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# ristotelica

Aristotle across Boundaries

Edited by Silvia Fazzo, Marco Ghione and Jill Kraye

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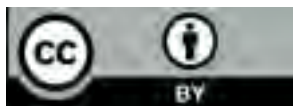
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## *ARISTOTELICA*

*Aristotelica* is a peer-reviewed journal devoted to Aristotle and Aristotelianism through the centuries with a special focus on the texts and textual traditions of Aristotle as a common intellectual background for European and Mediterranean cultures. Filling a substantial gap in existing academic journals, *Aristotelica* covers the works of Aristotle, with particular attention to his theoretical treatises, their textual constitution, and the entire exegetical tradition, and with an emphasis on philology as an appropriate scholarly approach to philosophical texts. The time span is from Aristotle's contemporaries and Greek philosophical literature in Roman times, through the medieval period (Byzantine, Arabic, Latin) and Renaissance, going up to the twentieth century. The journal also considers submissions on the relevance of Aristotelianism to theoretical, epistemological, and ethical debates, as well as to fundamental questions about the establishment, definition, and development of ancient philosophy and science.

Submissions, which can be very short or long (there is no word limit), and written in any of the main European languages, must meet the highest scholarly standards and be based on sound methodology. They should contribute significantly to the field by asking innovative questions and reaching well-argued and ground-breaking conclusions.

Based on a cooperative agreement between the Università del Piemonte Orientale and the Consiglio Nazionale delle Ricerche (ILIESI-CNR, Italy), *Aristotelica* will appear through two channels: Rosenberg & Sellier, a digital publisher with a strong profile in classics; and the ILIESI-CNR Open Journal System platform.



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## EDITORIAL

### ARISTOTLE ACROSS BOUNDARIES

by Silvia Fazzo, Marco Ghione and Jill Kraye

In June 2023, a group of ‘Aristotelians without Borders’ met in the splendid Villa San Remigio in Verbania, one of the beautiful premises of the University of Eastern Piedmont. Following in the footsteps of Aristotelians over the centuries, the participants were committed to the belief that engaging in dialogue has a value in itself. Our Aristotelian predecessors have collectively bequeathed to us a common language, a shared form of rationality and a grammar of thought which allow us to engage in dialogue despite our differences.

There are different types of borders: not only between geographical locations but also between languages, epochs, disciplinary fields, religious beliefs, methodological approaches and political orientations. Aristotelianism has been able to cross all these borders in different ways throughout history. As stated in the first editorial (*Aristotelica* 1/2022, pp. 1-4), even anti-Aristotelians are somehow Aristotelian insofar as they inevitably enter into dialogue in the context of a conceptually shared landscape. The conditions for crossing frontiers with a sense of unimpeded novelty are unprecedented today. Geographical frontiers no longer exist now that every instrument of research and of dialogue, including journals and most of our scholarly activities, is on a shared cloud that has no flag and knows no exclusions. But even historical and chronological frontiers disappear when we agree to take part in dialogues with those who have paved the way for us: the advanced tools we so avidly use drastically reduce the difficulties of documenting the past by means of access to a global web, which we hope one day to colonise with a platform dedicated to Aristotelianism.

Some of the contributions discussed at Verbania were delivered by scholars from countries where the conditions for research are notoriously difficult; these discussions, which went on at length in the conference and continued long afterwards, were among the most interesting and fruitful. Only a few of these contributions are included in this issue due to the limited time available to prepare them for peer review and publication. We intend to continue to publish ‘Aristotle without Borders’ in subsequent issues; but we wanted this specimen of the Verbania conference to serve as a prelude to the World Congress of Philosophy to be held in Rome in August 2024, the

theme of which is 'Philosophy across Boundaries', at which *Aristotelica* hopes to present an international round table.

The present issue starts off with Jean-Marc Narbonne's 'Talking Point'. This is a version of his *Argumentaire* for the conference in Verbania. It especially emphasises Aristotle's capacity to produce frameworks across a multiplicity of theoretical paths. It is followed by contributions which enter into the more technical aspects of the study of some of Aristotle's most challenging texts, in particular, the *Physics*. Aristotle's *Physics*, commented on by Averroes, had a powerful impact on university studies in the thirteenth century and continued to exert an extraordinary influence on subsequent developments in the discipline. It was for this reason that the *Physics* was one of the Aristotelian treatises most opposed by those who promoted what we now call the Scientific Revolution on the threshold of the modern age.

Yet, the more technical details of Aristotle's *Physics* show still today an impressive penetration by Aristotle of problems related to the central concepts of physics, such as the continuum, magnitude, motion and time. The very different approaches taken by Gottfried Heinemann and Monica Ugaglia in their articles clearly demonstrate this. Heinemann tackles the question of whether the accounts of continuity in *Phys.* V 3 and *Phys.* VI combine to make a coherent theory: his answer is that they do not; but that they both offer accounts (or theories) which are coherent in their own ways. Ugaglia is concerned with the problem of identifying time-independent properties of natural motions: how can Aristotle conceive of motion apart from time? Greek verbal tenses seems to have played a role. It is worth pointing out that Ugaglia's piece on time carries on from her previous contribution on circular movement as infinite and continuum; for it is one of *Aristotelica*'s aims to provide a venue for authors to synthesize their previous research and to share their progress. Crossing psycho-physiological borders, Giuseppe Feola's contribution on the Aristotelian conception of animal psychology – a subject of increasing topicality – explores the extent to which infant humans and animals share the same psychic faculties; while the difficult task of crossing chronological borders is represented by Peter Swallow, who convincingly shows small but significant paths of dialogue between Aristotle and Darwin.

Our heartfelt thanks go to all those who have contributed to this issue.

## ARGUMENTAIRE

### ARISTOTE AU-DELÀ DES FRONTIÈRES

par Jean-Marc Narbonne

Aucun auteur de l'Antiquité, peut-être, n'a permis autant qu'Aristote de mettre en contact les êtres humains entre eux malgré les frontières du temps et de l'espace, à travers les barrières des langues et de leurs traductions, des cultures, des religions et des idéologies diverses. Aucun philosophe n'aura entretenu des visées aussi universalisantes et sans frontières. C'est le cas, notamment, dans le domaine de la métaphysique, de la logique, du politique ou de la poétique.

En métaphysique, le questionnement poursuivi sur l'étant en tant qu'étant, sur les causes de l'être en général et sur tout ce qui relève de l'universel – c'est-à-dire du *καθόλου* – témoigne d'une volonté de se dégager de tout particularisme pour atteindre la scientificité la plus exigeante et la plus englobante.

La logique est par elle-même universelle dans la mesure où elle est de nature formelle, or c'est Aristote qui entame ