y. On the other hand, if x is existing and y is existing and we merely consider x and y insofar as they are existing, i.e., we set aside any other relations that might also hold between the two, then x and y are together (or simultaneous). Hence, if x was something existing and y had not yet come to be, but then y came to be, x would be something existing both as prior to y and then

[24] There may be a certain misgiving that through some manipulation of the ordered system it might turn out that my baptism predated my birth. This inclination comes from mistaking the system of numbering from that which is being numbered. The numbering system is just a convenient way of marking off distinctions of before and after in something which is essentially before and after. Thus to manipulate the number system such that "my baptism" predates "my birth" is no different than tweaking our mathematical system such that "2+3=6" comes out true just by assigning the multiplication function to the sign "+"; the collection of two thing and three things will always be five things regardless of how much one distorts some mathematical system.

together (simultaneous) with y. The one caveat on x's being both prior to and together with y is that x is not prior to y while it is together with y. Consequently, something that had belonged to x, insofar as x was prior to y, ceased to apply to x when x and y came to exist together. Stated differently, there is no paradox in the claim that x is prior to y and x is together (or simultaneous) with y, provided that x is something that can persist existing in one state, or with one intention, and then with another state or intention.[25]

Once again a concrete example may help. My father came to exist in 1939 and is still continuing to exist. Between 1939 and 1965 he existed while I had not yet to come to exist and hence he existed prior to me; however, after 1965, when I came to exist, we exist together (simultaneously). Thus with respect to our existence only, he no longer exists prior to me, but with me. Consequently, the relation of priority, which had belonged to my father between 1939-1965, ceased to belong to him with my birth, since he is now

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[25] The Arabic *ma*ᶜ*ana*, which I have translated, following the Latins, as "intention," literally means concept and often translates the Greek term λόγος and has much the same scope of meaning. [Cf. Richard Frank, "*Al-ma*ᶜ*nâ*: Some Reflections on the Technical Meanings of the Term in the Kalâm and its Use in the Physics of Muᶜammar" [*Journal of the American Oriental Society* 87 (July-September 1967): 248-259] for some of its various meaning within the medieval Arabic milieu]. Intentions are in general those properties which, though not essentially material, nevertheless belong to some sensible form. [Cf. Deborah Black's "Estimation (*Wahm*) in Avicenna: The Logical and Psychological Dimensions" in *Dialogue* XXXII (Spring, 1993): 219-258.] Thus Ibn Sînâ is fond of giving the example of hostility in the wolf. We have seen, though, that time, and consequently priority and posteriority, must belong in a substratum, albeit through the intermediacy of motion, or, as Moses Maimonides nicely describes it, as an accident of an accident of a substratum [*The Guide to the Perplexed*, II.13, "first theory"].

together with me, although my father does not cease to be when he ceases to be prior.

The situation is different with respect to the intention or state by which one thing is prior to another (158.7-13). For the state of priority is essentially prior and thus cannot become together with or posterior to anything, without ceasing to be all together. In other words, we recall that one thing, x, is said to be prior to another, y, just in case x's existence is congruent with some thing (i.e., some state or intention) that is essentially prior; however, when both x and y are congruent with the same thing (or state or intention), they are together with each other (i.e., they are simultaneous). On the other hand, that state by which x is prior to y cannot be together with that state(s) by which x and y are together; but rather one state (or intention) must cease to be when the other one come to be.

Section 158.13-16 is a response to a potential objection. Above, Ibn Sînâ had observed that x is prior to y only if x exists when y does not exist. Hence one may be tempted to argue that existence and nonexistence are sufficient conditions to explain priority and posteriority. One does not need to appeal to some magnitude that is essentially ordered into before and after. We might want to view Ibn Sînâ's comments here as a rebuttal: existence or nonexistence, although a necessary condition for x's being prior to y, is not a sufficient condition. For x can exist after y and then x would exist when y does not exist, and yet x would not be prior to y but posterior to y. Thus there must be something more than just the existence or nonexistence of x or y to determine the proper relation of priority and posteriority between the two. Thus if x is prior to y, then not only must x exist when y does not exist, but x must exist with some other thing by which x is indeed prior to y and not posterior to it.

Having argued that things not essentially before and after are only such by relation to something that itself is essentially before and after, Ibn Sînâ reiterates that indeed time (or at least something intimately related to time) is what is essentially before and after (158.16-159.2). For if this thing by which x is prior to y is time, then time is nothing more than what has been described. Namely, it is something that is essentially before and after which can be marked off according to distinctions of prior and posterior and each distinction can be assigned a number such that other things' existing congruent with these distinctions are either prior to, posterior to or simultaneous with one another. On the other hand, if this other thing by which x is either prior or posterior to y is not time, but is related to time, we must consider this relation. If the relation of priority and posteriority of this other thing belongs to it through time, then that in which priority and posteriority inhere first is not this other thing, but rather time and priority and posteriority only inhere in this other thing on account of time. Therefore, x is prior to y because (1) x exists when y does not exist and (2) x exists congruent with some thing that is before the existence of y; and this something is either time itself, which is essentially before and after, or something that receives its beforeness and afterness because it is related to time. This, continues Ibn Sînâ, is all in keeping with and in fact entailed by the earlier discovery that time is a certain magnitude of a capacity belonging to motion.

G. Time's Mode of Existence: 1. Time Is Not Subsistent. From this discussion, Ibn Sînâ concludes that time cannot be something with an independent existence (159.2-8). Ibn Sînâ most likely has Abû Bakr ar-Razî as his target, since, as we have seen, ar-Razî included time among his five eternal principles.[26] Absolute time for ar-Razî, though perhaps revealed by motion, has its existence independent of the universe and its motion. In contrast, Ibn Sînâ observes that if something is to have its existence independent of anything else, then as a minimum the essence of this self-subsistent must exist fully realized (159.3). An essence is fully realized, we might add, if what it is to be that thing can exist all at once. For example, rational animality exists all at once in humans. It is not the case that what it is to be human is to be rational and then later an animal (or vice versa); but rather an human is both rational and an animal all at once. On the other hand, if the essence of something cannot exist all at once, but has its existence by being in some state and then in some other state, then that thing can only exist if there is some substratum in which these different states

[26] Cf. chapter 6, §B.2, "ar-Râzî's Absolute Time".

occur. Thus if there is a change or a motion, there must be the matter that undergoes this change (159.3-4).

The essence of time (or what it is to be time), we have seen, is to be prior and posterior. Furthermore, the prior and posterior cannot exist together or all at once, as has been noted. For what is prior in time ceases to be or is corrupted when that which is posterior comes to be or is generated; for that which is essentially prior can never exist together with that which is essentially posterior, since then that which cannot but be prior would be posterior and that is absurd (159.6-7). But if the essence of time is to be prior and posterior and yet the priority and posteriority of time cannot exist together, then there must be a ceasing to be of what is prior and a coming to be of what is posterior (159.5-6). In short, in order for the essence of time to be, there must be motion. Thus with reason Ibn Sînâ makes the peculiar claim that time is material (159.4). For there cannot be time without motion, nor motion without the material substratum that undergoes the motion and thus time is related to matter through the intermediacy of motion (Ibid).

Consequently, if there is to be time, there must be motion, which as it were renews the states of priority and posteriority that make up the essence of time (159.9). That is to say, some present state must become prior and some posterior state must become the new present. This coming to be and passing away, however, are nothing more than motion.

2. Time Is Not Atomic. Moreover, this renewal of the priority and posteriority of time must be continuous (*yastamirra*), i.e., the motion must be continuous (159.9).[27] To prove this thesis Ibn Sînâ has us imagine the case where time is not continuous (159.10-16). Under this new scenario one state of priority or posteriority comes to be and then ceases to be all at once, and then another state comes to be and ceases to be all at once and so on. Thus, instead of imagining time as, for example, the continuous flow of a spot light, we are asked to imagine time as the lights on a marquee, where one light goes on then goes off and then the next light goes on then off and so on. The notion of time which is being suggested is an atomic conception of time, where each of the states is the minimum, indivisible time unit and time is the composite of these units.[28]

Assuming the atomic conception of time, the relation between any two time units must be in one of two ways (159.10.11): either (1) between any two time units there is the possibility that one thing can be prior or posterior to another or (2) there is no such a possibility. To gain a purchase on option (1), once again consider the example of the marque lights. Imagine one light going off and then a pause during which there is nothing and then the next light goes on. What Ibn Sînâ wants to know is whether between any two time units there is an interval or not. If there is an interval, then we

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[27] Although we would prefer the verb *yattaṣila*, which is the more philosophically appropriate term for what is continuous, the context is clear that Ibn Sînâ is concerned with the continuity of time.

[28] Cf. *Shifâ'* II.10, 151.4-11 and also Moses Maimonides' *The Guide for the Perplexed*, bk. I, ch. 73, prop. 3.

can conceptually divide the interval according to differing states of priority and posteriority. Consequently, there must be the change from one state to another and hence a renewal of priority and posteriority; however, we are assuming that there is no renewal. Therefore, option (1) cannot hold and there cannot be an interval between any two time units. Hence, concludes Ibn Sînâ, the two must be adjacent (*mutalāṣiq*) (159.12). Adjacency can be understood in two ways (159.12-13): either (2a) as continuous (*mustamirr*) or (2b) discontinuous. We can make short order of (2b); for if two time units are in succession according to discontinuous adjacency, then we merely ask whether an interval exists between the two or not, but then we have returned to our original question and we find ourselves in a circle (159.14). On the other hand, (2a) is more interesting. For although Ibn Sînâ claims there is an impossibility in asserting time composed of minimum time units, he does not make clear here what the impossibility is. Moreover, he promises he will clarify what is impossible with the suggestion in the sequel; unfortunately, it would appear as if he forgot his promissory note.[29] Thus it is up to us to suggest what Ibn Sînâ may have found objectionable with composing

[29] I have looked at book III.4, 188.7-197.11 (especially, 189.8-190.11) of Ibn Sînâ's physics, which contains his discussion of atoms and the composition of magnitudes from indivisible units. He provides three argument against the composition of magnitudes from indivisibles, which I have included as appendix F. The first argument is analogous to the one I offer in the body. The second argument assumes the premise that if something is truly indivisible, then it cannot have extremities. My suggestion as to Ibn Sînâ's argument employs just this premise. The third involves impossibilities explaining geometrical relations (e.g., the relation of the hypotenuse to the sides of a right triangle) if one posits minimum, indivisible spatial units. This argument clearly does not translate into temporal terms.

time from indivisible time units.

Shayegan believes that the impossibility that Ibn Sînâ has in minds is Zeno's "Arrow" paradox.[30] The paradox runs as follows. Recall that time, on the account that Ibn Sînâ is criticizing, is constructed from indivisible time units, which are the minimal units of time. It cannot be the case that a motion occurs in a single time unit, because then the time unit could be divided into prior and posterior parts according to the priority and posteriority of the motion. Hence we would be able to distinguish amounts of time less than the time unit, which is contrary to the assumption that time units are indivisible and the minimum units of time. Now anything that occupies a space equal to itself is at rest. Therefore, at each time unit a flying arrow occupies a space equal to itself; for otherwise there would be motion in a time unit, which we have precluded. Consequently, at every time unit during the arrow's flight it is at rest; however, if at every time unit during its flight it were at rest, the arrow would be at rest during the whole time of its flight. Thus during the motion of the arrow, the arrow would not have moved. Therefore, since the Arrow paradox rests on the assumption that time is composed of indivisible time units and this supposition is the one being put forth Shayegan sees the Arrow paradox as the offending impossibility.

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[30] Shayegan, "Avicenna on Time," 144-146. Shayegan limits her discussion of the paradox to a quotation from Aristotle; "at any given instant during the whole of its supposed motion the supposed moving thing is in the place it occupies at the instant, the arrow is not moving at *any time* during its flight" (*Phys.* VI 9, 239b6-8). I shall try to present the paradox more fully.

Ibn Sînâ may have in mind a different impossibility, which, though related to Shayegan's suggestion, appears more immediate. This is Aristotle's objection at *Physics* VI 1 concerning the composition of any magnitude from indivisibles. Once again, the position which is being refuted by Ibn Sînâ is that time is the composition of immediately adjacent time units. Now assuming that these time units are indivisible, which seems to be demanded, then they cannot have parts; for then they could obviously be divided into their component parts. Now if a time unit has no parts, then neither can it have extremities; for if it has extremities and these extremities are distinct, then the time unit could be divided into these extremes. On the other hand, time does have a magnitude, but no magnitude can be formed by placing one dimensionless magnitude "next" to another. For neither can that which has no dimension produce a dimension nor can that which has no extremity be placed "next" to another. (Especially if that other is also lacking an extremity.) Thus if one assumes that time units are contiguous with one another continuously, it is impossible to explain the magnitude or continuity of the time.[31]

Although Shayegan's suggestion that the impossibility that Ibn Sînâ has in mind is Zeno's Arrow paradox has merit, I prefer my own for three reasons. First, Ibn Sînâ's vocabulary (159.9-16) hearkens back to *Physics* VI 1. Here Aristotle constructs his argument against composing a magnitude from discrete points in terms of *suneches* ("the

[31] Cf. chapter 3, §E, "The Continuum" for Aristotle's complete argument.

continuous") and *haptomenon* ("in contact"), which are just the corresponding Greek terms for Ibn Sînâ's Arabic *mustamirr* and *iltiṣāq*. Second, the issue at hand in Ibn Sînâ's discussion is whether time is continuous or composed of discrete time units; however, this is the very issue that *Physics* VI 1 immediately addresses, since it is impossible to compose a magnitude from discrete, indivisible units. In contrast, Zeno intended the Arrow paradox to show that motion itself is not real, not that time cannot be composed of indivisible time units. Third, my suggestion is more consistent with the comments Ibn Sînâ does make about atomism, or more specifically, why bodies cannot be composed of indivisible atoms. Once again, Ibn Sînâ, to the best of my knowledge, never explicitly refutes the theory of atomistic time; nevertheless, he does attack the doctrine that bodies can be composed of indivisibles (III 4, 189.8-190.11) and we can generalize his argument there (or at least his first argument) to show that no magnitudes are composed of indivisible.[32] Once we generalize his argument and adapt it to time, Ibn Sînâ's argument looks much like the one I have suggested.

Ibn Sînâ concludes this chapter by once again reiterating that if there is time then there must be a continuous renewal of prior and posterior states, which can only come about if there is a continuous motion, whose continuity in turn is explained by an appeal to the continuity of the spatial magnitude through which the motion occurs. Nevertheless, though time is continuous and not composed of

[32] Cf. appendix F for a translation of his arguments.

indivisible units, there is an "imaginary" division which belongs to time and by which time may be conceptually divided into units. This division is the now and is the subject of Ibn Sînâ's next chapter.

H. Conclusion. Ibn Sînâ's account of time clearly has an Aristotelian flavor to it. Indeed, in one place Ibn Sînâ virtually quotes Aristotle's canonical definition of time.[33] Yet no one can accuse Ibn Sînâ of merely aping Aristotle. Ibn Sînâ provides an explicit proof for the reality of time that is lacking in Aristotle. Furthermore, he undertakes an analysis and examination of the manner in which time is a measure of motion and the exact role of before and after (or the prior and posterior) concerning this measure. Again, he also explains the way other things are said to be before and after according to their relation to time. Finally, Ibn Sînâ's account confronts issues which, if not unique to the Arabic context, are at least closely associated with this milieu, viz., the notion of time as a self-subsisting, eternal principle and the developed doctrine of atomic time. Even in light of Ibn Sînâ's originality in this chapter, I believe, his next chapter, i.e., his discussion of the now, reveals Ibn Sînâ at his most creative.

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[33] Cf. Aristotle's "time is the number of motion according to prior and posterior" [219b1-2] and Ibn Sînâ's "time is the number of motion distinguished into prior and posterior" [157.6].

CHAPTER 8

IBN SÎNÂ'S ELUCIDATION OF THE NOW

I.
Translation: *Shifâ'*, physics, II.12

(160.4-7) We say: the now is known from knowing time. Thus since time is continuous, necessarily it has a division which is imagined and is called the now. This now is absolutely not something in act existing in time itself, otherwise it would sever the continuity of time. Its existence, rather, is only as the estimative faculty imagines it,[1] viz., a connector in a linear extension.[2] For the connector is not something actually existing in a linear extension insofar as it is a connector; otherwise the connectors would be infinite, as we shall make clear later.

(160.7-161.1) Indeed [the now] would only be in act, if it

[1] *ᶜalā an yatawahhamahu al-wahm*; lit. as estimation esteems it. "Estimation" is a complex notion for Ibn Sînâ. Roughly, estimation is one of the internal sense faculties, which has intentions (*maᶜānī*; see *supra*) for it proper objects. Cf. Deborah Black's "Estimation (*Wahm*) in Avicenna: The Logical and Psychological Dimensions" in *Dialogue* XXXII (Spring 1993): 219-258. I have chosen to use the English "imagine" instead of "esteem" to express the activity of the Avicennian estimative faculty or its operation , since "imagine" seems to make more sense in English; nevertheless, one should not confuse my use of imagine with the Avicennian imaginative faculty (*mutakhayyilah*) or its operation. These are two distinct faculties.

[2] Literally, "something straight in extension".

were to sever time with a kind of discontinuation. But it is impossible that it sever the continuity of time, because if a discontinuation is attributed to time, then that discontinuation must be at either [I] the beginning or [II] the ending of the time.

[I] On the one hand, if it is at the beginning of the time, then from that it is necessary that no "before" belonged to that time. If no "before" belonged to it, then it is necessary that it was not something nonexisting, and then it exists; for when there is something nonexisting and then it exists, its existence is after its nonexistence. Thus its nonexistence would be *before* its existence. Hence a "before" would necessarily belong to it and that "before" would be an intention other than the "nonexistence" characterized according to the manner which we asserted in this situation.[3] So this thing of which this species of beforeness is predicated would be fully realized (*ḥâṣilan*), when this time was not. Thus before this time there would be a time continuous with [this time]--that one before and this one after--and this division would join the two, whereas it was posited as a division, so this is a contradiction.

[II] Likewise, if [the now] imposed a division in the manner of an end point, then either [A] there would be the possibility of something existing after it, or [B] there would not be. [B] Now on the one hand, if it were not possible that something exists after it, not even that whose existence is necessary,[4] (so that it is

[3] Excising *bihi* with the manuscripts.

[4] The phrase employed here is *wājib al-wujūd*. *Wājib al-wujūd* is the technical terminology for God, yet as Professor Michael Marmura has pointed out to me the

impossible that something exists with the nonexistence which is reached after the end point), then absolute possibility and that something necessary exists necessarily would have been eliminated; but necessary existence and absolute possibility are not eliminated.[5] [A] On the other hand, if that [i.e., the possibility of the existence of something] were after it, then it would have an after so that it would be before [and argument [I] applies]. Thus the now is a connector, not a divider.

(161.1-7) Hence time, in relation to itself, does not have a now existing in act, but rather [the now exists] in potency. I mean by ["in potency"], potency proximate to act, i.e., time is always disposed to the now being posited in it, either by someone positing it or by the motion coming to a concurrent, undivided boundary, like the starting point (*mabda'*) of the rising and setting [of the sun] or the like. This does not really produce a division in the essence of time itself, but rather in its relation to motions, like the relative divisions produced in other magnitudes. For example, one part of a body is divided from an other part by [the one part being] parallel to or in contact with [the other] or by someone positing it without an actual division having occurred in it in reality; rather a division occurs in it through a comparison to something else. When this now occurs by means of this relation, then its nonexisting is only in the totality of time after it.

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context virtually demands that Ibn Sînâ be discussing existents within the temporal order. Consequently, *Wājib al-wujūd* here should be taken as short hand for *Wājib al-wujūd bi ghayrihi*, the necessary existent through another.

[5] Reading *la yartaffʿān* with the Teheran manuscript.

(161.7-12) One [can only] say "[the now] is corrupted in the immediately following now or a now which does not immediately follow it" after committing [oneself] to [the now] having a corruption which begins at a now, or even the beginning of its corruption is at the limit of time during the whole of which it is nonexistent.[6] However, nothing more is understood by "corruption" than that something is nonexistent after its existence. [The now's] existence in this situation is that it is a limit of time [but] during [time] it is something nonexisting; as if you said that [the now] is an existing thing at the limit of time [but] during [time] it is something nonexisting. Now its corruption does not have a beginning which is the first now in which it is corrupted;[7] on the contrary, its existence is nothing other than a division between [time's] existence and its nonexistence. And you will learn that there does not belong to being moved and resting and generating and corrupting a first now in which there is being moved or resting or generating or corrupting, since potentially time is infinitely divisible.

(161.12-162.10) Should someone suppose on the basis of this that he can say either that the now becomes nonexistent gradually (so that its setting off into nonexistence extends over a space of time) or that it becomes nonexistent "all at once" (so that its nonexistence is in a now), the falsity of [this] assertion will need to be explained.

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[6] Reading *bal* for *bilā* with the Teheran manuscript.

[7] Literally, "belonging to its corruption there is not a beginning of corruption, which is the first now in which it was corrupted."

We say that the nonexistent or existent happening "all at once" (in the sense of occurring in a single now) is not necessarily the opposite of what either gradually comes to be or ceases to be, but rather it is more specific than that opposite. That opposite [i.e., the opposite of what comes to be gradually] is what does *not* go gradually to existence or nonexistence or alteration or the like. This holds true [1] of what occurs "all at once"; and it holds true [2a] of the thing which is nonexisting in all of a certain time, but is existing in [time's] limit which is not time, or [2b] the thing which is existing in all of a certain time but is not existing in [time's] limit which is not in time. For indeed it is not the case that these two exist or not exist gradually, and the first, i.e., that of which the existence or nonexistence is in a now, is also thus.

The latter viewpoint [2], however, is distinct from that first viewpoint, because the first viewpoint has assumed that the judgment concerning the now of time, which is essentially [time's] end point, is like the judgment concerning all time.[8] On the other hand, in the latter viewpoint [2] it has been assumed that the judgment about the now is different from the judgment about time, from [the fact that] one now is not placed after a different now (otherwise the nows would be adjoining);[9] however, [according to the second view] that now is

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[8] Reading *ān* for *an*.

[9] *Mushāfa*^{c}*a*, which I have translated "adjoining", is not a standard Arabic term and possibly Ibn Sînâ coined it. In *Shifâ'* III.2, 181.9-10 Ibn Sînâ defines *tashāfu*^{c} as a state of touching the following [thing] *qua* following; *wa ammā at-tashāfu*^{c}*u fa huwa ḥāl mumāssin tālin min ḥaythu huwa tālin*. Thus given the similarity of meaning

nothing other than a limit.

Our debate does not concern whether this second viewpoint turns out to be true or not; for we are not debating it with a view to affirming its existence, but rather we speak about it insofar as a certain negation is predicated of it, namely, the negation that it comes to exist or not exist gradually. Now there belongs in that [negation] a partner (*sharīk*); but that partner is more particular than this negation and the more particular is not intrinsic to the more general, nor is it necessary that something insofar as it is conceptualized as a subject or predicate be such that it is affirmed or not affirmed in its existence--this had been learned in the art of logic. Hence if the claim "it comes to exist or not exist gradually" is more general than the claim "it comes to exist or not exist 'all at once'" (in the sense that that thing's state is in an initial now), then the assertion that "either it is gradually or it is 'all at once'" (in this [previously mentioned] sense) does not hold true through the validity of a disjunction covering either the two extremes of the contrary, or the contrary and what is intrinsic to its contrary.

(162.10-14) And again: the opposite of what exists "all at once" is what does not exist "all at once", i.e., it does not exist in an initial now. But it is not necessarily intrinsic to [the opposite of that which exists or does not exist "all at once"] that it exists or not exists gradually; indeed that which is in accordance

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between forms III (fāᶜala) and VI (tafāᶜala) *mushāfaᶜa* could mean to bring about this state of being in contact with what is next.

with the aforementioned viewpoint [viz., 2] might be truly asserted in relation to it. Unless of course by "something existing 'all at once'" one means that which does not exist now unless (a) existence is fully realized in it, and (b) there does not exist a now at which it is still in process. It is also likewise for "something not existing 'all at once'" according to [what has been said]. For if this is the meaning, then this is intrinsically the opposite and the premise is valid. Yet it is not necessary that [without these stipulations this opposite's] initial existence or ceasing to be is "all at once".

(162.14-163.11) Here is something important, and even if it does not fit in this place, it is appropriate that we mention it in order to verify what we have said. That is to say, it is worth our while to investigate whether [given] two times, in one of which things are in one state and in the other in another state, then could things in the now common to [the two times] be entirely lacking both states? Or is it in [the now] according to one of the two states without the other? Now if the two things are potentially mutually exclusive, such as the contiguous and the noncontiguous or the existent and the nonexistent and the like, then it is impossible that the thing with respect to the posited now be entirely lacking one or the other of them. Hence it necessarily follows that it is according to one of them, and I wish I knew which one of them it is!

So we say that it is necessary that something comes to the existing thing [i.e. the thing existing in a particular state], and makes it cease to be [existing in that state]. So either [1] that thing which arrives is among those whose being found in a now is permissible, i.e., something whose state remains the same in any now you take during the time of its existence, and it does not need a now which corresponds to an interval of time (*muddah*) in order to be.[10] Now whatever is such, the thing in the common division is described by [the state], like the contiguous and the quadruple and other fixed dispositions, whose existence remains the same in each now during the time of their existence. Or [2] [that which comes to the thing existing in a particular state] is something contrary to this description. So that its existence will occur in a time, yet it will not occur in a now; and its existence will be in the second time alone, and it will not be possible [that it exist in] the now dividing the two [times]. For in it there is an opposition (*muqābalah*)[11] like separation or loss of contiguity and motion. For some of these, then, their state can remain the same during the nows of their time, leaving aside the nows of the occurrence initially; and for some of them, their states can absolutely not remain the same. As for the one which can [remain the same], it is like the

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[10] Reading *fī an* for *fī ān*; cf. the Latin "non est necesse ut in quantum sit comitetur eam tempus; it is not necessary that in as far as it is it accompanies its time" [*Sufficientia*, 35r]. Y. Shayegan translates: "it does not need to be in a 'now' whose [stretch] to another 'now' corresponds to duration" (67). This translation requires us to take *ila* as syntactically independent of the verb *yaḥtāju*, which seem unlikely. Further her translation countenances the existence of "stretches" (her addition) between nows which are not periods of time, a position which is dubious. See the commentary for a discussion.

[11] Cf. the Arabic translation of Aristotle's *Posterior Analytics* 72a12-13 where the Arabic *muqābalah* translates the Greek ἀντίθεσις.

noncontiguous, which is to be apart; for it does not occur except by motion and variation of state. Yet it remains not touching; indeed, it is apart for a time during which it remains the same, even if its states vary from other perspectives; for that is not from the perspective that they are separate and not touching. As for those which cannot [remain the same], they are like motion. For its state does not remain the same in any now, but rather in every now there is a renewal of nearness and remoteness, both being among the states of the motion. Hence the immobile thing when it is set in motion and the contiguous when it is made no longer to touch is such that there is in the now which is the division between [the changing thing's] two times contiguity and lack of motion (since in it there is neither a beginning of separation nor motion). Even if this [issue] is external to our goal, it is useful concerning [this issue] and concerning other issues.

(163.11-164.1) That which we have discussed is the now surrounded by the past and future; as if time occurred and then after its occurrence it was marked off by this now. But a different now may be imagined according to a different description. Hence the limit of a mobile (and let [this] be some point) [1] assumes a certain spatial magnitude,[12] even indeed a certain line, in its motion and flow (as if it--that is, that limit--is something borne along) and then [2] in that line points are assumed which do not

[12] *Masāfa*, which I have translated here as "spatial magnitude", can also be rendered "interval", "stretch" or "distance". Indeed, certain later claims require translating *masāfa* as "interval" or "stretch".

actually make the line, but rather are imagined connected with it. Likewise it appears that something like that [i.e., the moving point] is in time and in motion (in the sense of a traversal), and also something like the interior points in the line which did not make [up the line]. That is because being borne along and a time are imagined as existing[13] with reference to a spatial magnitude. Therefore a continuous time is congruent with what is borne along because of a continuous transition along a continuous spatial magnitude; for that which is borne along, or rather the state which attends it with the motion, is an indivisible limit, which through its flow makes a continuity. From the spatial magnitude there corresponds to [that which is borne along] a point and from time a now; however no line of spatial magnitude accompanies [that which is borne along] (for [that] had followed it) nor motion in the sense of a traversal (for [that] had come to an end) nor time (for [that] had passed). Rather what does accompany [that which is borne along] from each of [these, i.e.,spatial magnitude, motion and time] is an indivisible limit belonging to [each of these three] which is not divisible the way [each of them] is. [14]

(164.1-4) Thus accompanying [that which is borne along] from time there is always the now, and from the traversal the thing which we in fact showed to be motion (so long as the thing is moving), and

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[13] Reading *wujida* with Zayed for the Teheran manuscript's *wa ḥadd*.

[14] *Inqisām;* Ibn Sînâ has preferred *faṣl* or *fāṣil* to indicate a division in time (or any continuum) throughout his account of the now. This is one of the few occasions where he deviates from this tendency.

from spatial magnitude the boundary, whether a point or the like. Each one of these is an end point. Even what is borne along is an end point in its own right insofar as it is borne along; as if [being borne along] were something in a spatial magnitude extending from the beginning to wherever it reaches. Thus, insofar as it is what is borne along, it is something extending from the beginning to the end; and the essence of the persistent existing thing now[15] is a boundary and an end point essentially insofar as it has been carried to this boundary.

(164.4-13) Thus it is appropriate for us to consider: whether just as the essence of what is borne along is one and makes its boundary and end point and also the interval by its flow, so likewise with respect to time is there something that is the now which flows? Thus it would essentially be indivisible *qua* it, i.e., it would remain the very same insofar as it is that, and yet it would not remain the same insofar as it is the now. For it is only a now when it is taken to mark off time, just as the former one is [only] what is borne along when it marks off what it marks off, but in itself it is a point or the like.

Just as that which is borne along *qua* that which is borne along may happen not[16] to exist twice but rather passes away with the passing away of its being borne along, so the now *qua* now does not exist twice. However, the thing (which for whatever reason became a

[15] *wa dhātuhu al-mawjudah al-muttaṣilah al-ān.*

[16] Reading *annahu lā* with the Teheran manuscript.

now) could exist several times, just as that which is borne along *qua* a thing which happens to be borne along could exist several times. Thus if something like this exists, then it would be true that the now, through its flowing, would make time, but this now would not be that one which is posited connecting two times, just as the point which is imagined to make an interval by means of its motion is different from the point imagined in the interval.[17] Hence if this thing exists, then its existence is something joined to the intention[18] (which in what preceded we confirmed to be motion) without [being joined to] before or after or coinciding.

(164.13-165.5) Now just as [that which is borne along] possessing a "where" when it continues to flow in spatial magnitude produces motion, likewise, it possessing this intention which we call the "now" when it continues [to flow] in the before and after of motion produces time. Thus the relation of this thing to the before and after is [that] its being is a now, which in itself is something making time, and it numbers time by means of boundaries in [the motion] which are produced when we take a now. Thus it produces numerable befores and afters, as points number the line, in that each point is common between two lines by means of two relations.

Now the actual numberer is that which first gives the thing unity and then gives it multiplicity and number through repetition.

[17] Literally, "different from the point of the distance imagined in it (m.)" The antecedent of "it" in *fīhi*, however, is unclear. Since the most obvious antecedents are all feminine, we should most likely emend the text to *fīhā*.

[18] See above for discussion of "intention."

Thus the now that is associated with this description numbers time; so that unless there is a now, time is not numbered. The before and after also number time according to the second viewpoint, i.e., that they are its parts. [Time's] quality of being partitioned occurs by means of the existence of the now, because the before and after are parts of time, and each part of it has a natural propensity for being divided just like the parts of a line. Thus the now is better suited for the unit, and the unit is more appropriate for enumerating. Hence the now numbers according to the way which the point numbers and yet is not divided. The motion numbers time by producing the before and after on account of the spatial magnitude. Thus by means of the magnitude of the motion there will be the number of before and after, so the motion numbers the time according as it produces the number of time, i.e., before and after. Time numbers motion in that [time] is a number belonging to [motion] itself.

(165.5-9) An example of this is people who owing to their existence are the causes of the existence of their number, which is for instance ten; and due to their existence, their "tenness" exists. The "tenness" does not make the people existing beings or things; however [it does make them] things which are countable, i.e., endowed with a number. When the soul counts the people, what it counts is not the nature of the human being, but rather [it counts] the "tenness" produced by the distinction which occurs in the men's nature, for instance. Thus the soul by means of the men numbers the "tenness", just as motion numbers time according to the aforementioned intention. Were it not for the motion in connection with the boundaries of before and after made in spatial magnitude, then a number would not exist for time.

(165.9-14) Time, however, measures motion and motion measures time. Now time measures motion according to two modes. The first is that it makes [motion] possess a measure. The second is that it indicates the quantity of its measure. Motion measures time according as it indicates [time's] measure by means of the before and after existing in it. But there is a difference between the two situations [i.e., time measuring motion and motion measuring time]. As for indicating the measure,[19] sometimes it is just as the measure of wheat indicates the holding capacity for the wheat and sometimes it is just as the holding capacity for the wheat indicates the measure of the wheat [being held]. Likewise sometimes the spatial magnitude indicates the measure of motion and sometimes the motion [indicates] the measure of spatial magnitude. Thus sometimes one speaks of a distance of two parasangs [approx. 8 miles] and sometimes "a stone's throw" (*masāfat ramya*). However, that which gives the magnitude (*miqdār*) to the other is one of the two, and it is the one that in itself is a measure.

(165.14-17) Because time is continuous in its very being (*fī jauharihi*), it is permissible to assert [that it is] long and short. And because it is a number in relation to the before and after

[19] Reading *qadr* with the Teheran manuscript for Zayed's *qudra*; also cf. the Latin *mensuram* (*Sufficientia*, 35r).

according to what we have set forth, it is permissible to assert [it is] few and many. [This is] likewise [true] for motion, since continuity and discontinuity occur in it; hence the properties of continuity and discontinuity are asserted of it. However that occurs in [motion] extraneously, while what is most proper to it is fastness and slowness.

Thus we have indicated the manner of the existence of the now in act, if existing in act belongs to it; and [we have indicated] the way it exists in potency.

II.
Commentary: *Shifâ'*, physics, II.12

A. Two Arguments That the Now Is Not an Actual Division in Time: 1. First Argument (Aristotelian). Ibn Sînâ's account of the now begins with an observation respecting the relation between the now and time, which is then followed by a definition of the now. Our knowledge concerning the now comes from our knowledge of time; for time is continuous and everything that is continuous is divisible, and the now just is the dividing point between past and future. This now is *in potency*. It must be in potency and not in act, since there cannot be an actual division in time; for time is continuous and the continuous is infinitely divisible (at least potentially).[20] If the now actually were to divide time and time is infinitely divisible, there would be an actually infinite number of nows. However, there is never an actual infinite and so the nows cannot be actual

[20] *Physics* VI 1-2, 231a21-233b32.

divisions within time itself, but only potential divisions.[21] The now, then, is only a conceptual division, which the soul imagines or esteems in the time.[22] How the soul can imagine this division is explained in the sequel (161.1-7).

This argument is interesting. It is clearly Aristotelian, but it does not seem to be one that either Aristotle or at least two of his commentators employed. Aristotle certainly makes the point that the now is only a potential division in time, but he does not seem to have argued explicitly for it.[23] Alexander of Aphrodisias, on the other hand argues:

> If [time] were divisible in actuality, then in between its parts there would be an interval which is not time. Time, however, is one in actuality, although it is divisible in potentiality.[24]

The argument is *mutatis mutandis* one Aristotle employed at *Physics* VIII 8 (262a19-b4) to show that in any motion along a straight line a point lying between two extremes is a potential, but not actual, division of the motion. Philoponus likewise contends that the now can only mark a potential division in time; however, he argues from the nature of the motion that time measures.[25] Time, it is maintained, primarily measures the motion of the outermost sphere of

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[21] *Physics* III 6, 206b12-13; IV 13, 222a10-20.

[22] Cf. footnote 1 for a discussion of estimation.

[23] Perhaps Aristotle's comments at IV 11, 220a4-21 and 13, 222a10-20 are intended to show why the now can only be a potential division; however, if so, Aristotle does not make this point explicit.

[24] *De tempore* 21.14-16 [13].

[25] Philoponus, *In phys. comment.*, ed. H. Vitelli (Berlin: George Reimer, 1888) 732, 5-733, 36.

the fixed stars. If there were an actual division in time, there must be an actual division in the motion that time measures; however, there is only an actual division in a motion if the mobile actually comes to a rest. Since the sphere of the fixed stars never actually comes to a rest, there cannot be an actual division in time. Hence this division is only potential and in our minds. Although it would be hasty to say Ibn Sînâ's argument for the potentiality of the now is unique, it is different from various ancient arguments, which would have been accessible to him.[26]

2. Second Argument (Avicennian) Ibn Sînâ proffers a second argument, an argument, we might add, which is more properly Avicennian.[27] If the now were an actual division in time, then there would have to be a discontinuation in time and this severance of time's continuity would come either at the beginning or the ending of the time.[28]

The first horn assumes that the now belongs to the beginning of a period of time. Now either (a) there is a time which is before this time or (b) there is not. If (a) there is a time before the time which begins with the now, then the two times are continuous

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[26] For ancient commentators' positions concerning the potential division of continua see D. Furley, "The Greek Commentators' Treatment of Aristotle's Theory of the Continuous," in *Infinity and Continuity in Ancient and Medieval Thought*, ed. N. Kretzmann (Ithaca: Cornell UP, 1982), 17-36.

[27] At least part of this argument, however, can be traced back to Alexander's *De tempore* 24.3-6 [27].

[28] Although I reconstruct Ibn Sînâ's argument in terms of a particular time in order to show why the now cannot mark a real severance in time's continuity, the argument can also be framed in terms of an absolute beginning and ending of time. In this latter sense, Ibn Sînâ could use the argument to show the eternity of time and consequently the cosmos.

and one and the same now would join the two times while simultaneously separating them, which is absurd. In concrete terms, if 12:00-12:30 and 12:30-1:00 are actually divided at 12:30, then the two times are actually joined and actually separated simultaneously at 12:30, which is impossible. On the other hand, if (b) there is not a time before this time, then it is impossible that the time beginning with the now not have existed, and then existed. For its nonexistence would be before its existence, which is just to say there was a time before this time. Hence if there is no time before, then this time would have always existed and consequently there is not some now, which is its beginning point.[29] Nor could one say that between the two times there is only an interval, as for instance between 12:29:59 and 12:30:00; for that interval is either a time and thus argument (a) applies or it is not a time, but it would still be before the time and thus argument (b) applies.

The second horn assumes that the now is at an end point of time or a period of time. Now at this end point, there is either (a) the possibility of something existing or (b) there is not. If there is the possibility of something existing *after* this end point, then *mutatis mutandis* the arguments of the first horn apply. On the

[29] Cf. *De tempore* 24.3-6 [27]. "If someone says that this time was not before, since it was something generated (kâ'in) or that it will not be after, since it is something generated, then he has necessitated that before time there is a time and that after the end of time there will be a time; [for] if before, after, was and was not were not to require a time, then neither would hour, day and month require a time." See G. Vlastos' "Disorderly Motion in Plato's *Timaeus*" [in *Studies in Greek Philosophy, vol. II: Socrates, Plato and Their Tradition*, ed. D. Graham (Princeton: Princeton UP, 1995), 247-64 (especially 253-55)] for a discussion of why the claim "before the beginning of time" would *not* imply an inconsistency for Aristotle.

other hand, to maintain that it is not possible for *anything* to exist involves an implicit contradiction, since with positing an actual end point which absolutely nothing is after one would likewise have to deny the possibility of both the existence of the necessary (*wājib al-wujūd*) and absolute possibility.[30] For either these exist after this endpoint (and thus there is an after and likewise time) or the necessary and absolutely possible do not exist (and thus what is necessary is no longer necessary and what is absolutely possible is no longer possible--both absurd conclusions).

This argument is rooted in Ibn Sînâ's own conception of the nature of necessity and possibility. I limit myself to a discussion of possibility, although similar comments could be made for necessity (at least the necessary through another). First, when Ibn Sînâ speaks of absolute possibility, he is referring to whether something may or may not exist; hence if something has existed, then there must be an absolute possibility for its existence, otherwise it could not have been.[31] Thus one cannot deny the existence of

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[30] For a detailed discussion of the necessary and the possible in Ibn Sînâ see A.M. Goichon, *La Distinction de l'Essence et de l'Existence d'après Ibn Sînâ* (Paris: Desclée de Brouwer, 1937), 156-180; for a more recent discussion see G. Finianos, *Les Grandes Divisions de l'Etre "mawjûd" selon Ibn Sînâ* (Fribourge: Editions Universitaires Fribourge Suisso, 1976), 222-38.

[31] Ibn Sînâ distinguishes two meanings of the term possible: (1) that which is not impossible and (2) that which may or may not exist, which he terms absolute possibility here, but Real possibility elsewhere. The first sense of possibility might be thought of as logical possibility and the latter as physical possibility, i.e., that which truly could exist. For instance, information travelling at velocities greater than the speed of light is logically possible, but it is physically impossible (barring the existence of theoretical tachyons). Cf. *Avicenna's Treatise on Logic: Part One* of Danesh-Name Alai, trans. F. Zabeeh (The Hague: Matinus Nijhoff, 1971), 24; and *al-Ishārāt wat-Tanbīhāt, al-Manṭiq*, ed. Dunyâ (Cairo: Dar al-Ma'ârif fi Maṣr, 1971), IV.3, 272; *Remarks and Admonitions: Part One: Logic*, trans. S. Inati (Wetteren: Universa Press, 1984), 95.

absolute possibility without simultaneously implying that at some point all that has been, could not have been. Second, for Ibn Sînâ possibility does not have an independent existence, but always exists in something. Moses Maimonides, commenting on Ibn Sînâ's argument, asks: "What was the substratum of that possibility? For there must be in existence something of which that possibility can be predicated."[32] Very loosely stated, for Ibn Sînâ, possibility is not "free floating" but is always in or of something. Ibn Sînâ elsewhere puts the point thus:

> we call the possibility to exist the potential to exist and we call the bearer of the potential to exist in which there is the potential of the existence of something, the substratum, prime matter, matter or the like (*Najâh*, 536).[33]

Thus, Ibn Sînâ's argument may be reconstructed in the following manner: if the now actually were to divide time as an endpoint, there would still have to exist absolute possibility after that endpoint, but that possibility must exist in a substratum or matter that is after the existence of the time actually divided by the now. Consequently, there is something after the existence of the time, but something can only be after if there already is time. We have been forced back on to the first horn of the dilemma.[34]

B. The Manner in Which the Now Is a Potential Division in Time. (161.1-7) Thus having shown that the now cannot be an actual

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[32] *Guide to the Perplexed*, II.14, fourth method.

[33] Tehran: Danishgah-i Tihran, 1985/6.

[34] Vide Appendix C: "The Eternity of the World: Proofs and Problems in Aristotle, Aquinas and Ibn Sînâ" for an application of this argument to the question of the world's eternity.

division in time, Ibn Sînâ explains how the now is in time potentially. Time, we are told, is predisposed to one assuming a division in it or positing a division in it. Hence, one can posit a division in time in much the same way an examiner divides the time before a test from the time of a test, by saying "begin"; or we can talk about the moment the sun crests or sinks below the horizon, etc.. None of these indicates an actual division in time itself, but only a relative division--either relative to us or to some extrinsic boundary. The case is similar to that of a continuous plane ABCD. Although the lines AB and CD are parallel to one another and thus separate, we do not think the plane is divided on that account. Nor do we think that if we imagine a line, EF, between AB and CD that ABEF and EFCD are separated by an actual division, EF, in the plane, but rather only that there is a conceptual division between them. The same is true with time and its division, the now.

C. Ibn Sînâ and the "Paradox of the Ceasing Instant". (161.7-162.14) In the next three sections Ibn Sînâ addresses the puzzle posed by Aristotle at *Physics* IV 10, 218a11-21, which Richard Sorabji has dubbed the "paradox of the ceasing instant".[35]

1. A Restatement of the Paradox. The puzzle, we recall, runs as follows. Aristotle assumes: (1) successive nows cannot be simultaneously (i.e., the instant right now cannot be found with any past or future instant(s)); (2) the prior now must have ceased to be;

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[35] R. Sorabji, *Time, Creation and the Continuum: Theories in Antiquity and the Early Middle Ages* (Ithaca: Cornell UP, 1983), 7-12; also cf. Sorabji, "Aristotle on the Instant of Change" in *Articles on Aristotle: 3. Metaphysics*, eds. J. Barnes, M. Schofield and R. Sorabji (London: Duckworth, 1979), 159-177.

finally (3) nows, like points, cannot lie immediately adjacent to one another (i.e., between any two points/nows there are an infinite number of other points/nows). Assume the now is perpetually different (ἄλλο καὶ ἄλλο); but if the now is perpetually different, then the prior now must have ceased to be (2). The prior now, however, could not have ceased to be while it was (for that is when it is). On the other hand, it could not have ceased to be in the immediately adjacent now, for there are no immediately adjacent nows (3); further, if it were to cease in any now other than itself, it would be simultaneous with the infinite number of nows between any two nows (3), but it is impossible that the now be simultaneously with any other now, let alone an infinite number of nows (1). Therefore, the apparently paradoxical conclusion emerges that the past now and the present now are different, but could not have changed.

2. Ibn Sînâ's Pathology of the Paradox. (161.7-12) Ibn Sînâ begins with a pathology. The paradox only works if one assumes that the now is corrupted or ceases to be in a now or more exactly in time's limit. This assumption is unnecessary. The now simply is the division between time's existence and nonexistence and hence the now has its existence in time's limit and thus cannot be ceasing at that limit; rather its nonexistence is in the totality of time. One might protest that this explanation provides no account of when the now is corrupted, but Ibn Sînâ points out that "corruption" means nothing more than something no longer is after it was. Hence it is not required that there always be a first instant of corruption.

In fact, a number of states, such as motion and coming to rest or generation and corruption, do not have a first instant in which the process occurs. Ibn Sînâ clearly has Aristotle's argument at *Physics* VI 5, 236a7-27 in mind. Since this argument also provides the background for a later section (162.14-163.11) we should consider it briefly. Aristotle contends that there can be neither a first instant nor a first period of time in which a process of change begins. We shall just consider the claim that in a process of change there is no first instant. Imagine a period of time ABC in which a mobile, x, is in a state, S_1, in the entirety of AB and then changes to S_2 in BC (where S_1 and S_2 are contradictory states, e.g., moving and being at rest). BC cannot be an indivisible instant, otherwise x would simultaneously be both S_1 and S_2; since it was S_1 in all of AB, which includes B, while at C x had changed to S_2, but BC was assumed to be an indivisible instant and thus C and B are actually identical. Nor can there be an instant B´C such that x was S_1 in all of AB, but at B´C x was S_2. For B´C is either immediately adjacent to B and thus two instants are immediately adjacent, which is false; or there is an interval between B and B´C in which x is neither S_1 nor S_2, which is impossible since S_1 and S_2 were assumed to be contradictories such that one had to obtain. Therefore, there can be no first instant of change.

Fakhr ad-Dîn ar-Râzî in his *al-Mabāḥith al-mashriqīyya* points to an apparent inconsistency in Ibn Sînâ's position.[36] At *Physics* II.3 of the *Shifâ'* Ibn Sînâ had argued that the processes of generation and corruption must occur 'all at once' (*dufa*); for substantial forms do not allow of degrees of intensity.[37] Substantial forms might be compared to whole numbers; for example, there are no varying shades of two that eventually fade into three. Since there are not degrees of intensity in substantial forms, substantial coming to be or passing away cannot be a gradual process; for there is no intermediary between the being and non-being of a substance. On the other hand, Ibn Sînâ has just claimed that certain processes, such as generation and corruption, do not occur in an instant or now. The inconsistency comes in the immediately following section (161.12-162.9) where Ibn Sînâ defines *dufa* as change in an instant or now. In short, Ibn Sînâ argues that generation and corruption must occur "all at once", and then claims that they cannot occur in an instant.

Shayegan has tried to exculpate Ibn Sînâ on the ground "that Avicenna's intention in this passage is not substantial generation, [rather] he is merely concerned with logical notions of ceasing and beginning."[38] The rejoinder fails. What this solution implicitly sanctions is that logical impossibilities might be physically possible; for it is a physical fact that substantial forms do not allow of degrees of intensity, but a logical impossibility that two

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[36] F. ar-Râzî, *al-Mabâḥith al-mashriqîyya*, vol. 1 (Hydarabad: Majlis dâ'irat al-maᶜârif, 1924/25), 674.

[37] *Shifâ'* II.3, 98.10-18.

[38] Shayegan, 158.

opposing termini could exist simultaneously in the same thing, in the same way. Indeed what is logically possible may be physically impossible, but the converse is not true. Thus another solution must be sought.

Ibn Sînâ is not guilty of inconsistency, I maintain, but only of carelessness. We should understand "all at once" (*duf'a*) at II.3 as only meaning "not gradually", whereas at 161.13 "all at once" expresses the more technical sense of "that which occurs in an instant or now". The exact distinction between these two is made clear in the following section. For our purpose it is sufficient to note that there are two possible meanings for "all at once". Therefore, Râzî's critique rests on an equivocation between a technical and non-technical use of *duf'a*.

3. Ibn Sînâ's Solution to the Paradox. (161.12-162.9) Ibn Sînâ now responds to an objection in what quite possibly is his most original contribution to the discussion of the now. The objection is that the now must either be corrupted gradually or "all at once", i.e., in a now.[39] Hence, if the now is corrupted gradually, then it is simultaneous with other nows, which is impossible. Or if it is corrupted in a now, then it is corrupted in either the immediately adjacent now, which is impossible since there are no immediately

[39] Shayegan is undoubtedly correct to relate the following sections to the fourteenth-century Latin discussions of the *primo et ultimo instanti* and *incipit et desinit*. Still we must be careful to what extent we can honestly attribute the discoveries of fourteenth-century natural philosophers to Ibn Sînâ and to what extent we are merely reading back their advancements. See J. Murdoch, "Infinity and Continuity," in *The Cambridge History of Later Medieval Philosophy*, eds. N. Kretzmann, A. Kenny and J. Pinborg (Cambridge: Cambridge UP, 1982), 564-591 (especially 585-87) for a survey of fourteenth-century developments.

adjacent nows, or in itself, which is likewise impossible, since it then is.

This objection only follows if the disjunction between corrupted gradually and "all at once" is a real disjunction. Now, a real disjunction is one in which the two disjuncts are exhaustive, such as "every number is either odd or even."[40] Thus, the real disjunct of "is corrupted gradually" is "is not corrupted gradually". In contrast to real disjunctions, there are also unreal disjunctions, whose disjuncts can either both be false or both be true.[41] Thus both disjuncts are false in the proposition "either this is inanimate or an animal" when it is predicated of a tree; while in the proposition "either this is *not* inanimate or *not* an animal" both disjuncts are true of a tree. We are only concerned with the unreal disjunct in which both disjuncts might be false. This state can occur when one of the disjuncts is narrower than the opposite of the other; for instance, "animal" is narrower than the opposite of inanimate, viz. animate, since more things than animals are animate, viz. plants and angels or intelligences. Now (1) "to be corrupted in a now or 'all at once,'" maintains Ibn Sînâ, is more particular or narrower than "not to be corrupted gradually"; for those things that

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[40] *Shifâ', al-Qiyās*, ed. Zayed (Cairo: The General Egyptian Book Organization, 1964), 242.9-243.2; *The Propositional Logic of Avicenna*, trans. N. Shehaby (Boston: D. Reidel Publishing Co., 1973), 44. Also cf. *al-Ishārāt wat-Tanbīhāt, al-Manṭiq*, III.8, 250; Inati, 87. It should also be noted that zero would not have been considered a number, since numbers were viewed as collections of units; hence the proposition "all numbers are odd or even" is exhaustive.

[41] *Shifâ', al-Qiyâs*, 243.2-244.17; Shehaby, 44-46. And also *al-Ishārāt wat-Tanbīhāt, al-Manṭiq, al-Manṭiq*, III.8, 251-255; Inati, 87-88.

either (2a) have their existence in time, but not in time's limit or (2b) exist in time's limit, but not in time, also are not corrupted gradually, yet they do not cease to be in a now.

That (1) and (2) are distinct Ibn Sînâ makes clear by observing that our judgments concerning them are different. When we say that (1) the now is corrupted "all at once", i.e., in an instant, we are committed to judgments about the now being similar to those made about time. For instance, just as two times can adjoin, so two nows could adjoin; or also, just as any part of time is in time, so the now is in time. On the other hand, when we say (2) the now is not in time, but is time's limit, our judgments concerning the now are different from our judgments concerning time. Thus, two nows cannot adjoin, or a now is not in time the way a particular time is. Ibn Sînâ then asserts that it is not important to prove that the now fits one or the other of these models. It suffices that we grasp that the two models are different and that either one could describe the now; for then the supposed disjunctive syllogism will not carry through.

Despite Ibn Sînâ's cavalier attitude towards clarifying the distinction between (1) existing and ceasing to exist all at once in a now and (2) existing or not existing in time's limit, I shall try to disambiguate the two, especially in light of the fact that Ibn Sînâ's entire argument rests on these two accounts actually describing two distinct things and not merely a verbal distinction. According to the first viewpoint, Ibn Sînâ describes the now as a *nihāya* of time, i.e., an extremity or endpoint of time.[42] In this sense, the now belongs to time in the same way the endpoint of a line segment belongs to the line. Thus two line segments can abut one another at their respective endpoints and yet one line segment terminates with its respective endpoint and the other begins with its. In a similar way two periods of time, on this viewpoint, could adjoin at their respective endpoints, or nows, where the one period of time ceases, when its final now abruptly ceases and the other begins when its first now suddenly comes to be.

The second viewpoint conceives of the now as a limit (*ṭaraf*).[43] Even at the risk of sounding anachronistic, I want to suggest that Ibn Sînâ's notion of a limit is, though not identical, at least significantly like our contemporary mathematical notion of a limit. Mathematicians define some point, x, as a limit point of an ordering, if and only if, it is the least upper bound of the (non-empty) collection of points strictly less than x in the ordering. In other words, for any point y less than x, which one cares to take, there is a point z greater than y and yet less than x.[44] Thus, for example,

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[42] Ibid, 162.2.

[43] I am treating *ṭaraf* as conceptually distinct from *nihâya* in this context; however, in the volume of the *Shifâ'* dealing with geometry, Ibn Sînâ does says, following Euclid, that "the two limits of [a line] are points" (*ṭarafâhu* [i.e., *ṭarafâ khaṭṭ*] *nuqṭatân*) [ed. ᶜAbdulhamid Sabra (Cairo: The General Egyptian Book Organization, 1976), 16]. In this sense *ṭaraf* is no different from *nihāya*. The reason for this discrepancy is that in the context of Geometry Ibn Sînâ is simply following Euclid, who used the term πέρας (limit or extremity), of which *ṭaraf* is a good translation; however, in the context of the now, Ibn Sînâ is attempting to give *ṭaraf* a new philosophical meaning distinct from "extremity".

[44] Cf. Edward V. Huntington, *The Continuum and Other Types of Serial Order*, 2ed. (Cambridge: Harvard UP, 1917), §49.

if we say some particle is approaching the speed of light as its limit, we mean at any velocity at which the particle is traveling it can travel faster, but that faster velocity is always less than the speed of light. When we turn to Ibn Sînâ's conception of time and the now, we recall that time is a continuous ordering of what is essentially before and after, whereas the now is the limit point of the ordering which is time.[45] Consequently, for any past period of time that period ceases at the now, but one cannot go on to ask "when does the now cease?". One can only ask "when *has* the now ceased to be?". To which Ibn Sînâ would respond, "it has ceased at any subsequent future instant regardless of how close to (although excluding) the formerly present now one cares to choose."

Let us describe Ibn Sînâ's distinction again from a different vantage point. Envision two linear coordinate systems (see figure 1).

Figure 1.

The first viewpoint, viz., that the now is an endpoint of time, is captured by treating the now as a closed interval on a line. The second viewpoint, viz., that the now is time's limit, treats the now as an opened interval on a line.[46] Thus if we were to take a line on

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[45] Cf. *ash-Shifâ'* II.11, 157.18-158.5.

[46] J. Dubois draws a similar picture for Aristotle when he distinguishes between the now *qua* "limite" and "terme" [*Le Temps et l'Instant selon Aristote* (Paris: Desclée de Brouwer, 1967), 192-3].

a linear coordinate system, which ends with a closed interval, as a solution set to an equation, then every point on that line up to and including the closed interval would be a potential solution to the equation. On the other hand, if we were to take a line ending in an open interval as our solution set, then every point up to but excluding the open interval would be a possible answer to the equation. Similarly, if we assume that the now is a closed endpoint, then to the question "when has the now ceased?" the answer must be the present now *has* ceased to be when it is present. On the other hand, if the now is time's limit, then we can only say that of any future present now, that the formerly present now has ceased to be, but we cannot say that the present now has ceased to be when it is present.

Given the distinction between (1) existing and ceasing to exist all at once in a now and (2) existing or not existing in time's limit, Ibn Sînâ reasons as follows. One cannot argue that the now must either cease to be gradually or "all at once", since the real opposite of "to cease to be gradually" is "not to cease to be gradually". However, "not to cease to be gradually" can be broken down into (1) ceasing to be "all at once", i.e., in a now or (2) not existing in time, but existing in time's limit. Hence, one cannot argue by a disjunctive syllogism that since the now does not cease to be gradually it must cease to be in a now.

Ibn Sînâ employs the same move to show that the opposite of what does exist or does not exist "all at once" must exist or not exist gradually (162.10-14). One can, however, sufficiently stipulate "existing 'all at once'" such that its opposite is "to exist gradually". Thus something would only be said to exist "all at once", if (a) that thing were fully actual (*ḥāṣil*) as opposed to a limit or a merely potential division; and (b) there are no other nows at which this thing is coming to be, i.e., its coming to be does not involve a process. Given these stipulations, then the opposite of to come to be "all at once" is to come to be gradually; however, there is nothing inherent in the notion of coming to be "all at once", such that we must take coming to be gradually as its opposite.

D. Ibn Sînâ on Change of States. The following section (162.14-163.11) corresponds with Aristotle's *Physics* VI 5 (235b6-236b18), which might explain Ibn Sînâ's apology for discussing the topic out of place, despite the fact that it is germane to the present subject.[47] The following question may be posed: if something has changed from one state to another in a time ABC, such that in the first part of the time, AB, the thing was in the first state, but in the second part, BC, it was in the second state, then in which state is the thing at the now, B, which potentially divides the two times? It must be in one of the two states since if the states are mutually exclusive (such as being or not being, or being in motion or at rest) then it is impossible that the thing not be in one of the states. For everything must be or not be, and everything

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[47] See the discussion at section 161.7-12 for the Aristotelian background.

capable of motion must either be moving or at rest.[48] Therefore, that which undergoes change must be in one of the two states at B, but which one?

In a change something arrives, viz., a new state, and causes the old state no longer to exist.[49] There are two general types of states: (1) those that can be in a now and (2) those that cannot. Further, among those states that cannot be in a now, there are (2a) those states that cannot initially be in a now, but later can and (2b) those that can never be in a now.

Those states that can be in a now, (1), must meet two criteria. First, during the time of the state's existence the exact same state must be found at any now taken during that time. For instance, during the time AF if something possesses a state that can be found in a now, e.g., being a square, then at any instant during AF, say B, C, D, or E, the state of being a square obtains. Second, the state must not require some interval of time, or a now that has a duration, in order to be. This second criterion excludes both nows considered as atoms of time possessing a certain duration, and states such as motion, which require a certain interval in order to be. With regard to the states, which we might call states with a fixed disposition, that which has changed must at the now at which it first changed be in that state to which it has changed.

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[48] Cf. *Physics* VI 5, 235b13-16.

[49] Where Ibn Sînâ has framed his thesis in terms of something "arriving" (*yaridu*), Aristotle cast his claim in terms of "retiring from" or "leaving" (ἐξίσταται or ἀπολείπειν; *Physics* VI 5, 235b8).

While Ibn Sînâ does not offer an explicit proof for this thesis, we can find at least one in Aristotle's *Physics*, which fits premises provided by Ibn Sînâ. First, it is necessary that some new state come (*yaridu*) to the thing existing in a particular state and make the first state cease to be (162.19); but "coming" if not identical with change at least follows upon change (235b9-11). Every change, however, changes from something, A, to something, C, (235b6-7). Now if the thing were not C at the now at which the thing has changed to C, then "the thing which has changed, when it has changed, is changing to that which has changed; but this is impossible" (235b22-26). Whether this argument or another is the one Ibn Sînâ had in mind is irrelevant; what is clear is that Ibn Sînâ thought that at the now dividing two states, the thing that undergoes change is in the second state, when the state is one of a fixed disposition.

Now among those states that cannot be in a now, there are (2a) those states that cannot initially be in a now, but later can. Loss of contiguity is such a state. There is the initial now when two things (A and B) lose contiguity, but at any now after the initial now of separation, A and B are not touching, even if, for example, A is moving away from B. For when A is moving away from B, the relation between A and B is constantly changing, but that A and B are not touching does not change. On the other hand, other states are such that (2b) at any now one should take, the state of the thing undergoing change is different. For instance, consider a motion along a distance AF. At any now in the motion across AF, e.g. the mobile at B, C, D or E, the relation of the mobile to A or F is different. At B the mobile is closer to A than to F; whereas at C the mobile has drawn closer to F, but retreated from A, and so on. What both 2a and 2b have in common is that they involve an opposition. That is to say, the state itself is from something to something different, whether it is from touching to not touching or from some point A to another point B. We may refer to 2a and 2b as states with, at least initially, an unfixed disposition.

When a state with an unfixed disposition comes to that which is undergoing change, then, according to Ibn Sînâ, that which is undergoing change remains in the state with the fixed disposition at the initial moment of change. We may reconstruct the argument as follows. In states with an unfixed disposition, there is an inherent opposition, since the state itself involves a *terminus a quo* and a *terminus ad quem*, and these two are different. Thus it is impossible for that which is undergoing change to be in both termini simultaneously; and thus that which is undergoing change cannot be in a state with an unfixed disposition at the initial now, or at any now. However, at the initial now that which is undergoing change is at the *terminus a quo*, but the *terminus a quo* just was the state with a fixed disposition. "Hence the thing is immobile when it is set in motion and contiguous when it is made no longer to touch" (163.9-10).

Ibn Sînâ's position seems contradictory or at least unclear.

For at 163.4 he had said those states with an unfixed disposition have their existence in time and not in a now "and hence their existence is in *the second time* (*az-zamān ath-thānī*) alone." This claim seems to affirm the Aristotelian doctrine that with respect to that which changes the now always belongs to the later time (ὕστερον).[50] However, at 163.9-10 Ibn Sînâ claims that "the thing is immobile when it is set in motion and contiguous when it is made no longer to touch." This position suggests that at the initial moment of change the changing things remains in the state belonging to the first time. As a possible solution to this apparent inconsistency I suggest that Ibn Sînâ is retaining Aristotelian terminology, while generalizing Aristotle's point. Concerning Aristotle's argument Sorabji rightly observes "it is crucial to understanding the passage to notice that the earlier state, of which there is no last instant, is one which involves changing while the later state does not."[51] Ibn Sînâ's point is that whenever there is a change from one state to another and one of the states involves change, the state at the moment of change always follows that state which does not involve change, i.e., the state with the fixed disposition. Thus Aristotle's position requires that during the first time the state involves change, while during the second time the state does not involve change, whereas Ibn Sînâ's formulation includes both

[50] *Physics* VIII 8, 263b10-11.

[51] "Aristotle on the Instant of Change" (1979) 172. It should be noted the passage Sorabji is discussing is *Physics* VIII 8, 263b15-264a6, although he notes that this argument had been generalized at VI 5 235b-32.

Aristotle's case and the case where during the first time the state does not involve change, but the state during the second time does.

Shayegan has offered an alternative interpretation of this passage based on her translation of 163.3-5.[52] She translates our passage:

> Or else the thing is different from this qualification and it exists in time not in the 'now'; it will then come to exist in the second of the two times only. The 'now' which divides the two is not necessarily predicated of it; and there will be in it [the 'now'] the opposite characteristic such as distinction and lack of contact and movement (67).

Shayegan sees in this passage the introduction of a *nunc differens*.[53] The *nunc differens* is different from the now that potentially divides time; for the *nunc differens* is a "temporal 'now' [which] exists in a stretch of time", or more specifically the "second time," and its states are constantly changing. The *nunc differens* must be extended, or temporal, since "the opposite characteristic such as distinction and lack of contact and movement" can be found in it.

This interpretation has problems. The first difficulty, which I merely mention, is the philosophical morass inherent in the notion of an extended now. In fact, Aristotle gives several explicit

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[52] Shayegan, 192-3.

[53] There are passages in Aristotle which might lead one to posit a *nunc differens*; e.g., Aristotle says the now in one sense is just the same, but in another it is not the same in much the same way that Corsicus in the Market and Corsicus in the Lyceum are one and the same and yet different (*Physics* IV 11, 219b12-21). Shayegan does not solely view the *nunc differens* in this sense, as will be made clear in the body. For a discussion and critique of the *nunc differens* see N. Kretzmann, "Time Exists--but Hardly, or Obscurely (*Physics* IV, 10; 217b29-218a33)," *The Aristotelian Society* Supplementary vol. 50 (1976): 91-114 (especially, 100-107).

arguments against an extended now at *Physics* IV 10 and VI 3.[54] Certainly Ibn Sînâ is no lackey to Aristotle and thus a mere appeal to authority would bear no weight; nevertheless, when Ibn Sînâ does significantly diverge from Aristotle he is quick to point out the errors of his predecessor. Since to introduce an extended now would be a radical shift, we should rightly expect some defense of it by Ibn Sînâ. None is forthcoming. There is also a contextual difficulty with this reading. As both Norman Kretzmann and Shayegan herself observe there is a close association between the *nunc differens* and the *nunc fluens* (*ān sayalān*), or flowing now.[55] Hence the context of this passage would have had to shift from the now that is the potential division between past and future to the un-introduced *nunc fluens*. In almost the next line, however, Ibn Sînâ explicitly states "that which we discussed is the now surrounded by the past and future" (163.11-12). Only then does he begin to discuss a different description of the now, viz., the *nunc fluens*, or flowing now. The conception of a *nunc differens*, or extended now, does not emerge clearly from the text and would require much philosophical elucidation if it did. Thus we can rightly reject its introduction as a means of explaining the text.

E. The Flowing Now (ān sayalān). (163.11-164.4) To this point Ibn Sînâ has only considered the now as a potential division in time. The analogue is with a point in a line, which does not make up or

[54] 218a21-30; 234a11-24.

[55] Kretzmann (1976) 106-7; Shayegan, 192-3.

compose the line. The relation of the point to the line, however, can be considered differently; for we can also think of the point which describes a line through its flow or motion. Likewise, suggests Ibn Sînâ, perhaps the now can be considered as a temporal analogue to the moving point--a flowing now.

Ibn Sînâ countenances the comparison between a moving point producing a line and a flowing now producing time by indicating the relation between being borne along, time and spatial magnitude; for a time is proportional to the motion on account of the continuous motion along a spatial magnitude. In other words, spatial magnitude, motion and time are three linear extensions, all of which can be plotted against one another such that for any "point" on one continuum a corresponding "point" can be found on the others. The "one-to-one" correspondence occurs between the three since that which is borne along and its various dispositions, namely, to have a "where" and a "when", i.e., a now, seem to produce their respective continua through their motion. That is to say, the flow of the mobile produces motion, the flow of the "where" produces (or better yet describes) a spatial magnitude and the flow of the now produces time.[56]

Ibn Sînâ points to another similarity between that which is

[56] For discussions and critiques of the analogy between spatial extension, motion and time cf. G.E.L. Owen, "Aristotle on Time" in *Articles on Aristotle: 3. Metaphysics*, (1979) 140-158 (especially 154-158); E. Hussey, *Aristotle's* Physics *Books III and IV* (Oxford: Clarendon Press, 1983), 154-156; and M. Inwood, "Aristotle on the Reality of Time" in *Aristotle's* Physics*: A Collection of Essays*, ed. L. Judson (Oxford: Clarendon Press, 1991), 151-178 (especially 165-168).

borne along, the point and the now; they are all end points of their respective continua (164.1-4). It is relatively clear how a now and a point can be end points of time and a line or a spatial magnitude, but it is not so clear how that which moves along is an end point of motion or being borne along. Think of the motion as stretching from the mobile's starting point to wherever it has reached. Further, imagine an invisible string extending from the mobile's *terminus a quo* to the mobile itself. The mobile, then, can be viewed as the end point of this invisible string, i.e., the end point of motion *qua* an extension.

The preceding sections were not so much a proof of the existence of this flowing now, as an enumeration of the various similarities between spatial magnitude/motion/time and the point/that which is borne along/the now. Ibn Sînâ next poses the question whether there might in fact be a now that through its flow produces time in the way a moving point produces a line (164.4-13).

He begins by indicating the various implications for a theory of time and more specifically a theory of the now, if there should be such a flowing now. These implications include the following. That which is borne along can be viewed from two perspectives: first, as an object and second as a moving thing.[57] Now insofar as that which is borne along is an object it remains one and the same, e.g., the train in Philadelphia and then in New York are one and the same train. On the other hand, insofar as that which is borne along is

[57] Cf. *Physics* IV 11 219b12-33.

moving, it can be differently described; for example, the train's passing through Princeton Junction is not the same as the train's passing through Newark. Similarly, if a now were to produce time through its flow, then insofar as it is *what* is flowing, it would remain one and the same, just as the object that happens to be moving remains one and the same. On the other hand, insofar as it is *flowing* it can be differently characterized, e.g., 12:00:00, 12:00:01, 12:00:02 etc., and as such the now would be like that which is borne along *qua* moving.

A second implication is this. That which is borne along *qua* moving cannot exist twice with the same description or characterization, otherwise it would not be moving. For instance, imagine something, x, that is borne along a distance AF. Now during the motion across AF, x can be characterized as x-A, x-B, x-C, etc. to x-F. (Where "x-A" means "x potentially at location A" and similarly for the rest.) Thus if x were characterized twice as x-A, we would say x was at rest at A and not moving. Nevertheless, x, considered merely as x, can and does perdure or exist several times; for the x at A, B, C etc. is the same x. Once again, the now from the viewpoint of *what* is flowing would perdure. Only the now as variously characterized would not exist twice; thus, for instance, there could not be two instances of 12:00:00 PM 25 December 1997. This implication raises the question: "what is this temporal entity, the now, which supposedly perdures and produces time by its flow?"

A partial answer to the question just raised is that the flowing now that produces time would be other than the now posited connecting before and after; for just as the moving point that produces a line is other than any of the points within that line, so the flowing now would be different than the now that connects before and after. The difference between the two nows is that the now *qua* potential division is joined with before, after and coinciding, i.e., being simultaneous, while the now *qua* flowing would be joined with motion and thus that which is borne along; for there is no motion separate from that which is borne along.[58] Consequently, the flowing now would be neither before, after or coinciding, but the cause of being before, after or coinciding.

Ibn Sînâ next turns to two questions which the foregoing has raised (164.13-165.9): first, what is the flowing now's manner of existence? And second, how does it produce the before and after? The flowing now, we said, is joined with that which is borne along. Now that which is borne along possesses a "where" i.e., a spatial location, at any point in its traversal. With the motion of the mobile, this "where" describes a spatial interval in which we can mark off certain boundaries, which are spatial befores and afters. An analogous phenomenon occurs at the temporal level. That which is borne along possesses a "when" at any point in its traversal; for just as a mobile must be spatially located, so likewise must the mobile be temporally located. The flowing now is not conceived as some actual entity or object in its own right; nonetheless, it is a

[58] Cf. ***Physics*** III 1, 200b32-2041a3; III 3, 202a13-16.

real state belonging to that which is borne along.[59]

Where I have argued that for Ibn Sînâ the now, though not an actual object or entity in its own right, nevertheless is something real inherent in that which is borne along, Shayegan believes that the flowing now and the flowing point "are pure conjectures and are references to geometrical objects, not to actual things."[60] There is obvious merit in this suggestion; for understanding the flowing now as a mere mathematical abstraction would avoid the difficulties in explaining the philosophically embarrassing nature of a now that seems to be a physical or at least actual object.[61] Unfortunately, treating the flowing now as a mere mathematical abstraction has problems of its own. Fakhr ad-Dîn ar-Râzî observes that motion (or more specifically the motion of the flowing now), according to Ibn Sînâ, is the producer (*muḥill*)[62] and cause of time; however, if the

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[59] Inwood argues that treating the now as "instantaneous states of the moving object" offends against Aristotle, since (1) it carves up objects along temporal lines and it does not "account for those features of our experience--such as our ability to perceive movement and the smoothly continuous rather than jerky character of our temporal experience" (*op.cit.*, 167). The objection only works if we construe instantaneous states of the moving object as temporal analogues to frames in a motion picture. Thus as the frames of the movie make up the movie, so these instantaneous states of the moving object would make up time. This understanding of instantaneous states of the moving object is clearly not what Ibn Sînâ has in mind nor is he implicitly committed to it. Rather, to use Kretzmann's picturesque example ((1976) 97-8), instantaneous states of the moving object should be imagined as analogous to potential cuts (as opposed to slices) in a salami sausage. Such an understanding neither actually carves up objects along temporal lines nor gives our temporal experience a "jerky character".

[60] Shayegan, 205.

[61] Cf. F. Miller (1974) 145-46 for various attempts to characterize the nature of a flowing now. Miller suggest that perhaps the flowing now "could be characterized as the sort of material point that would occupy not a geometrical point but a three dimensional place" (145).

[62] The Arabic محل (which I am translating "producer") most naturally would be

flowing now is not something existing (*ma'dūm*), then how can it be the producer and cause of something that does exist, viz., time? One of course could say that time has no existence independent of the mind and thus also is a mathematical abstraction, but ar-Râzî is quick to add that Ibn Sînâ is not among these.[63]

Shayegan, following ar-Râzî, makes some remarks about Ibn Sînâ's "doctrine of coincidental *super addition* of existence to essence", but it is not clear how these remarks are intended to absolve Ibn Sînâ from Râzî's charge.[64] On the other hand, to construe the flowing now as the mobile's temporal location and as a real state inhering in the mobile deflects Râzî's critique and also avoids committing Ibn Sînâ to the existence of a now that is an actual object.[65]

Ibn Sînâ then turns to the second question: "how does the flowing now produce the before and after?" As the mobile is borne along, the "now" associated with it describes an interval and this interval is time. We can mark off boundaries, or befores and afters,

read as *maḥall*; however, *maḥall* means "a substrate, locus or site", which make no sense in the context. Therefore, I have opted to read محل as *muḥill*, the active participle of the verb *'aḥalla*, which can mean "to cause to set in or occur, bring about, produce" which the context, in fact, seems to require.

[63] *al-Mabâḥith al-mashriqîyya*, vol. 1, 551.

[64] Shayegan, 208-9.

[65] Treating the now as a disposition in a mobile is not a philosophical panacea for a theory that posits a flowing now. One need merely ask whether there are as many nows as there are mobiles possessing this disposition? Further, if there are, do all these nows have different velocities corresponding with the velocities of the mobiles? If we claim that the "true" now is the state possessed by the outermost sphere, the now still seems to possess a velocity. Therefore, time would be produced at a certain velocity, but velocity presupposes time. I do not want to suggest that these difficulties are insurmountable, but rather they indicate issues which a theory positing a flowing now must address.

in the time corresponding with the various locations of that which is borne along insofar as it possesses a now. The way that we mark off these boundaries is akin to the way we number a line; for although a line does not intrinsically possess a number it is inherently numerable. If we consider the line AD, which was described by some mobile x crossing a spatial magnitude, we can posit a point B in the line, which corresponds with a location *where* x was during its traversal. The line can then be conceptually divided into the units AB and BD, and hence the line is two insofar as there are two conceptually distinct parts. Or again, we can conceptually divide AD at B and C, which also correspond with various locations of x during its traversal. In this case, there are the three conceptually distinct parts AB, BC and CD; and thus AD is three, and so on. Similarly, the flowing now, which is associated with the motion of that which is born along, produces befores and afters, which correspond with the spatial befores and afters passed through during the motion of x. These derivative befores and afters are potential divisions in the motion and allow of being numbered as the line was numbered. Time, however, is the number of motion in respect of before and after.[66] Hence, since the flowing now produces these numerable befores and afters in the motion, it produces time.

Before we pass to the next issue, we should linger briefly over the question how we number a line. At *Physics* IV 11 (220a9-26)

[66] Cf. *Shifâ'* II.11, 157.5-6 and *Physics* IV 11, 219b1-2.

Aristotle had rejected two possible explanations.[67] According to the first means, we begin by imagining a line AE in which we conceptually mark off the midway point at C. We can say the line is two, because C is two, i.e., the ending of AC and the beginning of CE; however, in order for C to make AE two we must take C twice, i.e., it must exist twice. We have shown above though that the flowing now--the now that makes time numerable--cannot exist twice. Thus the now does not number time in this way. According to the second way we can number AE on account of its two parts, AC and CE. This suggestion also does not work for the reason given above and further the parts AC and CE properly correspond with time and not to the now. Aristotle's answer, and presumably Ibn Sînâ's too, is embodied in the cryptic claim that just as time is a number so are the extremes of the line.[68] As a suggestion for how to understand what Aristotle and Ibn Sînâ had in mind, let us divide AE into four segments AB, BC, CD and DE and then stipulate that we count B, C and D only insofar as they are beginning points and not end points. Then the line AE is four, since we have only marked off four beginning points--A, B, C and D. (We would not count E since it is not a beginning point.). The arbitrariness of taking the numerable now only as the beginning point of a period of time is reduced when we remember that there are philosophical reasons for taking the now with the "second time".

F. Numbering and Measuring Motion and Time. Ibn Sînâ next

[67] Cf. F. Miller (1974) 144-45.

[68] 220a14-16; ὥσθ' ὁ χρόνος ἀριθμὸς ... ὡς τὰ ἔσχατα τῆς γραμμῆς....

attempts to explain the way motion can number time and time can number motion with an example (165.5-9). Imagine a group of people. The existence of these people is explanatory of their number, e.g., ten; for if the group did not exist or if there were fewer people in the group, the group would not be ten. The possibility of characterizing the group as ten does not make the group exist, but it does make it something that can be counted. Thus we count the group not *qua* human, for that is one, but *qua* characterizable by ten, i.e., as individual units of counting. Analogously, motion is the cause of a number, or to be more exact that which is borne along possessing a now is the cause of a number; for as a mobile traverses a spatial magnitude, spatial befores and afters mark off potential divisions in the motion, which in turn correspond with temporal befores and afters. These temporal befores and afters can be assigned a number, which is time. Thus motion is the cause of a number, which is time. On the other hand, by means of the motion we can mark off boundaries of before and after and then by means of these boundaries we can ascribe a number to motion. The number is not the cause of the motion; nevertheless, the number, i.e., time, does allow us to number the motion. Hence, time numbers motion.

Having shown how time numbers motion and motion numbers time, Ibn Sînâ turns to a related question (165.9-18): How does time measure motion and motion measure time? Time can measure motion in two ways. The first is that time makes motion measurable in a certain way. Time does so in much the same way that the tenness of the group made the group countable. Since the tenness belongs to the group, the group can be counted; likewise motion possesses a certain magnitude, which we call time, and since magnitudes can be measured, motion can be measured with respect to this magnitude, i.e., time. The second way time measures motion is that it actually indicates the quantity of the measure of motion. Hence we can indicate the length of a trip, for instance, as two days or a walk around the block as ten minutes. Thus according to the second way we designate the extent or quantity of motion. Motion also measures time. It does so by specifying the extent of time according to the interval of motion that is found between a distinct before and after. Thus, for instance, we can measure a day as the interval between the sun's first appearance on the horizon and then its subsequent reappearance at the same place.

Now both motion and time measure the other insofar as they indicate a measure. A measure, however, may be indicated in two ways.[69] First, as a certain quantity is used to indicate that by which we measure; and second, as that by which we measure indicates a certain quantity. For instance, initially the meter was specified by the length of a certain rod, viz., the standard meter rod in Paris; hence a certain length (the length of the rod) was used to indicate that by which other lengths are measured (a meter). The meter, or that by which we measure, is then subsequently used to measure other rods and lengths. It is similar for time and motion.

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[69] Cf. Philoponus *In phys.*, 741, 21-742, 14.

Traditionally the motion of the outermost celestial sphere was used to indicate a certain measure, viz., the day. The day in its turn was used to measure not only the motion of the outermost celestial sphere, but also other types of motion.

This distinction between the ways of indicating measures is not merely true of time and motion, Ibn Sînâ adds; it is similarly true of any magnitude or measure. Hence we can indicate a certain distance by a motion or a certain motion by a distance. How long a drive is it from my home to the university? 10 miles. How far is my home from my neighbors? A stone's throw. In the first example, the extent of the motion from A to B is given by a spatial magnitude, whereas in the second the extent of a spatial magnitude is given by the magnitude of a motion.

In all of these cases (whether distance, motion or time) we see that one of them is made measurable by one of the other two; thus by a relationship between one of these continua to a second we can specify the extent of the first. Imagine a child asking how long a trip from A to B is. "How long is the trip?" asks the child. "One hundred miles," replies the father. "Oh... How long is one hundred miles?" the child inquisitively chimes out. "Two hours," the father abruptly responds. "But how long is two hours?" demands our young philosopher. "It's as far as from our house to Grandma's house" the mother says. "Ahh, O.K." says the child, comprehending. So we see that each of these three is itself a measure and made measurable by one of the other two.

G. Conclusion. In this final section (165.14-17) Ibn Sînâ enumerates a list of properties belonging to time and motion and also what distinguishes the two. First, since time and motion are continuous, they can both be said to be long and short as is true of any extent or interval. Further, since both time and motion can be cut up, at least potentially, into countable units, they can be few or many. Thus a week can be divided into few days, but into many minutes; and similarly a meter can be divided into a few decimeters, but into many millimeters. The property that is unique to motion and distinguishes it from time is that it is fast or slow; for fastness and slowness are defined by time. Hence time could not be fast or slow without time being defined by itself.[70]

Thus concludes Ibn Sînâ's account of the now: how it exists as a potential division within time and in what sense, if any, one can speak of the now in act, i.e., the flowing now.

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[70] *Physics* IV 10, 218b13-18.

CHAPTER 9

CONCLUSION

We have looked at two similar and yet widely dissimilar views of the nature of time. Both made time a number or magnitude that measures motions, but one conceived of this magnitude as static, the other as dynamic. We must now consider the various merits and demerits of these temporal theories. In the final analysis I argue that despite Ibn Sînâ's herculean efforts to extricate a dynamic theory of time from a morass of philosophical difficulties, the position is still left moribund. However, before we take up the weakness of the dynamic conception of time, we should consider a general attack on the very possibility of the reality of time offered by the twentieth-century philosopher J.M.E. McTaggart, and also Sydney Shoemaker's critique of the view that time is inextricably linked to motion, a premise accepted by both Aristotle and Ibn Sînâ.

A. McTaggart on the Unreality of Time. McTaggart's argument for the unreality of time requires that the so-called B series is insufficient to explain the essence of time, i.e., one cannot capture what time fully is merely in terms of "later than" and "earlier than" since one cannot explain change without reference to such characteristics as "past," "present" and "future", all A series terms. McTaggart then proceeds to show that the A series involves a contradiction and thus is unreal. He concludes that since the essence of time requires the A series and the A series is unreal, time as a whole is unreal. Aristotle and Avicenna can, and if fact do, deny that change requires appeal to A series characterizations. To appreciate their response to McTaggart let us spell out McTaggart's argument in full and then consider their response in detail.

1. McTaggart's Proof for the Unreality of time. McTaggart's argument involves three steps.[1] First, he distinguishes the A and B series. Next he argues that the B series is insufficient to explain change and that since time involves change, one must appeal to the A series, if one is to have a complete account of time. He concludes by drawing out a contradiction in A series characterizations, i.e., predicating "past," "present" and "future" of some event.

A thing or event can be located in time in one of two ways. Some event can be "earlier than" or "later than", where "there is a transitive asymmetrical relation" among the terms.[2] Thus, if some event M is earlier than N and N is earlier than O, M is earlier than O. Moreover, N and O are *never* earlier than M. Events and things can also be located in time as past, present or future. Now whereas the predicates "earlier than" and "later than" belong to an event

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[1] "The Unreality of Time," in the *Philosophy of Time*, ed. R. Le Poidevin and M. Macbeath (Oxford: Oxford UP, 1993): 23-34.

[2] Ibid, 24.

permanently, "past," "present" and "future" do not; for example, while the battle of Waterloo is permanently "later than" the battle of Hastings, during the battle of Hastings the battle of Waterloo was future, then it was present and now it is past. The temporal series that includes the predicates "past," "present" and "future" McTaggart terms the "A series", and the series involving "earlier than" and "later than" is the "B series".

The B series alone, McTaggart tells us, is inadequate to express completely the nature of time; for time is "universally admitted [to involve] change", whereas one cannot explain change merely in terms of the B series, but rather one must have recourse to A series terms as well. His general argument is that since the B series only involves permanent relations, then some event is always and forever related to some other event; nothing ever changes in this description, whereas it was posited that a full account of time must involve change. We are asked to think of some event (the death of Queen Anne is McTaggart's example) and the changes that take place in its characterization. Surely, that it is a death does not change, nor that it was the death of Queen Anne, nor that it is either earlier than or later than some other given event. Queen Anne's death changes in only one respect. "It was once an event in the far future. It became every moment an event in the nearer future. At last it was present. Then it became past, and will always remain past, though every moment it becomes further and further past."[3]

[3] Ibid, 26.

However, this characterization is just to appeal to the A series. Therefore, if we are to account for change (and thus time), we must have recourse to the A series; and consequently, if the A series cannot be real then neither can time.

McTaggart now attempts to show that the A series cannot be real, since there is an inherent contradiction in predicating "past," "present" and "future of any event. Two points must be noticed about the characterizations "past," "present" and "future". First, for an event to be past, is for it *not* to be present or future; similarly, for an event to be present is for it *not* to be past or future, and analogously for an event to be future. On the other hand, all events are ultimately characterized as past, present and future. My writing this sentence was future, is present and will be past. D. H. Mellor formalizes these two points as follows:[4]

(1) *Pe* |- -*Ne* & -*Fe*; *Ne* |- -*Pe* & *Fe*; *Fe* |- -*Pe* & -*Ne*

and

(2) *Pe* & *Ne* & *Fe*.

Where "P" is "past," "N " is "present" ("now"), "F" is "future," "*e*" is some event, "|-" means entails and "-" has its normal logical meaning. Clearly (1) and (2) entail a contradiction. The obvious riposte to this argument involves an appeal to more complex tenses. Thus, we say that when an event is present it "has been future" and it "will be past" and consequently (2) should be understood as:

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[4] "The Unreality of Tense" in the *Philosophy of Time*, ed. R. Le Poidevin and M. Macbeath (Oxford: Oxford UP, 1993): 47-59.

(2´) FPe & Ne & PFe.

Unfortunately, the response cannot be that simple, since now we are committed to complex tenses belonging to some events and we cannot just pick and choose which complex tenses apply and when. Hence, if FP (will be past) and PF (was future) hold of *e*, so will PP (was past), PN (was present), NP (is past), NN (is present), NF (is future), FN (will be present) and FF (will be future); and it is obvious that a contradictory pair of proposition analogous to (1) and (2) above can be generated. If one responds that this new contradiction can be resolved in terms of an even more complex set of tenses, McTaggart responds with yet another contradiction, generated in this more complex tense. Therefore, we find ourselves in a vicious infinite regress, since at each level a contradiction can be generated. "The reality of the A series, then, leads to a contradiction, and must be rejected. And since we have seen that change and time require the A series the reality of change and time must be rejected."[5]

As a brief note, this last stage in McTaggart's argument involves two steps. The first is the generation of the contradiction and the second is the claim that the obvious response involves a vicious, infinite regress. Thus an adequate response to McTaggart cannot merely be a resolution of the contradiction, but also must show how the resolution avoids an infinite regress. For example J.J.C. Smart when responding to the contradiction says:

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[5] "The Unreality of Time," 34.

> [T]he contradiction which he claimed to find in the A series is that since any event is in turn future, present, and past, we must ascribe these three incompatible characteristics to it. But an event cannot be future, present, or past *simpliciter* but only with reference to a particular time--for example, one at which it was future, is present, and will be past. If we restore the tenses, the trouble with the A series disappears.[6]

However, as McTaggart already observed, we can reconstruct a new contradiction in terms of Smart's "restored tense" and can do so *ad infinitum*. Thus Smart, and others following the same tact, have offered no response to McTaggart's real concern.

2. Aristotle and Ibn Sînâ's Response to McTaggart. We must begin with a few preliminary comments. First, if it turns out that McTaggart's argument depends upon a conception of time that either Aristotle, Ibn Sînâ or both reject, then an adequate response to McTaggart is to observe his argument rests on an erroneous conception of the nature of time. Similarly, it is not required of Aristotle or Ibn Sînâ to show what is wrong with McTaggart's argument absolutely, but merely how their respective accounts of time can avoid McTaggart's skeptical argument. In other words, the presumption is that time is real and the only reason one would deny the reality of time is that there is a compelling argument to do so. Now if some account of time can show how time can be real, even in the face of McTaggart's argument, then we should adopt that account of time. In short, we do not need to refute the skeptic so much as to avoid his skepticism.

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[6] The article "Time" in the *Encyclopedia of Philosophy*, ed. P. Edwards (New York: Macmillan, 1967).

There is a least some textual evidence to suggest that McTaggart held what I have termed a "dynamic theory of time" and if it turns out that his argument rests heavily on this theory, then at least Aristotle could reject McTaggart's conclusions out of hand. The textual evidence comes in McTaggart's first footnote, where he says that "[t]he movement of time consists in the fact that later and later terms pass into the present, or--which is the same fact expressed in another way--the presentness passes to later and later terms."[7] Clearly the idea of "the movement of time" and references to the present passing away are notions abhorrent to Aristotle and would be rejected as incoherent. Despite this use of dynamic temporal vocabulary, McTaggart's argument does not explicitly make use of it, nor is it, as far as I can tell, implicit in his argument. Thus some other means of attack must be found.

This other means presents itself when McTaggart argues that change can only be adequately or fully explained in terms of the A series. The claim is that time involves change, and we can only explain change by appealing to the A series. Oddly, McTaggart casts his argument in terms of an event's changing. Now an "event," McTaggart tells us, is "the contents of any position in time".[8] The phrase "any position in time" might be grasped if we imagine a segment or period of time on a time line; so if we consider a time line that includes 9:00-10:00 am 9 August 1999, then the event that

[7] "The Unreality of Time," 24, fn. 1.

[8] Ibid, 24.

is my tea time is my drinking my tea (the contents) during the time segment of time 9:30-9:45 (the position in time). In other words, an "event" is what occurs during some segment of time.

But in what sense can an event change? McTaggart himself, we have seen, denies that the content of an event changes. My drinking tea or Queen Anne's dying always remain the same. Thus if an event changed, and it cannot be the contents of the event that change, then it must be the time segment that changes. But for Aristotle it is conceptually incoherent that time changes, since time would change at some rate of change that itself would be defined in terms of time. Nor would Ibn Sînâ allow time itself to change, but rather it would be the now that changes. Thus neither the contents of an event nor the time of an event can change; the time itself is essentially before and after and thus does not change. The only things that could meaningfully change are the substances that make up the contents of an event, e.g., me, my tea, Queen Anne, etc.. Consequently, McTaggart's argument requires the unstated premise that things' changing ontologically presupposes the A series or the A series is ontologically prior to changing things. That is to say that there is no way, according to McTaggart, to describe or account for the change of a thing without doing so in temporal, dynamic terms.

It is at just this point that both Aristotle and Ibn Sînâ would balk. Time is a number of motion according to before and after, where "before" and "after" are further explained in terms of a motion's actuality and potentiality, which in turn are ultimately explained by reference to differences in spatial location. Change, then, is *not*, as McTaggart would have it, ultimately explained in terms of time (or the A series), but rather time is ultimately explained in terms of change (and spatial differences). Therefore, one can (and Aristotle and Ibn Sînâ do) explain change without appealing to the A series or its equivalent. Indeed the Aristotelian account of time in terms of "before" ("earlier than") and "after" ("later than") is just such an account. McTaggart might deny our claim that the ontological priority rests with the change and not the time; but if one does assume change's priority, then he or she can avoid McTaggart's skeptical conclusion, which, independent of Aristotle and Ibn Sînâ's own motivations, offers good grounds for opting for the priority of change over time. The essence of time can adequately be explained without recourse to the A series and thus McTaggart's argument need never get off the ground.

B. Time without Change? A central thesis of the Aristotelian/Avicennian theory of time is that time requires change; for time is a number (*arithmos*, 219b2), measure (*metron*, 220b32-221a1) or affection (*pathos*, 251b27-28) of motion. Consequently, if that to which time essentially belonged did not exist, then neither would time. Furthermore, Aristotle's and Ibn Sînâ's arguments for the connection of time and motion not only show that time *physically* requires motion, but also that it *conceptually* requires motion. That is to say, one cannot even coherently conceive of time independent of motion.

This latter, and stronger, claim has recently come under attack by such contemporary philosophers as Sydney Shoemaker.[9] Shoemaker maintains that we can consistently imagine a possible world where we have very good grounds for believing that some time has elapsed and equally good grounds for claiming that motion has not occurred. We are asked to imagine a universe in which all the matter is divided between three regions, A, B and C. Although there are boundaries that separate these three regions, the boundaries are not impenetrable. Thus inhabitants in one region can enter other regions and using telescopes look into other regions. What is of particular interest about this universe is that in very regular and well defined intervals, a region undergoes a complete and total "freeze" for a length of one year as measured by some "unfrozen region". That is to say, in the frozen region absolutely no motion occurs. This freeze occurs in region A in intervals of every 3 years, and in region B in intervals of every 4 years and in C in intervals of every 5 years.

Consequently, after 3 years regions B and C would observe a total freeze in region A; after 4 years regions A and C would see B frozen and after 5 years A and B would be aware of a freeze in region C. Furthermore, at 12 year intervals C would notice that both regions A and B were frozen; after 15 years B would observe that A and C were frozen; and after 20 years B and C would be frozen with

[9] S. Shoemaker, "Time without Change" in *The Philosophy of Time*, ed. R. Le Poidevin and M. MacBeath (Oxford: Oxford UP, 1993) 63-79.

respect to region A. What is of most interest is the situation that would occur after 60 years; for given the observations of the "freeze schedules" of the various regions, the scientist could predict a "Great freeze" in which all the regions would be frozen for an interval of one year. Therefore, concludes Shoemaker, "[s]ince these three regions exhaust their universe, to say that there will be simultaneous local freezes in all three regions every sixtieth year is to say that every sixtieth year there will be a *total* freeze lasting one year. ...If all of this happened, I submit, the inhabitants of this world would have grounds for believing that there are intervals during which no changes occur anywhere (70)."

If Shoemaker is correct, then something has gone terrible wrong with the Aristotelian/Avicennian analysis of time. Let us, then, consider a potential Aristotelian critique of Shoemaker's argument. Shoemaker has to make certain assumptions about the nature of time for his argument to work. The most notable is a minimal definition or understanding of time, viz., time is a certain interval. Indeed, during the "Great freeze" the inhabitants supposedly have the grounds for thinking an interval lasting one year occurred, during which there was absolutely no change.

Let us consider the nature of this interval. When one world freezes independently of any other, we can say that the interval of its freeze was one year relative to one of the "unfrozen worlds", i.e., an interval of one year has been measured in the unfrozen worlds. Likewise, when two worlds are frozen simultaneously, we say that the interval of their freeze was one year relative to the measurement of time in the single "unfrozen world". The question that arises is: when all three worlds are frozen simultaneously, relative to what do we say the interval of their freeze was one year?

Shoemaker must say that the interval is relative to some "empty" or "absolute" time, which is independent of motion. The question then is what is this "empty" or "absolute" time? Can we have any meaningful conception of such a time? If Shoemaker makes "absolute" time something abstracted from a time that involves change, then we analyze "absolute" time as follows. If there had been change, x amount of change would have been measured by time. That is to say that we conceive of this "empty" time as in fact involving some imagined (albeit not real) motion; however, Shoemaker's point was that "time without change ... is logically or conceptually possible (68)." On this abstractionist view, we are allowing for time without real motion, provided there is some imagined motion that allows us to distinguish one moment from another. In short, time is still conceptually tied to motion.

On the other hand, if we do away with all change--real or imagined--there can be no interval and consequently no time. Consider the following. For Shoemaker there is time, just in case there is some interval. An interval (of one year), however, is just a magnitude or duration that is marked off by, or extends between, two different moments--the one at the beginning of the interval and the one at the end of the interval. If there is no distinction between the initial and final moment, i.e., there is absolutely no difference between them, then in fact there are not two distinct moments and consequently, there is no interval. This is just the case during the "Great freeze" envisioned by Shoemaker. No change at all occurs during the "Great freeze". Consequently, if nothing changes during it, there can be no difference between anything at the beginning of it and at the end of it. Thus there can be no difference between the moment that initiates and the moment that concludes the "Great freeze"; however, if there is no difference between the moments, then, as we said, there is no interval and consequently no time. Shoemaker may very well have described a universe where we have a psychological proclivity to say that there is a time without change, but he has not presented one where we can conceive of time without change, but it was this latter thesis that he was trying to make.

The general Aristotelian/Avicennian premise that time requires change still stands. We must now turn to the more specific premises of Aristotle's and Ibn Sînâ's temporal theories.

C. Static vs. Dynamic Time. The most striking difference between Aristotle and Ibn Sînâ's theories of time was their solutions to the paradox of the now and the different temporal commitments that these solutions entailed. Aristotle conceived of time as the static magnitude found between two different characterizations of an unchanging now. Ibn Sînâ on the other hand, envisioned time as the "flow" of constantly changing now. Clearly, two such disparate views cannot both accurately describe time and thus we must choose between them. In what follows I present two arguments against a dynamic theory of time (or at least Ibn Sînâ's version) and address one objection raised by Ibn Sînâ against a static temporal theory.

1. Ibn Sînâ and Modern Cosmology. In a way that Aristotle's account of time is not, Ibn Sînâ's temporal theory is linked to ancient cosmology. Indeed, any cosmology that lacks some privileged motion or mobile leaves Ibn Sînâ's temporal theory appearing *ad hoc.* Consider the following. According to Ibn Sînâ (1) time is a type of motion, i.e., the flow of the now, and (2) there are no motions independent of mobiles. Furthermore, (3) all things, according to Ibn Sînâ, are in a single time, i.e., there are not several different times occurring together. These three points taken together imply that there must be a single mobile that produces time as its flow. That which flows and produces time according to Ibn Sînâ is the now (164.14-15). If the now flows, it must either be a substance in its own right or a constantly changing accident of some substance. The now is not a substance. Consequently, the now is an accident of a substance and that substance must be some unique thing. For if the now were associated with all motions, then there would be as many times as there are motions; however, Ibn Sînâ denies that there are as many times as there motions. He goes on and identifies this unique motion with continual circular motion, and consequently with the motion of the outermost celestial sphere which circles the earth (168.9-18).

The choice of the outermost celestial sphere was not an arbitrary one. First, circular motion, according to Aristotelian physics, was prior to all other motions. The Argument for the priority of circular motion occurs throughout *Physics* VIII and was adopted by Ibn Sînâ at II.13 of his *Physics.* The argument runs that the primary motion must be eternal and continuous, since time is eternal and continuous and time is an affection of motion.[10] Next, it is argued that locomotion is the primary type of motion because all other types of motion require it (VIII 7, 260a26-b7). Finally, it is concluded that of the three types of locomotion--circular, rectilinear and the compound of these--circular is the primary type since only it can be continuous (VII 8). The mobile associated with this motion was the outermost heavenly sphere. Furthermore, the motion of this mobile occupied a preferred place within ancient and medieval cosmology because its motion was the cause of all other motions. In short, when Ibn Sînâ associated the flow of time with the motion of the outermost sphere, this affiliation was principled and based on the best astronomical theory of the time.

In the cosmology of Aristotle, Ibn Sînâ and other Aristotelians the universe was finite and the sphere of the outer most celestial sphere demarcated the limits of this finite universe. The earth was positioned in the center of the universe and offered an absolute reference point from which to describe the universe. The closed,

[10] We have seen Ibn Sînâ's version of this proof in ch. 8; cf. *Physics* VIII 1, 251b10-28.

finite universe of the ancients has been replaced by the open, perhaps infinite, universe of the moderns.[11] Similarly, the absolute reference point by which to describe the universe is gone. There is no one, preferred mobile in modern astronomy that is comparable to the ancients' outermost celestial sphere. Consequently, although one could associate the flow of the now with the motion of some arbitrary mobile (and thus get Ibn Sînâ's temporal theory off the ground), the association would be *ad hoc*. In other words, Ibn Sînâ's account of time would no longer be science, since it lacks an explanation of why the now is associated with the particular mobile with which it is associated and not some other mobile.

On the other hand, we have observed in the chapter on Aristotle's theory of time (ch. 5) that a similar critique cannot be levelled against him. Since time is a flow for Ibn Sînâ, there has to be some mobile that flows if there is to be time. For Aristotle, time simply is a measure of motion and since no particular measured thing has to exist for the measure to be, no particular motion has to exist for time to be. The motion of the celestial sphere provided the best motion because it was the fastest, continuous and regular; nevertheless, this motion was merely adopted as a matter of convenience, not necessity. Associated with every motion there is a certain magnitude that can be used to measure any other motion. Ibn Sînâ's temporal theory is joined with an outdated theory of the

[11] Gödel has offered one solution to Einstein's field equations, which suggests a closed universe; however, the closed universe envisioned by this solution shares little, if any, similarities with the closed universe of the ancients and medievals.

universe in a way that Aristotle's is not.

2. The Velocity of Time? The objection just raised is based on our modern notion of the universe and we cannot realistically have expected Ibn Sînâ to anticipate it. Still there is an objection to his temporal theory, and indeed any dynamic account of time, which he should have recognized. If time is a type of flow, then we can treat it like motion. All motion involves a certain rate of displacement, or velocity, but velocity is understood in terms of time. Consequently, if time flowed, it would flow at a certain velocity and thus time would both be defined in terms of itself and also be measured by itself. Simply stated, does it make sense to ask "how fast does time flow?". Indeed Aristotle himself raised this objection when he was dealing with the various *endoxa* (218b13-20). Moreover, Ibn Sînâ had argued that a certain capacity is always associated with motion, which he went on to identify with time.

One may be tempted to explain time's rate of flow by appealing to some supra-time either in the way ar-Râzî did or the abstractionist "absolute" time suggested in our discussion of Shoemaker. If one does, however, posit a supra-time, then the same question can be asked of it: is it something that flows or not? If not, then the ultimate theory of time is static. If the supra-time flows, then, once again, we ask "what is its rate of velocity?".

A second option for getting around the difficulty of time's velocity is to special plead the case for time. Thus according to this suggestion, although one would argue that in most facets time is like motion, he would deny that time must have a velocity. Ibn Sînâ himself adopted this tact.

> Because time is continuous in its very being (*fī jauharihi*), it is permissible to assert [that it is] long and short. And because it is a number in relation to the before and after according to what we have set forth, it is permissible to assert [it is] few and many. [This is] likewise [true] for motion since continuity and discontinuity occur in it; hence the properties of continuity and discontinuity are asserted of it. However that [property] which occurs in [motion] and is most proper to it is fastness and slowness (165.14-17).

Time, like motion, Ibn Sînâ tells us, can be long or short, few or many, continuous and yet divisible. In all things time is like motion, except fastness and slowness, i.e., velocity, which is motion's proprium.

Is Ibn Sînâ entitled to such a move? At least one reason suggests that he is not. In Aristotelian science one only has science if she possesses a principled explanation of the fact. If time is the flow of the now, it is hard to see how time could not be a type of motion; however, motion's proprium is that it has a certain velocity. Consequently, we can demonstrate that a certain velocity belongs to time using motion as our middle term; we have a principled reason why time should have a velocity, if time were a type of motion. Ibn Sînâ would quite likely attack the premise that "time is a type of motion." However, he cannot argue that time is not a type of motion on the grounds that time has no velocity; for that is the very question at hand. Moreover, if we grant Ibn Sînâ that time is not a type of motion, then he must likewise retract his assertion that time is "flow". (Or if it is a "flow" we are in desperate need of a definition of a "flow" that is not kinetic.) Ibn Sînâ offers no principled reason why time, which is a flow, is not a motion, and thus his account is *ad hoc* and not truly scientific.

In the final analysis, Ibn Sînâ's dynamic temporal theory is embedded within a moribund cosmology and suffers from internal difficulties as well.

D. Troubles for Aristotle? Although Ibn Sînâ adopted a dynamic theory of time, he was aware of the static theory, which we have ascribed to Aristotle. Moreover, he was aware of troubles that plagued such a view. Indeed, it may have been with an eye to the difficulties surrounding such a conception of time that compelled him to embrace the dynamic theory. In the puzzles Ibn Sînâ relates:

> How is existence to belong to time, while we posit all time so that in the view of the one who posits it, [time] may be delimited by two nows: a past now and a future now which is in relation to the past? In any case it is not permissible that the two exist together. Indeed one of them is something nonexistent. But if it is something nonexisting, then how does what needs a limit which does not exist turn out to exist? For how [could] a nonexisting limit belong to something? On the whole, how is something a connector between something nonexisting and something existing? (149.10-14).

The objection envisions time as that which extends or is marked off between two nows. It then complains that for there to be some interval or magnitude both of the termini that mark off the interval must exist together. With time, however, only one of the termini ever is, and consequently there cannot be an interval or magnitude between two termini. Since time just is what exists between two termini, but there never are two termini, there never can be time.

The objection does not affect Ibn Sînâ's temporal account, since, as we have seen in chapter 7, it does not belong to motion that both of its termini exist together. Indeed, motion and time have their being through the continual renewal of a state (159.9), i.e., a new terminus continually comes to be and passes away. In the case of motion it is the various states of imperfect actuality; in the case of time it is the befores and afters. On the other hand, since for Aristotle time is not a type of motion, but rather a magnitude that extends between two termini, Ibn Sînâ's solution is not available.

Aristotle's response, I believe, is already present in his definition of time as a number. Numbers are clearly mathematical objects and I believe that Aristotle wants us to treat time also as a mathematical object. Although mathematical objects exist materially (*hulikôs*, *Metaphys.* XIII 3, 1078a30-31) in the world, their real existence is only in the soul (*De anima* III 7, 431b15-17; *Metaphys.* IX 9, 1051a21-33).[12] For example, although mathematical planes, lines and points do not exist in the world, surfaces, edges and corners do (*Metaphys.* V 13, 1020a7-14; XI 2, 1060b12-17). It is from our familiarity with these latter things that we come to know the former ones. Similarly with time, time has its existence in the soul, although it has an external basis in motion, which does not require a soul (*Phys.* IV 14, 223a16-29). Time is in the soul when

[12] Admittedly, Aristotle's account of the science of mathematics and its object is fragmentary and desultory. Consequently, my understanding is interpreative and rooted more in the Aristotelian commentary tradition than in Aristotle's own text. Also cf. M. White's "The Metaphysical Location of Aristotle's *Mathematica*" in *Phronesis* (38/2 (1993): 166-82).

the soul remembers one state of a mobile, which can be used to indicate some particular moment, and then is aware of a different state of the mobile, which can be used to mark off a different moment. The recognition of the interval between the two states--an interval found in memory (*On Memory* 1, 449b24-30)--is time. In response to Ibn Sînâ's objection we see that time's two termini do exist together, albeit only in the soul.

E. Conclusion. Both Aristotle and Ibn Sînâ share common conceptions concerning time. First, *contra* a thinker like McTaggart both Aristotle and Ibn Sînâ believe that time is something real, and its reality at least has its basis in the external world. Second, both philosophers hold that time is intimately related to motion. In this sense, they would both reject Shoemaker's argument that there can be time without change. Moreover, they both would concur in their rejection on fundamentally the same grounds. For anything meaningfully to be called time, there must be at least two distinct moments or instants. Aristotle would explain the differences of the instants in terms of accidental differences, Ibn Sînâ in terms of the changing states of a flowing now.

The dissimilar ways these two thinkers explained differences in the now in turn gave rise to fundamentally diverse conceptions of time. Ibn Sînâ, who is known for his subtle and recondite philosophical explanations, ironically is trying to make out our common-sense intuitions about time. Time, for this Arab thinker, is something which flows and moreover is a real feature of the external world. Aristotle, on the other hand, who normally receives the moniker "the common sense philosopher", categorically denies our temporal intuition that time flows and ultimately locates time in the soul. This is not to say that Aristotle's account is sophisticated and polished and that Ibn Sînâ's is maladroit and unfinished; if anything the reverse may be true. What these two accounts do is make us reevaluate our common-sense intuitions about time and think about our metaphysical commitments respecting time. They force us to think about time and time again.

APPENDIX A

THE THIRD MAN AND ARISTOTLE'S THEORY OF *PER SE* PREDICATION

Aristotle was fond of berating Plato's theory of participation on the grounds that it led to a third man regress (*Metaphys.* I 9, 990b15-17; *Peri ideôn* 84.21-85.3).[1] Ironically, based upon Aristotle's version of the third man argument in the *Peri ideôn*, it would seem a similar regress threatens his own theory of predication.[2] The argument of the *Peri ideôn* involves three premises: (1) a non-identity thesis, (2) a self-predication thesis and (3) an assumption that Forms are separate. On the basis of these premises Aristotle deduces a third man regress and then identifies the separability assumption as the offending premise. Despite Aristotle's diagnosis, the first two premises alone are sufficient to generate the regress, both for a theory of Platonic participation and Aristotelian predication. Aristotle must have been aware of this

[1] I do not concern myself with the secondary debates over the proper formulation and intent of Plato's third man argument. For my purposes a faithful exposition of what Aristotle thought the argument was will suffice.

[2] The thesis that Aristotle's theory of predication was a direct response to the challenge of the third man argument was presented by G.E.L. Owen in his article "The Platonism of Aristotle" [in *Articles on Aristotle: 1. Science*, eds. J. Barnes, M. Schofield and R. Sorabji (London: Duckworth, 1975), 14-34 especially the section "Substance and Criticism of the Forms"]. Although I take my starting point from Owen, the account of Aristotle's solution I present here is my own and substantively different from the one suggested by Owen.

threat since the theory of *per se* predication developed in the *Posterior Analytics* provides a bulwark against the regress. Aristotle's strategy there was to ensure that the non-identity and self-predication theses do not obtain simultaneously with respect to scientifically interesting propositions, i.e., *per se* propositions.

In what follows I present Aristotle's version of the third man argument found in the *Peri ideôn*, outline how a modified version of the argument applies to Aristotelian predication and show how Aristotle's theory of *per se* predication stymies the regress.

1. The Third Man Argument in the Peri ideôn. Although Aristotle's *Peri ideôn* has been lost, its account of the third man argument has fortunately been preserved by Alexander of Aphrodisias in his commentary on the *Metaphysics*. The argument in its entirety runs:

> if the predicated [man] is different from those of whom he is predicated and [he] subsists (*kata idian huphestôs*) on his own, and man is predicated both of the particular man and of the Idea, then there will be some third man apart both from the particular and from the Idea. In the same way there will be also a fourth man, predicated of the third man, of the Idea, and of the particulars; and similarly also a fifth, and so on *ad infinitum* (84.27-85.3; translation after Rose)

Of the initial premises, we can easily identify three. (1) The predicate is different from, and thus not identical with, the subjects of predication; call this the non-identity thesis. (2) The predicate is said of both the particulars and the Idea; since the Idea in this case was the original predicate, we can say the predicate is said both of the particulars and the predicate itself; call this the self-predication thesis. Finally, (3) the Idea is something separate from the particulars and it is by participation in this separate thing that the particulars are said to be alike; call this the separability or participation thesis.

Aristotle ardently asserts that the separability thesis creates the regress; for "this comes about for them because they supposed the like things were like by participating (*metousia*$_i$) in the same thing" (85.5-6). From this fact another fact follows. Aristotle's presentation is intended as a *reductio ad absurdum.* There are three premises which when taken together lead to an absurdity. If the argument is to force us to eliminate one of the premises, which is the function of a *reductio*, Aristotle must have assumed the validity of both the non-identity and self-predication theses.[3] Let us now consider the implications of these assumptions on Aristotle's own theory of predication.

2. TMA and Aristotelian Predication. In order to see the effect of the non-identity and self-predication assumptions on Aristotle's own position, we must briefly sketch a weak Aristotelian theory of scientific predication. I call the theory weak only in the sense that the requirements of the theory might be considered the minimum necessary for Aristotle's scientific project. The theory has

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[3] Peter Geach in his article "The Third Man Again" [in *Studies in Plato's Metaphysics*, ed. R.E. Allen (New York: the Humanities Press, 1965), 265-277] has argued that the non-identity and self-predication theses alone are formally contradictory; for if the self-predication assumption is "F-ness is itself an F" and the non-identity assumption is "no F is identical with F-ness", then these two premises are "related as 'p' and 'not p'" (265). The same criticism does not necessarily befall Aristotle's formulation of the regress despite superficial similarities. For although the premises "no F is identical with its subject" and "F is said of F" seems potentially contradictory, the latter premise actually means "F_1 is said of F_2" where the subject and predicate are not identical.

two desiderata:

(1) x can truly be said of F;
(2) an explanatory relation holds between x and F according to one of Aristotle's four causes.

Examples of condition (2) are "snubness belongs to nose" (for snubness has nose as its proper matter, i.e., material causality); or "man is a rational animal" (formal causality); "death belongs to slaughter" (for death is effected by a slaughter, i.e., efficient causality); and "health belongs to a constitutional" (for health is the end of walking). In all cases one thing is said of another in such a way that a causal relation (broadly construed) holds between the two terms. Condition (1), on the other hand, simply states that the propositions formed by connecting two concepts, i.e., the subject and predicate, are true. Whether (1) and (2) are sufficient conditions for an Aristotelian scientific theory of predication I leave unanswered and merely assert that (1) and (2) are necessary conditions of any such theory.

We are now in a position to consider the relation of Aristotle's tacit assumptions in the *Peri ideôn* and what I have labeled the weak scientific theory of predication. Take the proposition "Socrates is a man" (call it P1). The predicate "man" is truly said of Socrates and a relation of formal causality holds between the subject and predicate, i.e., the predicate actually indicates the essence or form of the subject. Thus the proposition meets the two desiderata and is an instance of a weak scientific predication for Aristotle.

Given the tacit commitments of the *Peri ideôn*, viz., the non-identity and self-predication theses, we can draw two further conclusions. First, from the non-identity thesis we can infer that the predicate "man" is different from Socrates. Second, from the self-predication thesis, we can assert that a new predicate 'man' can be said of our initial man-predicate. When we say "man belongs to man" (call this new proposition P2), we mean "what it is to be a rational animal belongs to man." Now what it is to be a rational animal just is the essence of man. Thus P2 is both true and a relation of formal causality holds between P2's subject and predicate. In P2 the new predicate "man" must, however, be different from the initial predicate "man" according to the non-identity thesis and thus a third man is introduced and similarly *ad infinitum*. In short, a weak theory of scientific predication coupled with Aristotle's acceptance of the non-identity and self-predication theses mire Aristotle in his own third man regress.[4]

3. Aristotelian Per Se *Predication.* Since Aristotle cannot

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[4] The argument for a third man regress in Aristotelian predication can be semi-formalized in the following manner.

(1) man belongs to Socrates (from WTSP);

(2) the essence/definition of a predicate belongs to the predicate itself (and thus the name also belongs to the predicate) (SP);

(3) a predicate is different than the subject of predication (NI).

//(4) Man is a predicate (from 1)

(5) the essence/definition of man belongs to man (from SP)

(5´) man belongs to man (variation of 5)

(6) The predicate of (5´) must be different from the subject (from NI)

(7) (5´) means "man_2 belongs to man_1" (from 6)

Conclusion: man_2 is a third man different from either Socrates or man_1; however, the same argument that generated a predicate man_2 of man_1 can likewise generate a predicate man_3 of man_2 and so on *ad infinitum*. Thus a weak theory of scientific predication and the tacit assumptions of the *Peri ideôn* lead to a third man regress Q.E.D..

deny the weak theory of predication without undermining his own scientific enterprise, some restrictions must be placed on the application of the self-predication and non-identity assumptions. On the other hand, the restrictions should be principled and not merely *ad hoc* assertions. Aristotle offers just such a principled account in the *Posterior Analytics* when he discusses the nature and types of *per se* predication, where *per se* predications and only *per se* predications are the philosophically rich and interesting propositions of science.

As an aside, the standard interpretations of *Posterior Analytics* 1 4, the passage concerning *per se* predications, is that Aristotle distinguished four distinct types of *per se* predicates.[5] I disagree and put the number at two for two general reasons. First, those commentators maintaining four types of predication are forced to claim that Aristotle only offered the last two "for the sake of completeness" and that they do no philosophical work.[6] On the other hand, if we can form an interpretation that makes Aristotle's later discussions of *per se* predication viable, a principle of charity says we should opt for the latter interpretation. Second, in no less than four different places (three times in the *PoA* and once in the *PrA*) Aristotle lists the types of *per se* predications and only indicates the first two modes.[7] Therefore, by my lights, the onus of proof is

[5] Aquinas, bk. 1, lect. 10; Ross (1980), 519; Barnes (1993), 112.

[6] Ross (1980), 519.

[7] *PrA*. I 27, 43b3-5; *PoA*. I 4, 73b4-5; 73b16-18; I 6, 74b7-10.

upon those who want to read more than two types of *per se* predication into this passage. For my part I believe that the later so called "modes of *per se* predication" are in fact comments concerning the formal structure and content of *per se* predication. Thus they place certain restraints upon what counts as a legitimately well formed scientific predication.

According to *per se* 1 predication, if the predicate belongs (*huparchei*) in the essence or definition (*to ti estin*) of the subject, then the predicate belongs *per se* to the subject (73a34-37). That is to say if x is contained in the essence or is a constitutive factor in the definition of y, then x belongs *per se* to y. In our passage Aristotle gives the examples of line as a *per se* predicate of triangle and point of line. How the one belongs to the other can be seen more clearly if we consider Euclid's definitions of triangle and a straight line.[8] A triangle is a figure contained by three straight lines and again a straight line is a line that lies evenly with the points on itself.[9] We see that the concept of a straight line is contained within the definition of triangle; and similarly we define a straight line in terms of points. The one must belong to the other; for without the one the other can neither be nor be defined. Simply put a *per se* 1 predicate stands to its subject as a definiens stands to the definiendum. It states what it is for the subject to

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[8] Since Euclid was but a single generation after Aristotle it is very likely that his definitions of these terms, or at least definitions similar to these, would have been familiar to Aristotle, and thus will suit our purposes.

[9] Euclid, *The Elements* [trans. Sir Thomas Heath (New York: Dover Publications, Inc., 1956)], Bk. I, defns. 19, 4 respectively.

exist.

According to the second mode of *per se* predication, whatever belongs to those things which belong essentially (*enuparchousi*) to what clarifies (*dêlounti*) the predicate belongs to the subject *per se* (73a37-8).[10] More simply put, x (the predicate) belongs *per se* to y (the subject) if x belongs to y and y is included in x's definition. Aristotle gives the examples of straight and curved in relation to line, and odd and even or prime and composite in relation to number, and equilateral and oblong in relation to figure. Unlike the *per se* 1 predicates, "straight", for instance, is not predicated as an element in the definition of a line; for then all lines would be straight. Nevertheless, "straight" and "curved" do belong to line; what would a line which was neither straight nor curved be? Moreover, line is included within the definitions of straight and curved; for if we were to say what it is to be straight or curved, we would have to make reference to line. In Aristotelian jargon, the subject plays the role of matter in *per se* 2 predications; for the predicate states some formal aspect or qualification of the subject and the subject is necessary if the predicate is to be.

We may now consider Aristotle's addenda to his theory of *per se* predications. I shall quote Aristotle's comments in their entirety and then discuss them.

> Certain items are not said of some other underlying subject: e.g. what is walking is something different walking (and

[10] 73a37-8; cf. Ross (1980), 520-21 for the distinction between ὑπάρχειν and ἐνυπάρχειν.

> similarly for what is white), whereas substances, i.e., whatever means this so-and-so, are not just what they are in virtue of being something different. Items which are not said of an underlying subject I call *per se* and those which are said of an underlying subject I call accidental.
>
> Furthermore, in another manner what holds of something because of itself holds of it *per se*, and what does not hold because of itself is accidental. For example, if there was lightening while he was walking, that was accidental; it was not because of his walking that there was lightening--that, we say, was accidental--i.e., if something died while being slaughtered, it died on account of (*kata*) the slaughtering, since it died because of the slaughtering, and it was not accidental that it died while being slaughtered (*PoA*. I 4, 73b5-16; translation after Barnes).

The first addendum, I shall argue, specifies what a well formed *per se* proposition looks like, while the second addendum requires that all *per se* predications involve a causal relation. We have already introduced the latter restriction when discussing the weak theory of scientific predication and I shall let those comments suffice.

The first addendum, on the other hand, begins with a division into (1) those items which are not said of some other underlying thing and (2) those items which are said of some other underlying thing. Items not said of some underlying thing are *per se*, Aristotle adds, whereas those said of another are accidental. The point which I see Aristotle making is that nothing which belongs to another as in a subject can itself be a subject of *per se* predication. Thus "the walking" or "the white" are illegitimate cases of subjects of *per se* predications, since something else underlies them as their proper subject; rather this underlying subject is the true logical subject.

Aristotle fills out the philosophical motivation of this restriction in *Posterior Analytics* 1 22, where he has us consider the sentence "the white is (a) log." Greek grammar allows this construction in a way that English does not and thus for Aristotle the sentence would be a grammatically correct one.[11] The sentence, however, allows of two possible interpretations.

1) the essence of white is a log
2) that thing which happens to be white is a log.

Interpretation (2) can further be restated as "the log (which happens to be white) is (a) log" and consequently white is not the *per se* logical subject of wood but only an accident which belongs to wood (83a1-14).[12] However, in a logically perspicacious language one wants to avoid propositions which allow of more than one interpretation, otherwise one's logic becomes riddled with equivocation. Therefore, according to Aristotle, if we must specify whether (1) or (2) is the proper mode of predicating and science only deals with *per se* predications, let us disallow predication of the second form (83a14-23). In general, then, if the subject of predication already itself belongs to a subject, the predication will not count as scientific predication.

4. Aristotle's Response to the TMA Challenge. We must now assess our discussion of *per se* predication and see what relation it has to the third man challenge presented above. First, consider *per se* 1 predications. In these cases the predicate just is what the subject is. Aristotle is very clear on this point, arguing in

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[11] Beyond the passage mentioned below, cf. *PrA.* I 46 for further difficulties with this manner of predicating.

[12] Also cf. Aquinas, *Comm. in PoA.* bk. 1, Lect. 33.

Metaphysics VII 6 that "it is necessary that of the things predicated *per se* [1] they be the same" (1031a28-9).[13] For the essence just is to be the predicate or name.[14] Thus instances of *per se* 1 predication will never entail a third man type infinite regress, since they always violate the non-identity thesis required by the third man argument.

This solution, however, is not open to instances of *per se* 2 predication. For Aristotle writes later in *Metaphysics* Z [11] that only those things are identical "which are not predicated as being some different thing in another thing and in a subject as in matter" (1037b3-4).[15] Aristotle's point is that whenever the subject is related to the predicate as the matter of the predicate the two are not identical. However, a relation of material causality holds between subject and predicate in *per se* 2 predications. Hence the subject and predicate are not identical. Thus it would seem that the third man regress still threatens a class of scientifically interesting propositions.

Here we must appeal to the formal structure of *per se* predication captured in the addenda discussed above. Consider the following instance of self-predication: the straight is straight. "Straight" we recall was an instance of a *per se* 2 predicate. As

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[13] ἐπὶ δὲ τῶν καθ' αὑτὰ λεγομένων ἆρ' ἀνάγκη ταὐτὸ εἶναι; also cf. 1031b13, 1032a5.

[14] One argument he gives is that we only know something when we know its essence; now, we have knowledge of things in the world, but if the essence were different from the things in the world, we would not know them; since we do know them the essence cannot be different (1031b5-22).

[15] ᾗ μὴ λέγεται τῷ ἄλλο ἐν ἄλλῳ εἶναι καὶ ὑποκειμένῳ ὡς ὕλῃ.

such straight already belongs to the subject "line"; however, we agreed to forbid any subject which itself already belonged to another subject from itself being a subject of a *per se* predication. Thus the proposition 'the straight is straight" must properly be parsed "the line (which happens to be straight) is straight. Indeed, all instances of self-predication among *per se* 2 predicates can be similarly analyzed. Therefore, a *per se* 2 predicate never is a subject which has itself as a predicate and thus there cannot be a instance of self-predication among *per se* 2 predicates.

Given these two observations about *per se* 1 and 2 predications, viz., that *per se* 1 predications always violate the non-identity thesis, while *per se* 2 predicates never are themselves the subject of *per se* predication, we can draw the obvious conclusion. A third man regress never threatens a scientifically interesting proposition for Aristotle, i.e., an instance of *per se* 1 or 2 predication, since no such propositions are simultaneously subject to both the non-identity and self-predication assumptions.

I shall conclude by way of summary. Aristotle's ongoing attack against Platonism, especially in the form of the third man argument, tacitly commitments him to two assumptions: (1) a predicate is different from the subject of predication and (2) a predicate can itself be a subject of self-predication. By a strange twist of fate, the two theses coupled with the necessary conditions of a Aristotelian scientific theory of predication, lead to the same regress in Aristotelian logic. In order to respond to this challenge

Aristotle provides a principled account which restrains the application of the non-identity and self-predication theses. These restrictions emerge in Aristotle's discussion of *per se* propositions in the *Posterior Analytics*. His solution is to ensure that *per se* 1 predications are never subject to the non-identity thesis, whereas *per se* 2 predications are always immune from self-predication. Thus the two assumptions necessary to generate the third man argument never obtain simultaneously of scientifically interesting propositions.

APPENDIX B

ARISTOTLE ON MATHEMATICS AND THE THEORY OF NUMBER

"Time is number of motion in respect of before and after" states Aristotle's famous definition of time. But what does it mean to say time is a kind of number (arithmos)? Time seems to be a continuous magnitude, while number is a discrete quantity. Further, Aristotle defines number as a plurality of units.[1] Thus time should be the "plurality of units of motion in respect of before and after." This definition is more obscure than the original one. For what are these units of motion? Yet Aristotle believes that his view of time is superior to that of his predecessors. Certainly, then, an account of Aristotle's theory of number is needed in order to clarify his conception of time. This theory of number, on the other hand, only emerges out of Aristotle's general philosophy of mathematics.

1. The Dilemma of Location. Let us begin at Aristotle's discussion of mathematical objects at *Metaphysics* XIII. He takes the reality of mathematical objects for granted, saying that "the subject of our discussion will be not whether [mathematical objects] exist but how they exist" (XIII 1; 1076a36). We are given three possible

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[1] *ho d' arithmos plêthos monadôn* (*Metaph.* X 1; 1053a30); he similarly defines number as a plurality of indivisibles (*plêthos adiairetôn*: *Metaph.*VIII 9; 1085b22); and a plurality of ones (*hena pleiô*: *Phys.* III 7; 207b7).

modes of existence: mathematical objects are either (1) separate (*kechôrismena*) from sensible objects or (2) in sensible things (*en tois aisthêtois*) or (3) in some other way which will need to be explained. That Aristotle is opposed to (1)--the platonic thesis--we can take for granted. Thus, we must concern ourselves with (2)--that mathematical objects are in things--and (3)--that mathematical objects have their reality in some third way.

Mathematical objects cannot be in things, argues Aristotle. He gives two basic proofs. The first had already been rehearsed in *Metaphysics* III and runs as follows. Some had said that number, line, figure and point are kinds of substances intermediate (*metaxu*) between the Forms and the individual, and these intermediates provide the subject of the mathematical sciences (996a13-14; 997b2; 997a23). Such a view implies that two solids, and consequently two substances, could simultaneously occupy the same place, which is absurd.[2]

If mathematical objects are in things, then a body could not be divided, claims the next argument.[3]

> For [a body] will be divided along a plane, and the plane along a line, and the line at a point, so that if the point cannot be divided, neither can the line, and if the line cannot, the rest

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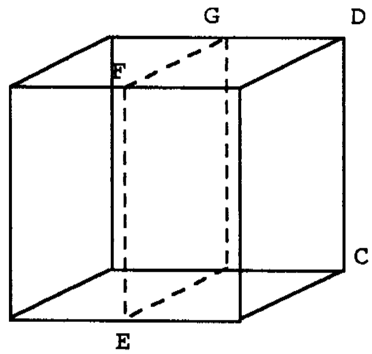
[2] This argument can further be extended to other powers and characteristics; thus giving rise to a second argument. Aristotle does not say at Mu (XIII) what the "other powers and characteristics" are, but from Beta (III) he suggests that the argument could be extended to any power or characteristic which belongs to a thing. Thus we read "for if there are intermediate sensible things and sensations (*aisthêseis*), an intermediate animal will enter into the animal itself and the corruptible animal" and by extension there will be a sensation intermediate to the sensation itself (997a23-24).

[3] Cf. Michael White's article "The Metaphysical Location of Aristotle's *Mathêmatika* (*Phronesis*, XXXVIII/2 (1993): 166-182) for a more thorough analysis of the argument.

cannot either (XIII 2; 1076a4-8; Annas' translation).[4]



Take the cube (body) ABCD and divide it precisely at the plane EFG. Now we have two bodies--AEFG and BEFG; but it is impossible that EFG belong to both bodies. For to say EFG belongs to both bodies is equivalent to saying E belongs to AE and EB when AB is divided. However, if E belonged to both line segments then a dimensionless point would have been divided into two which is clearly false. Further, to say that E belongs to one segment and the point adjacent to E--call it H--belongs to the other is impossible too; for between any two points there are an infinite number of points. Hence between AE and BH an infinite number of points would exist that were not included in the original division, which is likewise false. It does not matter whether sensible things are these mathematical objects or the mathematical objects merely are found in perceptible things; the same objection holds, Aristotle adds.

This second complaint is both stronger and broader in its scope than the first argument. Where the first argument required mathematical objects to be substances in their own right, this second argument makes no such restriction. Mathematicals need merely belong to sensible objects--as a constitutive element perhaps--for this

[4] *Aristotle's Metaphysics: Books* M *and* N, trans. Julia Annas (Oxford: Clarendon Press, 1976).

critique to hold. Such a challenge threatens the very possibility that points, lines planes etc. actually belong to perceptible objects.

A clearer knowledge of Aristotle's opponent will give us a surer idea of the way in which mathematical objects *cannot* exist in sensible things. Tentatively, I want to suggest that the object of Aristotle's critique was the Pythagoreans (or at least Platonists with definite Pythagorean leanings). Two considerations lead me to this view. First, at almost every point where Aristotle discusses mathematics it is done within a context of addressing either the Platonists or the Pythagoreans. Thus, since XIII 1 and 2 are, as it where, the preface to the closest thing to a mathematical treatises, it would be odd not to include the Pythagoreans.

Second, the doctrine that things are numbers is one of the most telling features of the Pythagoreans.[5] Aristotle believed that for the Pythagoreans numbers can be assigned to figures in accordance with the number of points it takes to contain the figure; hence since the line is bounded on two ends, lines can be assigned the number two, and likewise three can be assigned to planes and four to solids.[6] Thus by a solid's being composed out of planes, and a plane out of lines and a line out of points, sensible objects are in a way composed of numbers. These numbers would not be a separate

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[5] For a full discussion of the Pythagorean doctrine see W.K.C. Gutherie, "Numbers and things: the generation of things from numbers," *A History of Greek Philosophy*, vol. 1 (Cambridge: Cambridge UP, 1962), 239-281.

[6] *Metaphysics* N.5; 1092b9-13.

substance, but rather the constitutive elements of substances, i.e., of sensible things. But this position is just the one that the division argument is attacking. Thus we can read the dilemma of location as follows: if one accepts the Platonists' view of mathematical objects, one is committed to the separate existence of mathematicals, which is false; on the other hand, if one accepts the Pythagoreans' view of mathematical objects, one is committed to the reality of mathematicals in sensible things, which is likewise false.

2. Abstraction and the Solution of the Dilemma of Location. XIII 3 address how mathematical objects are real, yet neither separate from nor in sensible bodies. The traditional interpretation of XIII 3 says Aristotle held an "abstractionist" position.[7] Abstraction is seen as a psychological activity or epistemological theory, whereby the mathematical objects, which are potentially in sensible things, are separated, or abstracted (presumably by *nous* or the soul), from the sensible object and made actual.

Such an interpretation, I contend, is false. First, as John Cleary has observed, this interpretation requires abstraction to be a third mode of learning over and above induction and deduction, i.e., one comes to know what mathematical objects are by means of abstraction; however, at *Posterior Analytics* I 18 Aristotle gives an argument which requires that induction and deduction be the only modes of learning.[8] Thus we have reason to assume that abstraction

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[7] Annas, 32ff; M. Mignucci "Aristotle's Arithmetic," *Mathematics and Metaphysics in Aristotle*, ed. A Graeser (Switzerland: Paul Haupt Bern, 1987), 181.

[8] J.J. Cleary, "On the Terminology of 'Abstraction' in Aristotle," *Phronesis*

is not a third mode of learning. Second, if Aristotle does believe abstraction (*aphairesis*) is a third mode of learning by which we come to know mathematical objects, we should expect some discussion of this mode of coming to know mathematicals in his account of mathematics. Yet not only is there no discussion of *aphairesis* in XIII 3, but in fact the term is wholly missing.

Jonathan Lear has understood Aristotle's intention in XIII 3 as what we might label a "modified abstractionism".[9] For this expositor Aristotle's *qua*-operator (ᾗ) works as a "predicate filter".[10] The *qua*-operator forces us to focus on only a limited amount of information, namely, the information picked out by the *qua*-operator. Consequently, if one studies an object <a> *qua* F, one only concerns himself with <a> insofar as <a> is an F. Therefore, a doctor would only concern herself with a patient *qua* healthy and ignore all other properties of the patient, such as being white, 6'4", hirsute, etc., since these are irrelevant to the health of the patient. Such a reading has the advantage of avoiding Frege's abstractionist complaint; for the whole activity of Aristotelian abstraction is to pay attention, i.e., to focus intently on a single property of a thing.[11]

XXX/1 (1985): 13-45 (especially 15-16).

[9] J. Lear, "Aristotle on Mathematics," *The Philosophical Review* (April 1982), 161-192.

[10] Lear, 168.

[11] Frege's complaint against the nineteenth-century abstractionist, who made abstraction a type of inattention, runs as follows.

> Inattention is a very strong lye; it must not be applied at too great a concentration, so that everything does not dissolve, and likewise not too dilute, so that it effects a sufficient change in the things.... Suppose there

Unfortunately, this modified abstractionism is also wrong. As Lear himself unabashedly admits: "This interpretation of Aristotle's philosophy of geometry rests on the assumption that Aristotle thought that physical objects really do instantiate geometrical properties."[12] Thus straight lines and spheres truly do populate the cosmos, and they are the things geometers focus on when they practice their craft. On Lear's view then, there can be a bronze cube that possess straight lines, planes and the like; however, if these mathematical objects exist in the physical cube, then it could not be divided as Aristotle's division argument had shown. Modified abstractionism falls prey to Aristotle's own argument, but any reasonable interpretation would demand that Aristotle's abstractionism be immune from his own argument.

John Cleary has offered a new interpretation of "abstraction" (*aphairesis*) in Aristotle.[13] Cleary challenges the view that abstraction for Aristotle is an epistemological activity and rather asserts that it is a logical method, which had been an integral part

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are a black and a white cat sitting side by side before us. We stop attending to their colour, and they become colourless, but are still sitting side by side. We stop attending to their posture, and they are no longer sitting (though they have not assumed another posture), but each one is still in its place. We stop attending to position ; they cease to have place, but still remain different .... Finally we thus obtain from each object a *something* wholly deprived of content; but the *something* obtained from one object is different from the *something* obtained from another object--though it is not easy to say how ... (*Philosophical Writings, eds. Geach and Black* (Oxford: Blackwell, 1966), 85).

[12] Lear, 175; Lear goes to great lengths to show that such a view is consonant with Aristotle's text (175-183).

[13] Cleary, (1985).

of the Academy.[14] The core meaning of *aphairesis*, argues Cleary, is "to subtract". Moreover, this logical method frequently employed the *qua*-operator (ᾗ), or at least the dative case, where the term linked with the *qua*-operator signified that from which everything else is subtracted. The primary function of abstraction (or as Cleary prefers to term it, "subtraction") is "to identify and isolate the primary subject of predication for any given attribute."[15] He explains how this process works by an example from the *Posterior Analytics* (I 5; 74a32). Aristotle poses the following question: when does one know universally and *simpliciter* that every triangle *qua* triangle (and not merely as scalene or isosceles or equilateral) has internal angles equal to two right angles (2IA)? We begin with a sensible triangle, say one of bronze, and ask ourselves "does the property 2IA still exist when we subtract the bronze? Yes." We subtract another attribute and repeat the procedure. When the property 2IA is eliminated with the subtraction of a certain attribute, that attribute is the primary subject. Of course this subtraction cannot take place willy-nilly but must follow a specific order. "The order of subtraction follows a successive division of descending genera into their species" in Aristotle's example, notes Cleary.[16] The important thing is that subtraction indicates and

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[14] Ibid., 20; such a view would explain why Aristotle had so little to say about what later commentators would take to be a fundamental element of Aristotle's philosophy.

[15] Ibid., 39.

[16] Ibid., 23; similarly in XIII 3--where Aristotle claims: "in the case of moving things there will be statements and branches of knowledge about them, not *qua* moving but merely *qua* bodies, and again merely *qua* planes and merely *qua*

isolate the primary subject of a science and this method presupposes some dialectical division.

Although this view certainly represent an advancement over earlier discussions of abstraction, in that it spells out the logical method of abstraction, it falls victim to the same criticism as the others. If for Cleary mathematical objects are in sensible things and only after a process of subtraction do we finally arrive at them as the primary subject of mathematics, then Cleary's mathematicals are open to Aristotle's division argument; for they actually are in sensible things.

Let us, then, start afresh with XIII 3. Aristotle begins:

> Just as general propositions in mathematics (*ta katholou en tois mathêmasin*) are not about separate objects over and above magnitudes and numbers, but are about these, only *qua* having magnitude or being divisible, clearly it is also possible for there to be statements (*logous*) and proofs about perceptible magnitudes, but not *qua* perceptible but as being of a certain kind (1077b17-22; Annas' translation).

The "general propositions in mathematics" to which Aristotle refers are, as Lear observes, most likely to be identified with Eudoxus' theory of proportions.[17] In the past mathematicians had proved separately for numbers, lines, solids and time the proposition "four proportional things are alternately proportional."[18] The Eudoxus theory of proportion allowed them to prove this proposition for all cases with a single demonstration. Since the Platonic view requires

lengths, *qua* divisible and indivisible but with position, and merely *qua* indivisible" (1077b27-30, after Annas). There is a descent from general to specific branches of knowledge.

[17] Lear, 165-166.

[18] viz., if A:B::C:D, then A:C::B:D; see *PoA*. I 5; 74a19-25.

the existence of separate mathematical objects, in order for mathematics to be possible, the objects about which Eudoxus speaks must also exist. Seemingly such objects would have to be simultaneously numbers, lines, solids and time, since the theory of proportion is applicable to all of these. Thus Aristotle complains:

> So there will be another type of object here, between and separate from both Forms and intermediates, neither number nor point nor magnitude nor time. If this is impossible, clearly it is also impossible for the former to exist in separation from perceptible objects (1077a10-14; Annas' translation).

Mathematics functions perfectly well without positing separate objects, argues Aristotloe, as Eudoxus' theory shows. For Eudoxus' theory allows mathematical statements and proofs about sensible objects, not considered as sensible, but rather *qua* magnitudes or quantities. Aristotle repeats the same argument with reference to physics and medicine.[19] Physics deals with things considered as moving, but this fact does not necessitate that separate, eternal, unmoving moving-objects exist. Similarly, an ob-gyn will treat the healthy *qua* female; for there are certain attributes or properties that belong to humans *qua* female. Yet, as Aristotle observes, there is no female separate from animal. Therefore, "the mathematical branches of knowledge will not be about perceptible objects just because their objects happen to be perceptible, though not <studied> as perceptible; but nor will they be about other separate objects over and above these" (1078a125; Annas' translation). Aristotle's general trend of argumentation is clear: we have a plethora of

[19] 1077b23-31.

sciences, whose objects do not exist separate from sensible things; and for the same reasons we need not think that the objects of mathematics must be separate from sensible things.[20]

In the passage which follows Aristotle finally explains in what way mathematical objects exist, yet are neither separate from nor actually in sensible things.

> The best way of studying each object would be this: to separate and posit (*theiê*) what is not separate, as the arithmetician does, and the geometer. A man is one and indivisible as a man, and the arithmetician posits him as one indivisible, then studies what is incidental to a man as indivisible; the geometer, on the other hand, studies him neither as a man nor as indivisible, but as a solid object. For clearly properties he would have had even if he had not been indivisible can belong to him without them. That is why geometers speak correctly: they talk about existing things and they really do exist--for what exists does so in one of two senses, in actuality (*entelecheiai*) or as matter (*hulikôs*) (1078a21-31; Annas' translation)

I shall treat more fully Aristotle's comments about arithmetic, in the following section. For now the following comments are sufficient. First, Aristotle makes explicit the method of the mathematicians--a method already implicit in his discussion of the various sciences. The mathematician identifies and isolates the object of his science. Second, he treats as separate what is in fact not separate.[21] Third, this fiction is settled, or agreed upon, or even fixed in common with others (*tithetai*).

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[20] To this point Aristotle's account agrees with Cleary's view, and thus it may be more accurate to conclude that Cleary's reading is not so much wrong as incomplete. In fact, most of XIII 3 indicates that the various sciences subtract inapplicable attributes according to an orderly process; cf. 1007b27-31; 1078a9-10.

[21] I shall deal with this claim more fully in the sequel.

The second claim--the mathematician treats as separate what is in fact not--gives us reason to pause. Science concerns itself with universals and not particulars. Now a thing's matter individuates it. Thus to know the universal (and thus have science) one must know the thing separate from its matter, i.e. one must grasp what is one and the same in various similar objects. When someone perceives, say, a brick, a primitive universal (for instance, a cube-like thing) comes to reside in the mind (*PoA.* II 19; 100a16); after several similar experiences a "whole universal" comes to rest in the soul and from this universal there comes a principle of understanding (100a6-8). Thus, the actual object of mathematics is not some object actually existing in sensible things, but rather the universal existing in the soul of the mathematician.[22]

In another sense, however, mathematical objects are in sensible things (albeit not actually); they exist in sensible objects materially (*hulikôs*), i.e., as that out of which.[23] To make this mode of existence clear let us consider Aristotle's definition of

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[22] Ian Mueller argues persuasively that "mathematical objects are universals separated in thought from matter" ("Aristotle on Geometrical Objects" in *Archive für Geschichte der Philosophie* 52 (1970), 163), but then backs away, maintaining instead that mathematical objects are "substance-like individuals with a special matter" (164).

[23] The view presented here is heavily influenced by the position of Michael White in his "The Metaphysical Location of Aristotle's *Mathêmatika*" (1993). Where I see myself differing from him involves our notions of "abstraction". White seems to construe abstraction as a psychological activity that separates the mathematical objects from matter. ("Aristotle's conception of *aphairesis* can be applied ... to the geometer's *transforming* [my emphasis] his *mathêmatika* into something actual from their potential existence in the sensible and physical world" (179).) For me, abstraction is, as Cleary observed, simply a logical method; any "transforming" of potential mathematicals into something actual (i.e., the actual objects of the science of mathematics) is done via induction.

"quantity" (*poson*) in *Metaphysics* V 13:

> 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; in magnitude, that which is continuous in one dimension is length, in two breadth, in three depth. Of these, <finite> (*peperasmenon*) plurality is number, <finite> length is a line, breadth a surface, depth a solid (1020a8-14; Revised Oxford translation).

Aristotle's equating of number with plurality, line with length, surface with breadth and solid with depth suggests that numbers, lines, surfaces and solids need not be in sensible objects as mathematical objects; rather only pluralities, lengths, breadths and depths need be in perceptible objects. These (pluralities, lengths, breadths and depths) provide the matter of the so called mathematical objects, which only actually exist in the soul. Thus Aristotle speaks correctly when he says, "for what exists does so in one of two senses, in actuality (*entelecheiai*) or as matter (*hulikôs*)" (1078a30-31). Commentators have speculated over Aristotle's use of *hulikôs* instead of the more obvious correlative *dunamei* (potentiality). Aristotle was simply trying to avoid a possible confusion. For what exists potentially in a thing can be brought to a state of actuality, but planes, lines and points can never actually exist in a perceptible body--as the division argument shows--only the matter of the mathematical object can actually belong to sensible things, i.e., that from which mathematical objects come to reside in the mathematician's soul. From perceiving pluralities etc., primitive universals exist in the soul, which eventually becomes the principles and objects of mathematics.

3. Aristotle's Theory of Number. We are now in a position to consider Aristotle's theory of number.[24] We recall that Aristotle said of the arithmetician, "[he] posits (*etheto*) [man] as one indivisible, then studies what is incidental to man *qua* indivisible" (XIII 3, 1078a22-25). We note three things about Aristotle's arithmetic. (1) The *qua*-operator identifies the primary subject of arithmetic, viz., the indivisible. (2) The arithmeticians agree, or settle upon, what they consider indivisible. Finally, (3) they study and theorize about the properties that belong to man, or whatever, on account of its being indivisible.

Obviously, a treatment of the "indivisible" is demanded. At *Metaphysics* X 1-2 Aristotle links indivisibility with the notion of "one", claiming it means to be "the first measure of a kind". By means of this measure we know quantity (and subsequently the other categories); for "quantity *qua* quantity is known either by a 'one' or by a number, and all number is known by a 'one' ... and so the one is the principle (*archê*) of number *qua* number" (1052b20-25). Aristotle wants to draw a comparison between the units of measurement and those of counting. If we were presented with a pile of flour and asked "how much?" we would be at a loss how to answer until we had agreed upon a unit of measurement.[25] Likewise, since number is just a plurality of ones or indivisibles or units, if we were presented with some group, we would be at an equal loss to answer how many. For

[24] The positions of J. Annas (36-37) and M. Mignucci (189-193) have strongly influenced my own thought on Aristotle's arithmetic.

[25] *Metaph*. H.2; 1045a4-6.

instance, if we are given three shoe boxes with a pair of shoes in each, how would we answer the question "How many?" There might be three if the unit is "pairs of shoes"; or six if the unit is "individual shoes"; or nine, if it is "individual objects" (six shoes and three boxes, which ignores the complications of shoe strings, nails, pieces of leather etc.). Some unit has to be chosen as the measure by which we count the plurality.

How do we come to know what these one and indivisible measures are? In some sense the choice depends on us. The arithmeticians just posit the man as indivisible, i.e., they agree to treat 'man' as a unit for counting, although they could have just as easily settled on 'individual feet'. "Since even in lines, we treat as indivisible the line a foot long (1052b33)," says Aristotle. A line is continuous and thus can easily be divided at one inch, or smaller, intervals; and yet for the purpose of a measure we can posit a one foot line as indivisible. Mario Mignucci has explained 'being one and indivisible' in terms of sortal concepts. "To be one for a thing <a> means to be an instance of a sortal concept."[26] He gives the examples of "man", "horse" and "goose" in contrast to "water", "ink" and "red", arguing that the sortal concepts have "different and <divided> instances."[27] To his list of sortal concepts we might add "lengths" and "revolutions of the heavenly spheres"; for one inch or one revolution of the heavenly sphere is certainly distinct from

[26] Mignucci, *op.cit.* 191.

[27] Ibid.

another.

On the other hand, there are practical considerations which influence our choice of a measure. "Now where it is thought impossible to take away or to add, there the measure is exact" (105b35-36). In the absence of such a measure, we try to find the best approximation of it.

> For in the case of a furlong or a talent or of anything large any addition or subtraction might more easily escape our notice than in the case of something smaller; so that the first thing from which, as far as our perception goes, nothing can be subtracted, all men make the measure ... and they think they know the quantity when they know it be means of this measure (1053a2-8).

In short, we look for what is simple and naturally lends itself to be a measure. If the measure is too large, it lacks practical value. For instance, if the unit of weight were the ton, dieting would be useless; for differences of five or ten pounds would go unnoticed.

Another obvious constraint is that the measure must always be homogeneous with the thing measured. Musical bars can no more measure spatial lengths than inches can measure beats of music.

> "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 weight a weight, that of units a unit (1053a25-27).

Therefore, if we measure lengths, we must choose a length for our unit; and if we count horses, we choose a horse for our unit; and if we measure various times, we use a time.

Although these brief remarks hardly do justice to Aristotle's theory of arithmetic, they are sufficient for our purposes. Number is, as Aristotle says, a plurality of units or indivisibles or ones, where these are what is taken for the purpose of measurement or computation. Such a view avoids Plato's claim that numbers are some separate substance or form; for these units are nothing more than sensible objects considered *qua* indivisible for the purposes of counting.

APPENDIX C

THE ETERNITY OF THE WORLD: PROOFS AND PROBLEMS IN ARISTOTLE, AQUINAS AND IBN SÎNÂ

The issue of the world's eternity was one of a set of three focal points for medieval philosophers and theologians. (The others in the set included the immortality of the soul and God's knowledge of particulars.) These three topics formed a litmus test for orthodoxy in the Christian, Jewish and Islamic milieus. The orthodox, in the case of the world's eternity, denied that the world was eternal, and rather affirmed that there was a first moment, when, through God's creative act, the world came to be. The problem was that orthodoxy flew in the face of philosophy (or at least Aristotelian philosophy); for Aristotle had argued that since time is eternal so must the world be. Aristotle's argument, we shall see, suffered a flaw, which Thomas Aquinas most trenchantly exposed. Still the question of the eternity of the world engendered various proofs--both pro and con--which were independent of Aristotle's. Among these we find one provided by the Arabic philosopher Ibn Sînâ (Avicenna), which relies on Ibn Sînâ's own understanding of necessity and possibility. In what follows, I present a formulation of Aristotle's argument for the eternity of time and Aquinas' criticism of it. The concluding sections are a translation of and commentary on Ibn Sînâ's own argument for the eternity of the world and a discussion to what extent Ibn Sînâ avoids Aquinas' critique.

Book VIII of Aristotle's *Physics* begins with a question: "Was there some time when motion came to be, not existing before then, and will it cease to be again in such a way that nothing is moved, or did it neither come to be nor will it cease to be?"[1] Aristotle unequivocally maintains that motion could not come to be nor cease to be and consequently is eternal. As a corollary, since motion always requires a thing which is moved and the thing moved in this case is the world, Aristotle concludes, the world is eternal.

Aristotle's eternity argument demands a proof that time is eternal; for if time, which is an attribute (*pathos*) or state (*hexis*) of motion, is eternal, then clearly that of which time is an attribute, viz., motion, will also be eternal. The proof is this: the existence, even the conceptualization, of time is inextricably united with the now; for time is what is bounded by the now.[2] The now, however, is a link (*sunécheia*) between past time and future time. Therefore, "since the now is a beginning and ending [of time],

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[1] 250b11-13; πότερον γέγονέ ποτε κίνησις οὐκ οὖσα, καὶ φθείρεται πάλιν οὕτος ὥστε κινεῖσθαι μηδέν, ἢ οὔτ' ἐγένετο οὔτε φθείρεται.

[2] *Phys.* IV 11, 219a29. Even the more famous definition of time as a number of motion with respect to before and after (ἀριθμὸς κινήσεως κατὰ πρότερον καὶ ὕστερον) presupposes the now; for the before and after just is the now.

it is necessary that time always be on either side of it."[3] Consequently, given the nature of the now, time must be eternal; for if there should be either a first now or a last now, there would be a now which did not have time on both of its sides, which is contrary to the nature of the now.

Many of Aristotle's later commentators presented similar versions of the proof. Aristotle's third century A.D. commentator, Alexander of Aphrodisias, provides us with perhaps the must succinct version. If time were created there would be a before the coming to be of time, but a before the coming to be of time necessitates that there is a time before time. Similarly, if time were to cease to be, there would be an after the ceasing to be of time, which requires a time after time. To speak of a time before the beginning of time or a time after the ending of time are both incoherent notions and thus reason demand that time neither comes to be nor ceases to be.[4] The central premise for both Aristotle's and Alexander's arguments is that for any moment one could care to chose, there must always be some time both prior and posterior to it.

Although many philosophers accepted Aristotle's thesis for the eternity of time and the world, some actively opposed it. Included in this latter group was Thomas Aquinas (1225-1274). Aquinas attacked Aristotle's deduction of the eternity of time on the grounds

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[3] *Physics*, VIII. 1, 251b25-26.

[4] *De tempore* 24.3-6.

that it begged the question.[5] Thomas analyzed the argument as follows. To ask whether time could either be created or destroyed is to ask whether there could be a now which does not have time either prior to or posterior to it. Thus to assume as an initial premise that the now must have time on both sides is to commit a *petitio principii*. Whether there can be a now which has either no time prior to it or no time posterior to it is the very issue at stake. Aquinas makes the point clear with an analogy. The Aristotelian argument requires treating the now as a medium between past and future time; however, for Aristotle the now is the temporal analogue to the point of a line.[6] Thus, argues Aquinas:

> it does not belong to the account of a point that it be a medium [i.e., that a point is always the beginning and end of some line]; rather a certain point is only a beginning of the line and a certain point is only an end of the line. ... Therefore, it is not possible to prove that a line is infinite because every point is a beginning and an end; but rather the converse ought to be proved, viz., from the fact that a line is infinite, every point would either be a beginning or an end.[7]

Similarly, one could only prove that the now must always be a mid-point between past time and future time, if he assumed time was eternal, i.e., there has been an infinite past time and there will be an infinite future time; however, the eternity of time is the question at hand. Aristotle's argument is not effective, concludes

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[5] *In Physicorum* L.VIII, 1. ii, 983-984.

[6] *Phys.* IV 10, 218a18-19; VI.1, 231b6-8.

[7] *In Phys.* L.VIII, 1, ii, 983; non est autem de ratione puncti quod sit medium; sed aliquod punctum est quod est tantum principium lineae, aliquod autem quod est tantum finis. ... Non ergo posset probari quod linea sit infinita, ex hoc quod omne punctum sit principium et finis: sed potius e converso, ex hoc quod linea est infinita, probandum esset quod omne punctum esset principium et finis.

Aquinas, since it begs the question.

Even before Aquinas, however, certain philosophers began to develop proofs for the eternity of time independent of Aristotle. Perhaps they already recognized the flaw ultimately identified by Thomas. Among these philosophers was Ibn Sînâ, who formulated his version of the argument based on his theory of necessity and possibility. Ibn Sînâ's argument attempts to prove that time neither has a beginning nor end, regardless of whether one assumes every now is preceded and succeeded by a period of time or not. Thus Ibn Sînâ's argument represents an advance over Aristotle, since it avoids the obvious case of begging the question. Ibn Sînâ's full argument involves two steps: the first step explicitly argues against a beginning of time, and is just a version of Alexander of Aphrodisias' proof which we have seen and I shall let our comments above suffice.[8] The second step, and the one I shall present, is framed in terms of an ending of time and does not assume the question-begging definition of the now, viz., that the now is a medium point between past and future time. Although Ibn Sînâ employs one argument to demonstrate that there is no beginning of time and another to show there is no

[8] If [a now] were at the beginning of time, then from that it is necessary that no "before" belonged to that time. If no before belonged to it, then it is necessary that it was not something nonexisting, and then it exists; for when there is something nonexisting and then it exists, its existence is after its nonexistence. Thus its nonexistence would be *before* its existence. Hence a "before" would necessarily belongs to it and that before would be an account other than the "nonexistence" characterized according to the manner which we asserted in this situation. So this thing of which this species of beforeness is predicated would be fully realized (*ḥāṣil*[an]), but it would not be this time. Thus before this time there would be a time, which is continuous with [this time]--that one before and this one after--and this division would join the two while having imposed a division, but this is a contradiction (160.9-13).

ending, both proofs *mutatis mutandis* argue equally well for either thesis. Consequently, even though Ibn Sînâ frames his arguments in terms of "after" and a last moment of time, we can easily frame the argument in terms of "before" and a first moment of time; and thus it shows that time has both always been and always will be and hence that the world is eternal.

Let us now turn to Ibn Sînâ's explicit argument that there cannot be a last moment of time:[9]

> if [the now] imposed a division in the manner of an end point, then either [A] there would be the possibility of something existing after it, or [B] there would not be. [B] Now on the one hand, if it were not possible that something exists after it, not even that whose existence is necessary, (so that it is impossible that something exists with the nonexistence which is reached after the end point), then absolute possibility and that something necessary exists necessarily would have been eliminated; but necessary existence and absolute possibility are not eliminated.[10] [A] On the other hand, if [the possibility of the existence of something] were after it, then it would have an after so that it would be before.

Ibn Sînâ's argument involves two horns. Either [A] the now always will have something posterior (or prior) to it or [B] there need not be anything posterior to (or prior to) the now. It is this second horn which we must explore. The proof in its most general statement is this: the claim that there is a last moment of time accompanied by the impossibility of anything existing entails an implicit contradiction. For Ibn Sînâ will argue that either absolute possibility or necessity will always exist, which are so related to

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[9] *ash-Shifâ', aṭ-Ṭabîᶜiyyât*, vol. 1 *as-samâᶜ aṭ-Ṭabîᶜî*, 160.13-161.1.

[10] Reading *la yartafiᶜân* with the Teheran manuscript (*Kitâb ash-Shifâ', as-Samâᶜ aṭ-Ṭabîᶜî*, lithograph (Teheran: n.p., 1886)).

the supposed first moment as to be before it or to the supposed last moment as to be after it, but there can only be a before or after if there is a time.

Let us now turn to the argument in detail. If there is a last moment of time and it is false to say anything exists after that moment, then it must be false to say both the necessary and the absolutely possible exist after that moment. But it is impossible that necessity and absolute possibility cease to be; for a necessity is what cannot not be and an absolute possibility is what can either be or not be.[11] Hence if it were possible that a necessity were not, then what cannot not be would not be, which is absurd. Also if absolute possibility could not be, then what could be could not be, which is likewise a contradiction. The same points may be stated differently: if there is a last moment and it is false to say anything exists after that moment, then that which must exist, does not exist; and that which is possible is impossible. The consequent is false and thus the initial antecedent, viz., that (a) there is a last moment and (b) it is false to say anything exists after that moment, must likewise be false. If it is false that (a) there is a last moment, then there is not last moment and time is eternal. On

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[11] Both the terms "absolute possibility" and "real possibility" are used by Ibn Sînâ to indicate what we call "contingency". Ibn Sînâ distinguishes two senses of possibility: first that which is not impossible and hence also includes that which is necessary, and second absolute or real possibility, viz., that which can either be or not be and thus excludes the necessary. Cf. *Avicenna's Treatise on Logic: Part One of* Danesh-Name Alai, trans. F. Zabeeh (The Hague: Matinus Nijhoff, 1971), 24; and *al-Ishârât wat-Tanbîhât, al-Manṭiq*, ed. S. Dunyâ (Cairo: Dar al-Ma'ârif, 1971), IV.3, 272; *Remarks and Admonitions: Part One: Logic*, trans. S. Inati (Wetteren: Universa Press, 1984), 95.

the other hand, if it is false that (b) nothing exists after that last moment, then something does exist after the last moment; however, one thing can only be after another if there is some time in which it is after. Consequently there would be a time after the last moment of time, which is clearly a contradiction. The argument is complete; the claim that there is a last moment of time accompanied by the impossibility of anything existing entails an implicit contradiction. Therefore, since there cannot be an end of time (or by the same reasoning *mutatis mutandis*, a beginning of time), time is eternal.

In short, Ibn Sînâ argues that neither necessity nor absolute possibility could cease to be with a last moment of time, or fail to exist prior to a first moment of time. Hence there will always be something after the last moment or before the first moment; but if there is an after or before, then there is a time. The heart of the argument rests on the notion that absolute possibility and necessity exist after or before the supposed first or last moment. Thus we must consider in what way necessity and absolute possibility exist for Ibn Sînâ. For the sake of brevity I shall only analyze absolute possibility, although a similar analysis of necessity would make the same point.

Ibn Sînâ asks us to assume that there is a last moment of time of which it is false to say anything is after that moment. Thus we are to suppose that the world, having existed, ceases to exist. Now with the ceasing of the world either the possibility of the existence of the world also ceases to exist, such that the existence of the world is impossible, or the possibility of the world's existence continues to exist. That the existence of the world should be impossible is absurd. For a thing is absolutely possible if it's existence either may or may not be; however, since the world exists today, its existence is possible, otherwise it would not exist now. Since the possibility of the world clearly must continue to exist, the argument requires us to consider the nature of this possibility. We are invited to ask how does this possibility exist or more loosely where does it exist or in what does it exist? Moses Maimonides, commenting on Ibn Sînâ's argument, posses the question this way: "What was the substratum of that possibility? For there must be in existence something of which that possibility can be predicated."[12] Very loosely stated, for Ibn Sînâ, possibility is not "free floating" but is always in or of something. Ibn Sînâ elsewhere puts the point thus: "we call the possibility to exist the potential to exist and we call the bearer of the potential to exist in which there is the potential of the existence of something, the substratum, prime matter, matter or the like."[13] In short, if the world ceases to exist, there must still exist the absolute possibility of the world's existence, but that possibility must exist in a substratum or matter which is after the existence of time or the world. Consequently there is something after the existence of time, but something can

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[12] *Guide to the Perplexed*, II.14, fourth method.

[13] *An-Najah* (Tehran: Danishgah-i Tihran, 1985/6), 536.

only be after if there already is time. Likewise, since a similar argument can be made for a first moment of time there must always be a posterior and prior time and thus time is eternal.

Let us consider two possible counter-suggestions for the "bearer of possibility". First, one may suggest that the world's possibility exists in God, i.e., the Creator, and thus does not require a separate substratum or matter. Such a response fails. We must distinguish between active and passive powers or possibilities. Certainly the active power or possibility to *create* exists in God, but this power is not the same as the passive possibility to *be created*. An example may clarify. Within a carpenter there is an active power or possibility to make a table, but this power or possibility is distinct from being made into a table; this latter possibility belongs to the wood or matter. Similarly, within God there is the power or possibility to create the world, but this possibility is distinct from the power or possibility to become the world. The question at hand, however, only concerns what is the bearer or locus of this latter passive possibility; thus the response equivocates on the nature of the possibility in question.

One may be tempted to say that there does not need to be a substratum of the possible at all; rather possibility is something existing in itself, i.e., possibility can exist independent of any substratum or matter. However, to say that possibility is something existing in itself or capable of existing independent of a substratum is to make the possibility a substance in its own right;[14] for a substance, following Aristotle and accepted by virtually all medieval thinkers, is that which is neither said of nor exists in a substratum.[15] But if we make possibility a substance, then there was a substance, other than God, which was before the first moment of time, but if there is a before, there must be a time.

In short, Ibn Sînâ's argument forces us to say either that there is some substratum in which the possibility of the world exists *when* the world is not or that the possibility of the world is itself a substance which exists *when* the world is not. In either case something exists when the world is not and thus it exist either before or after the world, but if there is a before or after, then there is a time. Therefore there will always be some time before or after any moment one may posit. Hence time is eternal and consequently the world likewise is eternal.

Ibn Sînâ's proof for the world's eternity avoids Thomas' criticism that one must initially assume that the now is bounded by past and future time. Still the argument suffers from an analogous ailment. The thesis put forward by Aquinas and others who assume the creation of the world is that God created the universe *ex nihilo*, literally out of nothing. Ibn Sînâ's argument assumes that God does not create from nothing but rather God creates from some pre-existing

[14] Although I am not aware of Ibn Sînâ actually giving this argument (which is not to say that he did not), the Andulusian Aristotelian Ibn Bâjja, a philosopher influenced by Ibn Sînâ, does explicitly makes it in his commentary on Aristotle's *Physics* (*In phys.* (Beirut: *dâr an-nahâr lil-nashr*, 1973): p. 19).

[15] *Cat.* 5, 2a11-13.

possibility. The question which arises is: "Could God bring about the existence of the world simultaneous with the possibility of its existing?" That is to say, could God create possibility out of nothing. To argue "No" on the grounds that the possibility had to exist prior to the existence of the thing is simply to beg the question. To argue that there would be an infinite regress, since there would have to be the possibility of the possibility, similarly entails a *petitio principii*; for the suggestion is that God created the very possibility of the world together with the world *ex nihilo*. An independent argument that possibility must precede the thing created must be presented if Ibn Sînâ's argument is to be effective. No such argument is forthcoming.

Ibn Sînâ's argument for the eternity of time can be seen as an advance over that of Aristotle's. Whereas Aristotle merely assumed that any now must have some time before and after it and thus was guilty of begging the question, Ibn Sînâ attempted to demonstrate this key premise. Despite Ibn Sînâ's heroic efforts, his argument also ultimately rests on that which is to be proved, albeit in a much more subtle way. For Ibn Sînâ assumes that God can only create from a pre-existing possibility; and yet those who say God brought time and the world into being at some first moment maintain that God created *ex nihilo*, i.e., from nothing which pre-existed, which if pushed must also include possibility.

APPENDIX D

TRANSLATION OF *SHIFÂ'*, PHYSICS II.10: IBN SÎNÂ'S BEGINNING OF THE ACCOUNT OF TIME AND THE DISAGREEMENT OF PEOPLE SURROUNDING IT AND THE CONTRADICTION OF THOSE WHO ERR CONCERNING IT

(148.7-12) The examination of time is related to the examination of place, since it is among the things which are inseparable from every motion and the solution to the disagreement of people regarding its existence and essence (*mahiyyatihi*) is like the solution concerning place. Among the people there are those who deny that existence belongs to time at all. Also there are those who make existence belong to it not in any way whatsoever as it is in external individuals, but rather as it is something imagined. And there are those who make existence belong to it not according as it is a solitary thing in itself, but rather as it is a certain relation of things whatever they might be according to a certain standpoint to things whatever they might be.[1] And then it is said that time (*zamān*)

[1] The Teheran manuscript reads: *annahu nisbah mā ᶜalā jihah mā li-'umūr ayyihā kānat ilā umūr ayyihā kānat*; similarly the Latin reads: est aliqua comparatio aliqo modo ad aliquas res qualiscumque fuerint. Both suggest that time is a certain relation to things whatever those things may be. The point is explained more fully in chapter 11 of the *Shifâ'* (my chapter 7), where certain things are said to be before, after or simultaneous on account of their relation to something which is essentially

is a collection of units of time (*awqāt*), where a "unit of time" is an occurring accident with whose existence befalls the existence of another accident by means of being present,[2] so whichever occurring accident it is is the unit of time belonging to the other.[3] Also there are those who make existence and self subsisting reality belong to time. And also among them are those who make it a self subsisting substance in its essence.

(148.12-149.10) As for whoever denied the existence of time, he had depended upon puzzles; among them that if time is something which exists, then either [A] it is something divisible or [B] something indivisible. If [B] it is indivisible, then it is impossible that years, months, hours, past and future pertain to it. If [A] it is divisible, then either [A1] it is something which exists

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before and after, viz. time.

[2]The Teheran manuscript adds:

زيد مع طلوع الشمس

Thus, we could translate the text as "a unit of time is an occurring accident with whose existence befalls the existence of another accident [for example] by the presence of Zayd together with the rising of the sun. However, since the apparatus criticus of Zayd's edition only mentions one text with this variant (a Teheran text) and this variant does not occur in the Latin, there is good reason to think it was not part of Ibn Sînâ's original text, although given Ibn Sînâ's comments at 151.4-11 one can understand why a later scribe would make the addition.

[3]That is to say, we might think of the awqāt ("waqt" sing.) as the accidents which explains the temporal and sequential order of things. So, for example, imagine that we designate the awqāt by the minute markings on a watchg, such that you might have the following series: 10:00, 10:01, 10:02 ... (which will be further specified with respect to the exact date etc.). Thus, whatever possess the 10:01 waqt is temporally located at 10:01; and on account of this accident is posterior to whatever possess the 10:00 waqt, but prior to whatever has the 10:02 waqt. Furthermore, since these awqāt possess a certain duration, a collection of them would make up the extension we call time.

by means of all of its parts (*aqsām*) or [A2] some of them. If [A1] it is something which exists by means of all of its parts, then it is necessary that the past and the future parts of it are things which exist together. If [A2] some of its parts exist and some of them do not exist, then whatever part is taken into account it is deemed real either as the present, the future and the past, or it is real as hours, days and whatever else is like that. As for past and future, each one of these (in agreement with those who affirm time) is something nonexisting. As for the present, if it is a divisible, then the very same question must [be asked of it]. If it is indivisible, it is the thing which is called the "now" and it is not time. Also, notwithstanding the fact that [the now] cannot exist in act, if it could exist in act, it would either endure or cease to be. If it endured, however, then it is something to which prior and posterior pertain, and not all of it is now and the past and future are together in a single now, which is impossible. If it ceases to be, then either it ceases to be in a now which immediately succeeds it with no time between the two, or it ceases to be in a now between which there is a time. If it cease to be in a now between which there is a time, then necessarily it endures as a time, but we have refuted that.[4] If it ceases to be in a now which immediately succeeds it, the now succeeds the now in virtue of continuity without

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[4]The argument is just the one rehearsed by Aristotle above (cf. Ch. 4, Sect. B.4). If the presently existing now were to cease to be in any some subsequent now other than an immediately adjacent now, then between the presently existing now and the now in which it ceases to be, there would be an extension that just is time.

a time intervening between the two, but those who affirm time forbid this.[5]

(149.10-14) Furthermore, in general, how is existence to belong to time, when any time we posit may be delimited in the view of the one who posits it by two nows: a past now and a now which is future in relation to the past? In any case it is not permissible that the two exist together. Indeed one of them is something nonexistent. But if it is something nonexisting, then how does what needs a limit which does not exist turn out to exist; for how [could] a nonexisting limit belong to something? On the whole, how is something a connector between something nonexisting and something existing? This is the powerful sophism to which those who deny time cling.

(149.14-150.10) They also say [given] that [1] it is inevitable that [time] belongs to motion in order that from time belonging to it motion is, and [2] this motion in order to be a motion does not need another body which is also moved other than its body (although, perhaps in some cases it needed that [other body], not in order that there be motion, but rather because the originator[6] [of the motion] in order to move needs to be moved; but this is not part of the condition of motion in as much as it is motion nor does it belong to its necessary attributes). Thus, if this is so, for any motion which you posit, there is inseparable from it a time belonging

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[5]I.e., between any two points (whether they be spatial or temporal, i.e., a now) there always exists a continuum of points such that no two are every immediately adjacent to one another.

[6] Reading *mūjid* (Latin: qui facit motum) with the Teheran manuscript for Zayd's *mawjūd*.

to it insofar as it is a motion, but it is not inseparable from it that there be another motion insofar as it is motion. If that is so, each motion entails a separate time which is not dependent upon another motion, just as [each motion] entails a separate place.[7] Now a single time does belong to [motion] in the way a single place belonging to it, i.e., the single in general, but our debate does not concern that.

If motions are together (*maᶜā*) however, then their times are necessarily together. Their togetherness (*maᶜyya*) is either in the place or in the subject or in rank (*sharaf*) or in the nature or some thing other than the togetherness in time.[8] However, all of these significations of "together" do not forbid that some of them are

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[7]The argument is this: if (1) time is intimately associated with motion and (2) the particular motions are not dependent upon the existence of some unique body undergoing motion, but only the various particular bodies undergoing motion, then for each particular motion there is a particular time. Consequently, there would be as many times as there are motion, which seems false.

[8]What it means for a plurality of motions to be together in place or subject are clear enough. If two people walk the same path, the two walkings (motions) are together with respect to place, since they both occur in the same place. Likewise, two motions can be together in a subject; for example, if I walk along a beach (locomotion) and get a tan (alteration), then both motions are taking place in one and the same subject, viz., me. The last two ways motions can be said to be together, i.e. *qua* rank and nature, are not so clear, and so I can merely suggest what Ibn Sînâ might have in mind. At the beginning of book V (1) of Aristotle's *Physics*, Aristotle distinguishes three ways something might change: accidental change (e.g., when something musical walks), partial change (e.g. the body become healthy because the eye becomes healthy), change of a thing itself directly or essential change (e.g., when a body changes place, or a tomato ripens or a person thins). I hazard that these differences are differences of a motion's nobility or rank (*sharaf*). Thus if two things accidentally changed, then they would be together with respect to their rank or nobility. Concerning being together in nature, at *Physics* V 2 Aristotle distinguishes three varieties of motion, viz., locomotion, alteration and augmentation/diminution, which I suggestion constitute the different natures of change. Thus, to swim and to walk would be together insofar as they are both types of locomotion. I once again confess that I have no textual basis for this reading, but it does make sense of the passage as it stands.

before and that some of them are after, i.e., some of them are existing things, while some of them are nonexisting things. Thus it remains that [motion's] togetherness is the togetherness which is in time and the togetherness which is in time is that many things are in one time or in one now, which is a single limit of time. So from that it is necessary that one time belongs to many times. The discussion concerning the entirety of that time together with them (*maʿahā*) [i.e., the particular times] is in this sense just like the discussion concerning those collected in [a single time]. Thus it is necessary that an infinite [number of] times are together. But in the opinion of you [i.e., those who affirm time] times follow upon motion. Hence it is necessary that there is an infinite [number of] motions together because of them [i.e., the times] and thus it is necessary that there is an infinite [number of] mobiles simultaneously because of them and thus it is necessary that there is an infinite [number of] bodies simultaneously because of them, but this pertains to something impossible which they disapprove and forbid its existence.[9]

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[9]The Aristotelian argues that whenever there is a time, there must be a corresponding motion. Moreover, the above argument showed that for each particular motion, there is a particular time, and conversely, for each particular time, there is a particular motion. Ibn Sînâ now has us imagine a finite set of motions that occur together in a way other than as together in place, subject etc.. In such a case, we might say, the motions occur together at one and the same time; however, this time, is different from the times associated with any of the particular motions. Consequently, since this time in which all the particular time are together is itself a time and for each time there is a motion, there must be a particular motion associated with this new "super" time. We now have a new set of particular motions and times--all original the particular motions and their corresponding times and the super time and its corresponding motion; however, if these are all to be together at one time (and seems that they must), then we are on the road to an infinite regress. Moreover, since there will be an infinite number of times and an infinite number of motions, there consequently must be an

(150.10-16) Therefore, with respect to these puzzles and the necessity that existence belongs to time, many people are obliged to make another variety of existence belong to time and that is the existence which is in the imaginative faculty (*tawahhum*). The things which are such as to be found in the imagination (*wahm*) adhere in the intention, when they are comprehended and between them there stands the same relationship. So they create there forms of a relationship, whose existence is only in the imagination. Hence [these people] make time something which is impressed in the intellect from the relation of the mobile to the two limits of its spatial magnitude, of which one of the two [limits] is proximate in act whereas the other is not proximate in act since its being fully realized there is not permissible with its being fully realized here, regarding the concrete individuals.[10] However, it is permissible in the soul. Hence there exist in the soul together the two conceptualizations and the conceptualization of the intermediary between them; for there is not in the concrete individuals some existing thing which connects the two, but in the imaginative faculty there is something impressed on the intellect.

(150.16-151.3) Indeed, between [the mobile's] existence here and its existence there, there is something in likeness of it which traverses this spatial magnitude at this rate of fastness or slowness, which belongs to these motions or this number of compounded

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infinite number of bodies in motion (from the argument in the preceding paragraph), and each of these bodies must be actual. In short, on the assumption that time requires motion the argument apparently shows that there must be an actual existing infinity, which is impossible.

motions and rests. So this is a measure belonging to that motion [but] no existence belongs to it; rather the intellect causes it to occur within itself because of the limits of the motion occurring together in act in [the intellect], just as the predicate, the postulate and the premise and whatever is analogous are things which the intellect judges according as they are intelligible things and are relationships between them. But none of these are existing things.

(151.4-11) The [one] school which we mentioned at the beginning said that time is nothing but a collection of temporal units (*awqat*); for when you order sequential units of time and gather them together, you do not doubt that the collection of them is time. If that is so, then when you know the unit of time, you know time. There is no unit of time except what the one determining the time requires, i.e., that he designates the beginning of an occurring accident. Thus we say for example, "such and such [happened] after two days" meaning that it [happened] together with the sun rising twice. Even if the [one determining the time] were to replace [the rising of the sun] with the coming of Zayd, [the replacement] is equally permissible as the rising of the sun. Therefore the rising of the sun only becomes a unit of time which the speaker designates. And if he so desired, he might make something else a unit of time, except that the rising of the sun is more universal, better known and more familiar. It is on account these [facts] that [the rising of the sun] and what is analogous to it are chosen for keeping time.

Hence time is a group of things which are the appointed units of time or it is characteristic of [the group] to make appointed units of time. They also say that according to any other viewpoint no existence belongs to time, which is recognized from the aforementioned puzzles.

(151.11-18) [Another] school says that time is an eternal substance. And how would it not be a substance, since it is necessary of existence? For the necessity of its existence is such that there is no need to affirm it by means of a proof; rather whenever you attempt to eliminate time, it is necessary that you affirm time, because you eliminate it before something and after something. Whenever you do that you produce simultaneous with its elimination a beforeness and afterness. So you have affirmed time simultaneous with its elimination, since the beforeness and afterness which are according to this form are nothing but time or [something] in time. Hence time is necessary of existence and the existence of whatever is necessary of existence cannot be eliminated; but whatever cannot have its existence eliminated is not an accident, and whatever is something existing but is not an accident is a substance. Now if it is a substance necessary of existence, then it is an eternal substance. They also say that if it is necessary of existence, then it is impossible that its existence be dependent upon motion, since it is possible that time exist even if motion does not exist. Thus time according to their view sometimes exists together with motion so that it measures motion, and sometimes it is free [from motion], and at that time it is called everlasting (*dahr*).

(151.19-152.10) These are the aforementioned puzzles concerning the issue of time. It behooves us therefore, to indicate first the manner of time's existence and its essence (*māhīyatihi*) by making the way to its existence from its essence, and only then to turn and attack these sophistries and resolve them.

We say that those who affirm the existence of time as a single intention have also disagreed. Hence there are those who make motion time and those who make the motion of the heaven time, disregarding other motions, and there are those who make the return of the heaven time, i.e., a single revolution, and there are those who make the soul of the heaven time.

As for those who make motion itself time, they say that motion from among what we witness of existing things is that which includes something of the past and something of the future and it is in [motion's] nature that two parts of this description always belong to it and whatever is of this description is time. They also say that we only suppose there is time, when we perceive motion such that for the sick and afflicted time is long, while for the one in the extremes of wantonness it is short on account of the measuring motion's being deeply rooted in the memory of the former two [cases], while [these motions] are obliterated by wantonness and bliss from the memory of those paying them no heed. Now whoever does not sense motion does not sense time, just like the companions of the cave;[11]

[11] Cf. the surah of the Cave (al-Kahf), 18:1-23.

for since they did not sense the motions which were between the initial now of their experience, their souls' possessing rest through the day, and the now of their wakefulness, they did not know that they exceeded more than a single day. The first teacher [i.e., Aristotle] also narrates that something similar to that befell a group of godlike men and history indicates that they were before the companions of the cave.[12]

(152.11-153.3) These are the bygone sayings concerning the issue of time before the maturity of philosophy and all of them are incorrect. That motion is not time is because there might be a faster and slower motion, but there is not a faster and slower time than time, but rather shorter or longer [times]. Also there might be two motions together, but there are not two time's together. You will learn that two different motions might occur together in a single time, but their time is not different. Also motion's division is other than times division. And the vocabulary (*al-'umūr*, lit. the things) related to time like "behold" "suddenly" "now" and "previously" have nothing to do with the essence of motion. It is also possible in the definition of "fast motion" that time be taken as part of the differentiae, while it is not permissible that motion be so taken; rather it is taken according as it is a prior part. For it is indeed permissible to say that the fast is that which traverses a longer spatial magnitude in a shorter time, but it is not permissible to say [that the fast is that which traverses a longer

[12]Cf. *Physics* IV 11, 218b23-27.

spatial magnitude] in a shorter motion. The judgment of the first heavenly motion is none other than this judgment; for it is permissible to say concerning it that it is the fastest of motions, because it traverses together with the traversal of another motion a greater [spatial magnitude] (although with other considerations that we shall discuss later). This togetherness indicates something other than the two motions. Indeed it indicates an intention to which both are related and in which they are equal whereas they differ in spatial magnitude. That intention is not the essence of one of them, because the second does not make the other share in its essence, but it makes it share in something which the two are in together.

(153.4-15) From this position it is possible to reveal the incorrectness of the doctrine of those who make units of time accidents which appoint a time to [other] accidents. That is because they do not make that occurring accident itself, insofar as it is a motion or rest or black or white, a unit of time; but rather, they are forced to say that it becomes a unit of time by appointing a time and they are forced [to say] that appointing a time unites the existence of some other thing together with its existence. From this union and togetherness an account is necessarily understood different from the account of each one of the accidents. Each of the two united things are united in some thing and the two togethernesses (*maᶜayn*) are in some thing together. Thus if their existence is together or the existence of one of them is an appointed time in that it is together with the existence of the other, then the concept of togetherness is something which necessarily is not the concept of any one of the two and this togetherness is opposed to the account if one of these two should be prior or posterior. This thing in which there is the togetherness is the unit of time that combines the two things. Thus each one of them can indicate [the unit of time], just as if what occurs in that unit of time were other than that thing. But if that thing in itself were a unit of time, then when a period of time (*muddah*), which is one and the same, perdures, the period's perduring and [the period's] beginning must be one and the same unit of time. But we know that an appointed unit of time is a boundary between the prior and the posterior and that the prior and the posterior inasmuch as they are prior and posterior do not differ, but inasmuch as they are a motion or rest or the like they do differ. So it is not the case that its being an accident--like its being a motion or rest--is it being prior or posterior or together; rather, the reality of the prior and posterior and the together is something other. It is a state of time.[13]

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[13]The suggestion made earlier (§148.7-12) and reiterated at the beginning of this section is that time is a composite of awqāt, or units of time. Moreover, the waqt is simply some accident, such as a some motion, that has been so designated. Consequently, whatever occurs "together" with this accident happens at the time designated by the time unit. For example, if we let the sun's rising be our waqt and take some event such as Zayd's arrival, then we can say that Zayd arrives when the sun rose. Ibn Sînâ observes that the togetherness of these two events is different from either of the events; for Zayd's arrival could have been at high noon, in which case the togetherness of the two events would be opposed. Consequently, there must be some other thing that explains the two events' being together.

The next stage of Ibn Sînâ's argument is to show that the thing in which the events are together cannot itself be a waqt, or unit of time. The supporters of this theory assume three things about awqāt: first, the awqāt have some duration, or perdure; second, awqāt are boundaries between the prior and the posterior; and thirdly, it is on account of the awqāt that we specify the temporal location of various events. Imagine two events: one the beginning of some waqt and the other

(153.16-154.6) As for the proof upon which those who make time and motion [the same] depend, it is constructed upon an invalid premise. That [premise] is their saying that whatever requires a past and future in its nature is time. Truly this is invalid. For many things which are not time are past and future, like the flood and the resurrection. On the contrary, it is necessary that with these [i.e., being past and future] there is another condition, i.e. that which is essentially in such a manner that from it there is something which is itself the past and the future so that its nature is the thing which, when compared to another thing, is essentially at that time past and future. When motion is past, it is not the existence of the motion itself that is past, but rather it [i.e., the motion] has been united to the past. Therefore it is valid to say that motion is in a past time, but it is not permissible to say that motion is in a past motion, unless it is meant in a collection of past motions,[14] but that is not our intent [when we say this]; rather [we mean that] something is congruent with the existence of that in which it is.

(154.7-11) As for those who say that time is a single

the period of time during which this waqt perdures. One and the same waqt would indicate both these events. Now the beginning of some period is prior to the actual perduring of that period and the perduring is posterior to a period's beginning; however, if the waqt is the boundary between what is prior and posterior, then one and the same thing has to be prior and posterior to itself, which is absurd. Thus, concludes Ibn Sînâ, that by which we indicate that two events are either together, prior or posterior to does not have its being as motion or rests do, i.e., as something that perdures.

[14]That is to say, that some past motion can be *among* other past motions, e.g., eating breakfast was one motion among many that occurred during my morning regimen.

revolution of the heavens, we make clear its absurdity in that each part of time is a time, but a part of rotation is not a revolution.

More absurd than all these is the opinion of the one who supposes that time is the heavens by means of two affirmatives in the second form, in addition to the fact that one of the two premises in it is fallacious, i.e., the statement that every body is in heaven. Indeed that is not the case, but rather the truth is that every body that is not heaven is in heaven. As for that which is in time, perhaps it is every body absolutely; for the heaven itself also is in time according to the manner which bodies are in time.

(154.12-13) Since we have pointed out the invalid teachings concerning the essence of time, it is appropriate for us now to point out the essence of time so that its existence is evident to us from that and that the solution of the aforementioned sophistries concerning its existence are made clear.

APPENDIX E

TRANSLATION OF *SHIFÂ'*, PHYSICS II.13: IBN SÎNÂ'S SOLUTION TO THE PUZZLES MENTIONED CONCERNING TIME, ETC.

(166.6-14) As for time, everything that was said to undermine its existence and that existence does not belong to it, is based on existence not belonging to it in a now. There is a distinction between saying no existence belongs to [time] absolutely and saying no existence belongs to it determinately (*ḥāṣil^an*) in a now. We shall grant and consider as valid that existence occurring according to this mode [i.e., determinately] does not belong to time except in the soul and the imagination. As for absolute existence, which is opposed to absolute nonexistence, that truly belongs to it. For if that were not to belong to it, then its negation would turn out true, but then it would be true to say that between the two limits of spatial magnitude there would not be a measure of capacity belonging to motion according to a determined velocity, when the [spatial magnitude] is traversed. But if this negation is fallacious (and on the contrary, there belongs to motion according to that determined velocity a measure during which a traversal of this spatial magnitude is possible and a traversal other than this is possible at slower and faster [velocities] according to what we had made clear before),[1]

[1] Cf. II.11 (155.4-18).

then the affirmation which opposes [this negation] is true. That is to say, there is a magnitude of this capacity. The affirmation is an indication of the absolute existence of the thing, although it is not an indication of the mode of its existence determinately in a now or according to a certain viewpoint. This viewpoint [i.e., that existence absolutely belongs to time] does not belong to it because of the imagination; for even if it is not imagined, this mode of existence and this mode of truth occur.[2]

(166.14-167.5) Despite this it is necessary to know that of the existent things there are (1) those which are the realized, determinate things in existence, and also (2) those which are more tenuous in existence. Now it appears that time exists more tenuously than motion and falls in the category of an existence of things in relation with (*bil-qiyās ilā*) things (although time *qua* time is not a relatum (*muḍafa*), relationship (*iḍafah*) may indeed adhere to it).[3] Since spatial magnitude is a [determinate] existing thing and also the boundaries of spatial magnitude are existing things, that which is characterized according to [spatial magnitude] and either is congruent with it or is a traversal across it (*qaṭ*^{can} *lihā*) or is a

[2] Time can be thought of in two ways. Either as a certain interval that extends between two nows, or as a certain capacity belonging to motion by which we can account for difference in velocities. In the first sense time has no reality except in the intellect. In the second sense time is a absolute feature of reality, required whenever there is motion, and thus exists independent of any intellect.

[3] Cf. II.11 (157.13-158.5, 158.13-159.2). Time is that in which the relationships "before," "after" and "together with" essentially adhere. Consequently, time cannot be any of the specific relata in a relationship because the relationship among these may change and thus is not essentially before, after or together with. For example, my father existed before I did, but now he exists together with me.

measure of a traversal across it comes to be a mode of existence.[4] So that if it is said that existence absolutely does not belong to it, one speaks falsely. If one wants to make existence belong to time not according to this way, but rather according the way of being fully determined, then [the relationship] does not [exist] except in the imagination. For in that case the employed premise, i.e., that no constant [*thābit*^{an}] existence belongs to time, in the sense that no existence belongs to it in a single now, is affirmed. On the other hand, we do not forbid that existence belongs to it, just not in a now. Indeed, its existence is according to the way of becoming, in that between any two nows which you posit there is something which is time, whereas it absolutely is not the case [that it exists] in a single now.

(167.6-14) In general, their desire that time, if it is something existing, be something existing in a now or in time, or their desire [to know] "when" it is in existence is the sort of thing with which one need not occupy himself.[5] For, time is not something existing in a now, nor existing in time, nor does a "when" belong to it.[6] On the contrary, it is something existing absolutely and it is

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[4] The challenge was to explain in what way time exists. Clearly, time does not exist as a determinate fully realized thing; nevertheless, it does have a certain mode of existence insofar as it is related to something that is determinate and fully realized, viz., spatial magnitude. Time involves a relationship between spatial magnitude and an object moving over the spatial magnitude insofar as time is a measure of that motion over that magnitude. Thus the reality of spatial magnitude and moving bodies guarantees the existence, albeit tenuous existence, of time.

[5] مما ليس يجب أن يشتغل به.

[6] That is to say, we cannot ask, "When is time?"

itself time; for how would existence belong to [time] in time? So then their doctrine (*qaul*) that time is either something not existing, or its existence is in a now, or its existence perdures in time, is not a valid doctrine. Indeed, the opposite of our doctrine is not that [time] is something not existing; [the opposite of our doctrine] is that [time] is something existing in a now or [that it is] something existing perduring in time. Indeed time is something existing but not [in] one of these two [modes of] existing. Thus, it is not in a now nor [is it] perduring in time. This is just like those who say that either place is something nonexisting or it is something existing in a place or in a border of place. That follows because it is not necessary that either [place] is something existing in place, or in a part of place, or [it is] something nonexisting. On the contrary there are some things which absolutely do not exist in place and some things which absolutely do not exist in time, where place is among the group of the first division and time is among the group of the second division. You will learn this later.

(167.14-168.9) As for saying that if existence belongs to time, then a time must follow every motion and thus each motion entails a time, the answer to that is that there is a distinction between (1a) saying that time is a measure belonging to every motion and (1b) saying that [time's] *ipseity* (*annīyatahu*) is attached to (*muta*ᶜ*alliqa*) every motion. Further, there is a distinction between (2a) saying that the essence of time is attached to motion in the way accidents belongs to [motion] and (2b) saying that time is attached to the essence of motion according to the way that time is accidental to [motion], because (2a) means that something belongs accidentally in something, while (2b) [means] that one thing entails something.[7] As for the first, [we can distinguish (1a) from (1b)] because it does not pertain to the condition of what measures something that it be an accident of it or a constitutive factor [of what it measures].[8] Indeed some distinct thing may measure by means of communication and being set opposite what it is distinct from.[9] As for the second, [we can distinguish (2a) from (2b)] because it is not the case that when the essence of x is attached to y's nature, that the nature of y must not be free from x.[10] Pertaining to time, it is only demonstrated to us that it is attached to motion and [that] its form (*hai'atuhu*) belongs to [motion], whereas pertaining to motion [it is only demonstrated] that each motion is measured by time. So it will not be the case that a time is attached to each motion which is particular to [the motion], nor that whatever measures something is

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[7] We might distinguish these as (2a) *per accidens* accidents and (2b) *per se* accidents; where an example of (2a) is whiteness of an human, and of (2b), risibility of an human.

[8] Reading *au* with the Teheran manuscript for Zayed's *wa*.

[9] بل قدر المبا ين بالموافاة و الموازاة لما هو مباين له.

Lit. "Indeed perhaps it measures something distinct by arriving and being [set] opposite what it is distinct from." For example, we can set one and the same meter stick next to several different things, all of which have their own capacity for being measured. This capacity of the measured things does not entail that there is a multitude of different measures; for one and the same meter stick measured all of them. The same hold for time.

[10] Perhaps an example is that though it belongs to the nature of color (a quality) to be in something extended (a quantity), it does not follow that something extended cannot be devoid of color.

an accident belonging to it, so that for each motion there would be an unique time accidental to it. Indeed, time is not [essentially] attached to the motions which have a beginning and an ending. And how could time be attached to [such motions]? If time were to belong to them, there would be a division between two nows, but that we have asserted is impossible.[11] To be sure, when time exist in a motion, in such a way that it is proper that the existence of time be attached to [motion], then by means of the [time], the other motions are measured. This motion is a motion of which continued existence holds, and limits actually belonging to [this motion] are not delimited.[12]

(168.9-18) Now suppose someone should say, "Do you not think that if that motion did not exist, then time would be lost, so that other motions different from [that motion] would be without priority and posteriority?" Or suppose someone should say what we mentioned in the *aporiai*, [viz.] that the body in order to exist as a mobile does not need the motion of another body.[13] Thus, [given the assumptions that (1) the essence of time is attached to a single motion, and (2) no mobile needs the motion of another body in order

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[11] Ibn Sînâ observes that the argument used to make individual times associated with each individual motion is based on two equivocations. Laying bare these equivocations, he now shows why it would impossible for motions that begin and end to have a time associated with them essentially. The argument is just a condensed version of the one presented at II.12 (160.4-161.1). There would have to be a before or after the beginning or ending of the time, which itself would entail that there be a time either before or after the time began or ended, which clearly is absurd.

[12] The motion to which Ibn Sînâ refers, we shall learn, is the eternal circular motion of the heavenly spheres.

[13] Cf. II.11 (149.14-150.10).

to move] it would be possible that [a body] move, but it would be impossible that time belong to it."[14] The answer to that is (as we shall make clear to you)[15] that if there were not circular motion belonging to a circular mass, then directions would not befall the rectilinear (*mustaqīm*), and so there would neither be natural rectilinear motions nor forced [rectilinear motions]. Thus it is possible that there be a motion of some one body alone without there being other bodies [but that there is motion of other bodies without that one] is impossible,[16] even if [the impossibility] is not a manifest impossibility. For not every impossible thing which comes to mind is a clear exhibition of impossibility. Indeed many impossible things are neither obvious nor is their impossibility

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[14] The difficulty is this: Ibn Sînâ has uniquely identified time with the measure of the motion of the outermost celestial sphere, and all other motions have their priority and posteriority on account of this one motion. Now it does not appear that other motions depend upon the motion of outermost celestial sphere in order to be. Thus, suppose the motion of the outermost celestial sphere ceases and yet something else continues to move. This other motion, according to Ibn Sînâ's theory, cannot have priority and posteriority, which seems patently false. (Cf. Augustine's *Confessions* XI, 23, 29).

[15] Cf. IV.6.

[16] The text must be corrupt here. As it stands, it reads:

فيجوز أن تكون حركة جسم من الأجسام وحده و لا أجسام أخرى مستحيلا؛

and in the Latin: "Ergo posse esse motus unius corporis tantum absque aliis corporibus est impossibile". Literally, then, it says: "Thus that it is possible that there is a motion of some body alone without other bodies is impossible." *Mustahîl* (impossible) is masculine (and thus without alteration) cannot be modifying "motion" [f.]. Moreover, no matter how we modify *mustahîl*, the meaning seems to be the opposite of what Avicenna needs and takes as proven. My suggestion is that a homoioteleuton occurred early in the transmission. If so, the addition I have made would not be too radical of an emendation. Whatever the case, my suggestion certainly captures Ibn Sînâ's intended meaning.

manifest except by explanation and demonstration.[17] However, if we rely on imagination, then, when we remove the circular [motion] by means of imagination and we assert as valid a terminated rectilinear [motion] in the imagination, then in the imagination a bounded time is maintained which the imagination does not reject; however, we shall not look into this case, but only into what is true in reality.

(168.18-169.3) Thus it is the case that the existence of time is attached to a single motion which [time] measures. Moreover, [time] also measures the motions for which existence is impossible except in the imagination, without the motion of the body which by means of its motion makes time. That [motion] is like the measure existing in a body which measures it and measures what is parallel to

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[17] Ibn Sînâ's solution is to observe that although there does not appear to be an impossibility in the motion of the outermost celestial sphere ceasing and some other motion continuing to be, there, nonetheless, is an impossibility. Ibn Sînâ's argument at *Shifâ'* IV.6 appear to be an adaptation of arguments found in Aristotle's *Physics* VIII 8. The argument in its simplest form is this: motion can never cease, and thus there must be some motion that never ceases. (For time can never cease and yet time is an affection of motion (cf. appendix C).) The only motion that never ceases is continuous motion. Motion can be either rectilinear, circular or compound. Now if one of the first two types of motion is not continuous, then neither can compound motion be continuous. Furthermore, rectilinear motion cannot be continuous; for at some point rectilinear motion must reach its extreme limit and then turn back. (If rectilinear motion never turned back, then space would have to be actually infinite; however, the Aristotelian tradition excludes the possibility of an actual infinite.) Thus, the only type of motion that can be continuous is circular motion.

It is not clear how this argument proves that all motions are dependent upon circular motion. Perhaps the underlying argument is the following. Rectilinear motion depends upon circular motion, since (1) if there were not circular motion, then it would be possible for all motions to cease, e.g., if everything were moving rectilinearly and "turned back" at the same time. However, (2) it is impossible that motion cease all together, since that would imply the cessation of time, which is impossible (cf. 160.7-161.1). Consequently, it is impossible that circular motion, not be. Once again, it is not clear how this argument show that all motions depend upon circular motion, but it does show that it is impossible that there not be circular motion, and this is sufficient to respond to the objection, which requires that there is no circular motion, while some other motion is.

it and equal to it. It is not the case that one and the same [measure], measuring two bodies, necessitate that [the measure] is attached to the two bodies; rather, it can be attached to one of them and measure it, and also measure the other one to which it is not attached.

(169.3-13) The motion is continuous only because the spatial magnitude is continuous. Because the continuity of the spatial magnitude becomes a cause for existence of priority and posteriority in the motion, the motion by means of the two is a cause for the existence of a number belonging to [motion], i.e., time. Hence, motion is continuous from two sides: from the side of the spatial magnitude and the side of the time. As for [motion] in its essence, it is only a perfection of what is in potency and neither continuity or being measured enter into the quiddity of this intention. For it is not understood from a perfection of what is in potency or being borne along from something to something and from a departure from potency to act that there is a certain continuous interval between the beginning and ending [that is] subject to a division which the continuous receives; rather, this [viz., that there is a certain continuous interval between the beginning and ending of a motion and that what is continuous is subject to a division] is known by a type of ratiocination by which it is known that this intention is nothing but a continuous measure. For if we were to imagine three indivisible parts[18] and a mobile when it is moved to the middle of

[18] ajzā' la tatajazza' is one of the standard terms for atoms and should be taken

these, then with respect to [the mobile] at its motion from the first to the third, there is a perfection of what is in potency, but not as continuous.[19] So *ipso facto*, the true sense of a perfection of what is in potency does not necessitate that [motion] is something divisible. Likewise so long as other things are not known, the necessity of that [i.e., motions' divisibility] is not known; for [motion] is not such except in the manner of something continuous, subject to division. Thus it is clear that continuity is something accidental inhering in motion either on the side of spatial magnitude or time, [but] not entering into its quiddity. In general then, if we were not to take into account spatial magnitude or time, then we would not find continuity belonging to motion. Likewise, whenever we need to measure motion, we need to mention either spatial magnitude or time.[20]

(169.13-170.6) As for the continuity of time, its proximate cause is the continuity of motion in spatial magnitude, not the continuity of spatial magnitude alone; for the continuity of spatial magnitude alone, so long as there is no existing motion, does not

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here to mean three indivisible spatial units.

[19] That is to say, imagine an interval composed of three spatial atoms, ABC, and a mobile at one moment at A, then at B and then at C; call the motion across ABC $\alpha\beta\gamma$. Now during the motion $\alpha\beta\gamma$, when the mobile is at B, the mobile's potential to be at C is being actualized and will be actualized when it is at C. Thus, there is a perfection of what is in potency, but this perfection is not continuous, but atomic.

[20] The overall point of this section is clear enough. If we just consider the essence of motion, viz., the actuality/perfection of potential *qua* potential, then we have no reason to think that motion must be continuous and thus potentially infinitely divisible. Ibn Sînâ makes this point clear with his thought experiment of motion over discontinuous space. What determines that motion must be continuous is the continuity of the space over which and time through which a mobile travels.

necessitate the continuity of time. Likewise, there may be spatial magnitude in which the mobile moves, stops, then begins from there and moves until it exhaust [the spatial magnitude], so the continuity of the spatial magnitude will be something existing, while the time is not continuous.[21] Rather, it is necessary that the cause of time be the continuity of spatial magnitude through the intermediacy of motion. Now in order that the continuity of time be the continuity of spatial magnitude (on the condition that there is no rest along it), the cause of the continuity of time--one of motion's two continuities--[must] be on the part of the essence (*mā huwa*) of motion's continuity. And this is nothing other than the continuity of spatial magnitude related to motion, which does not obtain when there is rest. This continuity is not the cause for time's becoming continuous; but rather for the production[22] of time. For time is not something which a particular continuity befalls. On the contrary, it is itself that continuity. For if there were something which gave to time continuity, over and above the account of the production[23] of the being (*dhāt*) of continuous time, the continuity would be an accident belonging to time, not the substance of time. Just as we say that the reason why (*sabab*) for color is color, or the reason why

[21] That is to say, there can be a motion over a continuous spatial magnitude, even though the time it takes to complete the motion may be discontinuous. For instance, if I go for a hike and walk until noon, then stop for lunch and after an hour resume my hike, although the terrain over which I marched is continuous, the time of my actual walking is discontinuous, since it is punctuated by an hour break in the middle.

[22] Reading ījād with the Teheran manuscript for Zayd's ittiḥād.

[23] Again reading ījād with the Teheran manuscript for Zayd's ittiḥād.

for heat is heat, and by that we mean that they are reasons why for the existence of colors or heat, not for the being of the quality heat [or color], likewise we say that continuity is a reason why for the existence of continuity, not that it is a reason why for that thing's [viz. time's] becoming continuous. For it is a continuity in its being (*bidhātihi*), just as that is heat essentially.[24]

(170.7-13) Now it is not permitted to say: "we do not understand a continuity belonging to motion unless it is by reason of (*bisabab*) spatial magnitude or time. You all [i.e., Ibn Sînâ] denied that spatial continuity is a reason why (*sabab^{an}*) for time, and it is not possible for you all to say that temporal continuity is a reason why for time. Once more, you all say that the continuity of motion is a reason why for time, but there is no continuity other than these two [i.e., spatial and temporal continuity]!" We answer saying that we do make spatial continuity a reason why for time, but not

[24] In this section Ibn Sînâ is interested in explaining the cause of the production of continuous time, which he identifies with the continuity of space through the intermediacy of motion. He offers two arguments as to why space alone could not explain the continuity of time. First, if there were merely space and no motion, there would be no time. Second, the time of some motion would be discontinuous, if the mobile stopped during its motion, even though the spatial magnitude it traverses is continuous. Ibn Sînâ is quick to add that motion over a continuous spatial magnitude is not the cause of the continuity of time, but rather of continuous time. The distinction is subtle, but important. We should not think of time as some x, to which an accident of continuity befalls (for time is essentially continuous); rather continuous spatial motion produces a continuous time. Ibn Sînâ uses the examples of heat and color to make the point. The form of heat, for example, explains why some thing is hot, but it does not explain why heat is hot, i.e., the form heat is not some x which heat befalls (for the form heat is essentially hot); but rather it is the cause of heat. In the same way, time is not some x which continuity befall (for time is essentially continuous); but rather, time is the cause of {a certain kind of) continuity in other things. That time is produced by motion over continuous space does not nullify the fact that time is essentially continuous, any more than the fact that rubbing two sticks together produces heat should nullify heat's (i.e., the form of heat) being essentially hot.

absolutely; rather insofar as [continuity] comes to belong to a motion, then motion comes to be continuous by means of [spatial magnitude]. The signification (*iʿtibār*) of the continuity of spatial magnitude in itself is one thing and its signification as joined with motion is some [other] thing. For understand now that the continuity of spatial magnitude insofar as it belongs to motion is a cause for the existence of the being of time, which in its being is continuous or a continuity, not that [the continuity of spatial magnitude] is a cause for the being of time being continuous; for that is something for which there is no cause. Thus by this it is true that time is something accidental to motion and neither a genus nor differentia (*faṣl*) of it, nor is it some reason why, but rather it is something inhering in [motion] commensurate with the whole of it.

(170.14-171.12) Among the objects of inquiry concerning time is that we know the generation (*kawn*) of something in time. Thus we say that something is only in time according to the principles which we laid down, namely, that the intention of prior and posterior belong to it. Now whatever, in its essence, has the intention of prior and posterior belonging to it is either a motion or endowed with a motion. As for motion, that [intention, i.e., being prior and posterior] belongs to it by way of its substance. As for the mobile, that [intention] belongs to it by way of the motion. Now because it may be said of the species of some thing and of its particulars and of its endpoints that they are something in the thing, then the before and after and hours and years and also the now are said to be in time. For the now is in time as the unit is in number; and the prior and posterior [in time] are like the even and the odd in number; and hours and days are like the two, three, four and ten in number; and motion in time is like the contingent ten [i.e., what happens to be ten] in tenness; and the mobile in time is like the subject for the contingently ten in tenness.

Because rest either [can] be imagined as something eternally remaining stationary, or it [can] be imagined such that prior and posterior accidentally befall it. (That is because of the two motions which surround it, since rest is privation of motion in what is in its nature movable, not privation of motion absolutely, then it is likely that there is [rest] between two movements). This latter sort of rest has in a certain way priority and posteriority. Thus [this latter sort of rest] admits the two sides of rest into time albeit accidentally.[25]

Also changes which resembles local motion in that they begin from a limit [and end at] a limit, just as boiling takes off from a limit [and ends at] a limit, enter into time on account of the priority and posteriority belonging to them. So when a certain

[25] Rest can be thought of in one of two ways: (1) as something that never changes or moves, such as God or Platonic Forms, and thus it belong to its nature not to move; or (2) something that happens to be a rest at some time, but it belongs to its nature to move, such as a soccer ball that was moving, was brought rest and then moves again. In the case of the resting soccer ball, the interval of rest began when its first motion ceased and the interval ceases when its second motion begins. Since the ceasing of the first motion (one of the rests "sides") is before the beginning of the second motion (the rest's second side), we can mark off a before and after in the soccer ball's rest at its two sides. Consequently, since the rest that is surrounded by two motions has a before and after, it is in time. The same is not true for the rest that belongs to God or the Platonic Forms, and so we cannot say that they are in time.

change takes the whole of the changing thing altogether, and proceeds towards increase or decrease, then the continuity belonging to it is temporal continuity only; for priority and posteriority in time belong to it only. Because of that, there does not belong to it the efficient [cause] (*fāʿil*) of time which is the continuity of motion in spatial magnitude or an analogue of spatial magnitude, although it does possesses priority and posteriority. Thus it is related to time; for its existence is after the existence of the cause of time, i.e., the motion in which there is being borne along. Hence these changes share with spatial motions that they are measured by time, but they do not share with them that the time is dependent for existence on them and is caused by them; for indeed this belongs to spatial [motions][26] alone. You have now learned what we intend by saying "spatial motions".

(171.12-15) As for the things in which there is neither priority nor posteriority in any way, they are not in (*fī*) time, even if they may be together with مع (*mʿa*) time, like the world. For [the world] is together with a mustard seed, but it is not in a mustard seed.[27] Now if there is something which from one side priority and posteriority belong to it (for instance, with respect to what is a mobile), but from another side receptivity to priority and posteriority do not belong to it (for instance, with respect to essence and substance), then with regard to what is not receptive to

[26] The text's al-masāfiyāt should be taken as short hand for al-ḥarakāt al-masāfah.

[27] Cf. Aristotle's *Physics* IV 12, 221a21-23.

priority and posteriority, it is not in time, but with regard to the other it is in time.[28]

(171.15-172.5) Now the thing existing together with time, but not in time, so that its existence is together with the whole of the continued existence (*istimrār*) of time is endless duration (*dahr*); and a whole continued existence of a single existence (*kullu istimrār*[i] *wujūd*[in] *wāḥid*[in]) is in endless duration. (I mean by "continued existence" its very existence is like what is together with each moment of time one after another, continually.) It is as if endless duration is a comparison of permanence to impermanence, where the relation of this togetherness to endless duration is like the relation of that instant (*faina*) of time.[29]

The relation of some permanent things to others and the togetherness which belongs to them from this perspective is an intention beyond endless duration (*fawqa d-dahr*), and appears to be

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[28] We might, for example, think of the birth of a child. In one sense, a human comes to be, but that is not to say that human comes to be. The seed (or fetus) is a subject of change, but the essence of human is not.

[29] The point of this paragraph and the next is not all together clear. It seems as if Ibn Sînâ is distinguishing between something being "everlasting" (*dahr*) and "eternal" (*sarmad*). Something is "everlasting" just in case it is at rest and has lasted for all time. Since it is for all time at rest, it cannot be encompassed by two motions and thus it cannot be accidentally in time (cf. 171.2-5). Still there can be a comparison between things in time and things in *dahr*; for at any moment in the history of a changing/impermanent thing, there is a corresponding moment for the everlasting/permanent thing. For example, if we consider the existence of the universe, it is a permanent thing that is not encompassed by motions and thus it is in *dahr*; however, we can still say of the universe that it is presently existing at such and such a day at such and such a time, etc.. In contrast to *dahr* there is *sarmad*. *Sarmad* appears to correspond with Boethius' definition of eternity, viz., the perfect and simultaneous possession of everlasting life. If something exist in *sarmad*, it absolutely cannot be compared with temporal things; for its being is not "spread out", as it were, (as in the case of *dahr*), but exists all at once in an "eternal now". An example of *sarmad* is God's existence, which is all at once and perfect.

the most worthy of what is called "eternity" (*sarmad*). Every continued existence's being (*wujūd*), in the sense of an absolute denial of change without a comparison (*qīyas*) to one moment after another, is eternity. One marvels that someone could says that endless duration is the interval of rest or a time unnumbered by motion, when one cannot grasp an interval or a time in whose being there is neither a before nor after; but if there is in it a before or after, then a state must be renewed according to what we said. So [endless duration] is not devoid of motion, whereas priority and posteriority exist in rest solely according to the manner of what we said previously.[30]

(172.5-12) Time is not a cause of anything; however, when something together with the continued existence of time is produced or destroyed and we do not see a perceptible cause for it, the people attribute that to time, since they do not find there some associated thing other than time, or they do not notice it. So if the thing is something commendable, they praise time, and if it is something objectionable, they blame [time]. However, existing things in the majority of cases [have] perceptible causes, while ceasing to be and corruption [have] a hidden cause; for the cause of the building is recognized while the cause of lessening and obliteration are unknown in the majority [of the cases]. And likewise, if you wish, you may examine many particulars instances, and from that it will become apparent that most of what is ascribed to time belongs to cases of

[30] 171.2-5.

ceasing to be and corruption, like forgetfulness and senility and impairment and the passing away of the matter and the like and that is why people love to disparage and ridicule time.

(172.12-173.2) There are accidental properties and issues belonging to time which expressions indicate; thus it is appropriate for us to mention and enumerate them. Among those is the "now". By it might be understood the common boundary (*ḥadd*) between past and future, to which our discussion was restricted.[31] Also, by it might be understood [every common division (*faṣl*), even if [it were] in the parts (*aqsām*) of the past and future. Also, by it might be understood the limit (*ṭaraf*) of time, even if it does not indicate a common [boundary] (*ishtirāk*). Indeed it is permissible to make [the now] a non-continuous dividing limit (*ṭaraf*[an] *fāṣl*[i]) in imagination, although it is known from outside the concept [of the now] (*khārij al-mafhūm*) that it is necessary that it is common and cannot be a division (*faṣl*). But that [is known] by a species of ratiocination (*naẓar*) other than a conceptualizing of the intention of its expression. Also they may say "now" to refer to a short time very close to the present now.

A verification of the reason for this account (*qaul*) is that all of time spoken about has two boundaries, which certainly are nows assumed to belong to [time] in the mind, even if [the time] is not sensed. These two nows are necessarily present in the mind together; however, the mind for some of the moments of time (*awqāt*) might sense

[31] Cf. II.12.

a priority of a now in existence and a posteriority of a now, because of the interval (*buʿd*) of spatial magnitude between them, as, for instance, the [mind's] sensing the prior now of the two nows of an hour and of a day. But for some of them [i.e., moments of time], the two nows are so close that the mind does not sense what is between them immediately. As long as [the mind] does not rely on attentive investigation, then the mind will sense the two as if they are occurring together and as if the two are a single now, even though investigation and thorough examination forbid the mind from that on the least amount of contemplation; however, until the mind itself critically examines [it], the two nows are as if they occur together.[32]

(173.3-11) Also among the temporal expressions is their saying "suddenly" (*baghta*). "Suddenly" is the relation of something that occurs in a time whose magnitude is not sensed due shortness to its time; in addition, the things is not expected to occur. And also among the temporal expressions is their saying, "all at once" (*dufʿa*). It indicates the occurrence of something in a now and it may indicate

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[32] In this section Ibn Sînâ identifies four different conceptions of the now. First, the now in the strict sense is the immediate present, potentially dividing past and future. Second, the now can be thought of as what was or will be present, e.g., the now when you began reading this paragraph and the now when you finish reading this paragraph. Third, the now can be thought of as an actual division in time, but only in the intellect, not as something existing in reality. For example, those who maintain that the universe was created, posit a first now, which is not continuous with an earlier one. (Once again, Ibn Sînâ acknowledges that this is one of the senses in which people speak of the now, although there is not really such a now.) Fourth, the now may be associated with a very short period of time, which includes several nows taken in the strict sense, but we are not aware there has been more than one because of the shortness of the period of time.

the opposite of our saying "gradually", but we have expounded on that.[33] [Another] among these expressions is their saying, "right away" (*huwa dhā*),[34] which indicates a now in the future close to the present now for which the magnitude of the interval between them is not sensed appreciably. Also among their expressions is "just before" (*qubaila*) and it indicates a relation to a now in the past near to the present now, except that the period between the two is sensed. Also, "just after" (*bu^caida*) is in the future just as "just before" is in the past. The "prior", is either in the past, indicating what is more remote from the present now, while the "posterior", is its opposite, or it is in the future, indicating what is nearer to the present, while the "posterior" is [again] its opposite. When they are taken absolutely, the prior is the past, while the posterior is the future. The "abyssal past"[35] (*qadīm*) is a time for which interval between it and the present is considered long in comparison with the recognized boundaries belonging to time. Moreover, the "abyssal past" in time, absolutely and in the literal sense, is that whose time does not have a beginning.

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[33] 162.12162.14.

[34] *Huwa dhā*; "right away" is the best translation I can offer for this expression. The phrase literally mean "that one" as in the sentence "look at that one!" and seems to carry a sense of surprise about something which is immediately present.

[35] Cf. Shakespeare "the dark backward and abysm of time".

APPENDIX F

TRANSLATION OF *SHIFÂ'*, PHYSICS III.4: IBN SÎNÂ AGAINST THE COMPOSITION OF BODIES FROM ATOMS

(189.8-190.3) As for the school of those who compose the body from the non-body, it is necessary that we make clear its falsity. So we say that when these atoms are aggregated, so that from them there is a body, then either they are aggregated (1) by way of succession only, or (2) by way of contiguity or (3) by way of interpenetration or (4) by way of continuity. Since aggregated things either have an interval (*buᶜd*) between [their atoms] or they do not, if there is not an interval between them, then their meeting is either altogether (*balasri*) or not altogether. If it is altogether, then they are interpenetrating, as we have made clear.[1] If it is not altogether, then either each has something particular to it (*an yakhtaṣṣa*) through which it meets the other, or that something is common to both. Thus, if it is particular to it, there is contiguity; and if it is something common, there is continuity.[2]

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[1] "When two things are such that the coming together of each of the two things is not confind to the limit of the other such that it altogether comes together with the essence of the other (*dhâta alâkhar*), then that is not contiguity, but rather interpenetration" (179.4-5).

[2] Cf. Aristotle's discussion of the contiguous and the continuous at *Physics*

Likewise, when these atoms are aggregated, their aggregation is not free of one of these [four above] viewpoints. If they are aggregated according to succession only, then from them bodies continuous in perception do not come to be, but our discussion concerns these. If they are aggregated according to either contiguity or continuity, then each one of them is divided into occupied and unoccupied and what is contiguous and vacant, according to what we set forth in the preceding chapters.[3] It is necessary, if there is not interpenetration, that when one of them meets one, and then a third comes to meet one of them, that [the one] is separated from its meeting the other by means of the intervention of this [third] meeting thing. Thus through the meeting each will have received from its essence what does not belong to the other. This is clear in itself. Therefore, what intervenes is divisible. On the other hand, if the meeting is altogether, then they interpenetrate, so that a magnitude is not increased by aggregating [indivisible atoms]. Hence whenever they are aggregated, they will be as the unit (*al-wāḥid*) which is lengthless, breadthless and depthless. Thus since these atoms, which are indivisible, are not aggregated in such a way that a body is composed from them, the body then cannot be broken down into them (muntaqiß *ilayha*). So since it is not the case that the division of bodies ends with atoms, it is not possible that they be divided into a species of some part and likewise for the rest of the magnitudes,

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V 3, 227a6, 10-17

[3] *Shifâ'*, physics, III.2.

i.e., planes and lines.

(190.4-7) Furthermore, what sensible person would concede that we could say that [if] the sun illuminates a sheet of indivisible atoms [one atom thick], or [if] some state befalls [the sheet of atoms] from one side, then it is necessary that the other side is in that state too; or that we could say two sides do not belong to the sheet of itself, but rather the light falls on what is one side of the sheet and the side that is not facing the sun is the very same side; for if one sees this side, then he has seen that side, because this and that are one? There is no this and that, so that the one looking at one side of the sheet could see the sheet as something illuminated from the other side.

(190.8-11) Again, it would be necessary from the existence of atoms that are not divisible that there would not be circles nor right triangles nor many other [geometrical] figures, since the circle necessitates that the outside ring [of a circle] is bigger than any inside ring which is in contact with [the outside ring], but that which is in contact is equal to that with which it is in contact and it is not larger. And also the right triangle, when each one of its two sides is ten [units], then the hypotenuse is the square root of two hundred; that is to say, either [an hypotenuse which is the square root of two hundred] is impossible and does not exist, or it is true and atoms are broken up into smaller parts, but atoms are not broken up into smaller parts.

APPENDIX G

TRANSLATION FROM THE *NAJÂH*, "CONCERNING TIME"

For every motion that is posited in a spatial magnitude and possessing a magnitude of velocity (*ᶜalā miqdār min masāfa*), and another together with it possessing [the same] magnitude of velocity, and the two beginning together, then the two traverse the spatial magnitude together. But if one of them begins when the other has not yet began, but, they end together, then the latter of them will cross less than what the first crosses. And if a slow [moving object] begins with a fast [moving object], and the two agree in setting-out (*al-'akhdh*) and leaving-off (*at-tark*), then the slow one is found to have crossed less [spatial magnitude] while the fast one has crossed more. If that is so, then (1) between the setting-out of the first rapid [moving object] and its leaving-off, there is a capacity (*imkān*) to cross a fixed distance at a fixed velocity and less than that at a fixed slower [velocity] and (2) between the setting-out of the second [moving object] and its leaving off there is a capacity less than that [of the first] at that fixed velocity [i.e., the velocity of the second moving object]. Thus this capacity [of the second] corresponded with a part of [the capacity of] the first, but [the capacity of the second] did not correspond with another elapsed (*mutaqaḍḍiy^{an}*) portion [of the first]. For "elapsing" is characteristic of this capacity, because if [the capacity] remained fixed in a single state for the motions, then the things' agreeing in velocity, any time they began and left-off, would cross a single spatial magnitude exactly the same,[1] and one capacity would not be less than [any other] capacity.

If that is so, increase and diminution, which are marked off (*yataᶜayyanān*), exist in this capacity. And if this is so, this capacity possesses a magnitude which corresponds with motion, and the motion occurs in it with its parts, which belong to [motion] due to the spatial magnitude.

Consequently, there is a magnitude belonging to motions corresponding with them; but whatever corresponds with the motions is continuous, and [anything] continuity elapses is renewed. Thus, consequently this magnitude is an interval (*mudda*), i.e., something continuous by way of elapsing (*ᶜalā sabīl at-taqaḍḍī*).

The existence of this measure is in matter, because there is one part of it after another, and for whatever is such, any part of it of it that one posits comes to be, and everything which comes to be (*ḥādith*) is in matter or from (*ᶜan*) matter, as was said in the [section on the] principles [of nature]. But it is not the case that this [magnitude] is *from* matter, because it is not the composite of

[1]I.e., if there are different motions, but they agree in their velocity, then no matter if one begins earlier than the other or later, they will cross the same spatial magnitude and their capacities to cross a certain spatial magnitude will not differ.

matter and form that comes to be in a primary fashion, but rather it is disposition and form. Therefore, it is a magnitude *in* matter. But every magnitude that exists in matter and a subject is either a magnitude of matter [itself] or of a disposition in [the matter]. However, this magnitude is not [one] of matter [itself], because if it were a magnitude belonging to matter in [matter's] being, then by its increase there would be an increase of matter. And if it were such, then whatever is faster would be larger and greater; but the consequence is absurd, thus the premise is absurd. Therefore, it is a measure belonging to the disposition.

Each disposition is either fixed (*qārrah*) or not fixed. Therefore [this magnitude] is either a magnitude of a fixed disposition or a non-fixed disposition. However, it is not magnitude of a fixed disposition; for every fixed disposition, to which a magnitude is posited to belong, is either together with the entirety of its magnitude in matter or it is not. However, this disposition is not together with the entirety of its magnitude in matter, because every disposition is such that there appears in the matter an increase by an increase of [the disposition] and a diminution by a diminution of it, but the case is not like that. Furthermore, [another argument that the disposition] is not together with the entirety of its magnitude in matter, is that it remains when it increases distinct from the matter, but it is not the case that any [fixed] dispositions of a matter is like that; so this is impossible. Consequently, this magnitude is not a magnitude of a fixed disposition. Therefore it is a magnitude of a non-fixed disposition, i.e., motion. On account of this, one does not conceptualize time except together with motion, and whenever one does not perceive motion, one does not perceive time, just as was said in the story of the companions in the cave.[2]

This measure is not the measure of the body, for the reason stated. Nor is it the measure of the spatial magnitude, because if it were the measure of the spatial magnitude, then the character of [a spatial magnitude] and the character of this measure would be one. And if that were so, motions that agree in one spatial magnitude would themselve be one in fastness and slowness, but then motions that differ in fastness and slowness would not cross different distances in this measure, as has been said. Nor is it the fastness and slowness themselves, because two swift things or two slow things may be equal in swiftness and slowness, but differ in this measure, as you are aware. So therefore, it is a measure distinct from these [i.e., spatial magnitude or fastness and slowness].

[The magnitude we are discussing, i.e., time] is such that if motion were assumed not to exist at all, it would not be contested that [motion's] originator could create a motion or motions before the first, such that it ended with the beginning of the first and had a magnitude belonging to it. He could not possibly create something

[2]Cf. Qur'ān 18:1-23; also cf. *Physics* IV 11, 218b23-27. In both accounts men go into a sound sleep for a long period of time; however, when they wake up they either think no time has passed or only a short period of time. Aristotle explains why they think this as follows. They imagine that the now of their going to sleep and the now of their waking is the same now and so are unaware of the interval between the two nows.

corresponding with [the first motion] in beginning and ending that at the same time is greater than it, despite the possibility of creating what is greater than it and ends with it without condition. If this is such, one recognizes the possibility (*imkān*) for two different motions occuring in [this scenario where we are assuming] nothing exists, and so there must be two capacities. Thus one of two things must happen: either the two are together or one of them precedes [the other]. However, they are not together, because if they were together, then the two motions, the greater and the smaller, would be able to occur together, and this is impossible. So consequently, one of them must have preceded and the other followed it and so corresponds with some of [the other]. Now when there are two things that have this form; they must be two [different] magnitudes. Consequently, the measured capacity and its magnitude will be one existing when all things are non existing. But the two, as was said, are [both] among the things which are in a subject, and accompany the existence of motion in it (*fīhi*). But for whatever is like that, the subject and the motion exist too, but [these] two were assumed not to exist. This is a contradiction.[3]

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[3]Ibn Sînâ's argument is difficult and the target is not clear; however, I believe he has in mind those who claim that time and motion could have some first starting point, i.e., someone who denies the eternity of time or motion. Working on this assumption we can reconstruct the argument as follows. Ibn Sînâ asks us to do a thought experiment. Imagine a "time" when there is absolutely no motion. God can certainly create a motion equal in magnitude to the real motion he actually did create, i.e., a motion beginning with the first moment of creation and going to the present. Call this imagined motion, motion-1. However, in our imagined situation God could also create a different motion (motion-2) greater than motion-1 insofar as motion-2 would supposedly beginning "before" motion-1, but still continue to the present. Now in this imagined situation there is no real motion and yet there still is the capacity for different motions. These

So therefore, time is not something coming to be temporally; rather, [it is] a primal coming to be (*ḥudūth ibdā*ʿ), whose originator is not prior to it in time or a temporal interval, but in essence. If a temporal starting point were to belong to it, then its occurrence is after its not being, i.e., after a proceeding time, so it would be after due to a before not exiting with it; hence, it would be after a before and before an after. So it has a before that is not something existing when it exists. And whatever is like that is not the first before and whatever is not the first before is not a starting point for the whole of time. Thus time is something primal, i.e., only its Creator precedes it.[4]

The meaning of coming to be temporally is that [something] was not, then it was, where the meaning of "it was not" is that there was a state in which it was nonexisting, where that state is something which had existed and passed. However, if the meaning of "it was not" is not nonexistence in a fixed past time, but rather nonexistence with respect to non being (*lā wujūda*), then the eternal (*al-qadīm*) also will not be something existing in non being; but

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capacities, moreover, will both be measurable magnitude and a measure (at least a measure of possible motion). And herein lies the contradiction. These capacities are different times, which we have seen, are only found in motion as a substratum; however, we are assuming that there is not motion. In short, the temporal creation of motion involves the reality of the possibility or capacity for a motion, i.e., a time, independent of motion, but this possibility or capacity cannot be real unless there is motion. The argument here is analogous (though not exactly like) the argument developed in appendix C.

[4]The argument here is roughly the argument of Alexander of Aphrodisias. If there were a temporal beginning of time, then that beginning, i.e., the "first before" comes to be *after* not being; however, if the "first before" comes to be after not being, then there is a before, the first before, viz., when the first before was not. Since a before the first before is clearly a contradiction, the suggestion that there is a first moment of time, i.e., the assumption that lead to the contradiction, must be false.

rather it is something that will be nonexisting in many existing things. For example, it will be something nonexisting in motion, and in alteration, and in change; but it is not the case that "nonexisting in something" and "nonexisting" is one and the same thing, just as it is not the case that the meaning of "it is not in something" and "it is not something" is one [and the same thing]. So time is not something coming to be, which comes to be temporally.[5]

Motion is also such, but we shall make clear that not all motion is like that, rather only circular motion, whether situational [i.e., rotational] or spatial [i.e., a revolution]. So therefore, the *ipseity* (*huwīya*) of this magnitude, which belongs to motion, is due to circular motion, and it is essentially dependent upon [circular motion]. But if its essential relation, which is to a non-fixed disposition in matter, as has been made clear,[6] were only

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[5]Both the Arabic and the philosophy of this section are obscure. Ibn Sînâ begins with the condition under which something comes to be in time, viz., it was not, then it was. "It was not" is further explained in terms of nonexistence. When we deal with something which had existed, but then passed away, the same analysis holds; however, now we say that "it was not" in non-being, i.e., it was. The second half of the section responds to an unstated objection, viz., if something is either nonexisting or not coming to be with respect to something, then it is not. Ibn Sînâ gives the example of eternity, which is not existing with respect to many things, viz., motion, change and the like, but one cannot go on and say that it does not exist with respect to somethings nor can one say that it is not some one thing; likewise just because time is something which does not come to be, one cannot say that it does not exist with respect to something or that it is not some one thing.

و معنى المحدث الزماني أنه لم يكن، ثم كان، ومعنى لم يكن اى كان حال هو فيه معدوماً وذلك الحال أمر قد وجد وتتقضّى فإنه إن كان معنى لم يكن عدماً، لا في وقت معين ماض، بل عُدِمَ بالقياس إلى لا وجود. فإن القديم أيضاً ليس هو موجوداً في اللاوجود، بل هو في كثير من الموجودات غير موجود، مثل أنه غير موجود في الحركة، وفي الاستحالة، وفي التغيّر وليس أنه غير موجود في شيء، وأنه غير موجود شيئاً واحداً، كما أنه ليس معنى أنه ليس في شيء وأنه ليس شيئاً واحداً فإذاً الزمان غير محدث حدوثاً زمانياً.

[6]Reading tabayyana for nubayyinu.

to what is a non-fixed disposition which is non-circular, then it would not exist in [some] time; and that, as explained, is impossible.[7]

So therefore, time is a magnitude belonging to circular motion with respect to the prior and the posterior, not with respect to spatial magnitude. The motion is continuous, and thus time is continuous, because it corresponds with the continuous, and whatever corresponds with the continuous is continuous. Consequently, time is disposed to being divided by the estimative faculty (*tawahhum*), because every continuum is like that. When it is divided, endpoints are established for it in the imagination (*wahm*), which we call "nows". Also just as it is possible that numerous fixed disposition in matter may be measured by a single fixed magnitude, likewise it is possible that numerous unfixed dispositions may be measured by a single unfixed magnitude, i.e., by a single time. Thus this time first is due to some one of them [i.e., the motions], and second it belongs to them in their being measured by [that one] by means of a correspondence; and also that [particular] motion is a cause (*ʿilla*) for measuring the remaining motions, and its Mover is a cause for it and for its magnitude, and for measuring the remaining motions.

[7]The argument must be that since there cannot be a coming to be of time, and time is essentially related to motion, then the motion must never cease to be; however, only circular motion, in the Aristotelian universe, is capable of never ceasing. For the Aristotelian universe is finite and thus a rectilinear motion, once arriving at an extreme, would have to turn back, but it can only turn back (i.e., move in the opposite direction) after ceasing to move in the first direction. Thus there is a rest, where there is no motion; however, this rest would be in time. Consequently, there would be a time when there is no motion; and this is impossible. Therefore, the motion must never stop and this can only hold of circular motion.

It is not the case that whatever exists together with (*maʿa*) time is in it (*fīhi*); for we exist together with a single grain of wheat, but we are not in it. As for the things which exist in time, first are [time's] divisions, i.e., the past and the future, and its limits, which are the nows; second is motion; and third are mobiles. For the mobiles are in motion and motion is in time; thus the mobiles are in a certain way in time. The existence of the now in [time] is like the existence of the unit in number; the existence of the past and the future in it are like the divisions of number in number; and the existence of the mobiles in it are like the countables in number. But whatever is excluded from this group is not in time. However, if it is compared with time and considered with it, and has a permanence corresponding with the permanence of time, and what is in [time], then that relationship and that consideration is given the name endless duration (*dahr*); for endless duration encompasses time.

Just as every continuum of existing measures may be cut up, so that number falls to [what is continuous], so it is no surprise if time is cut up by the imagination, so that it makes days and hours, and indeed years and months; for that is either by the design of the estimative faculty, or by the consideration of the correspondence of the number of motions with it.

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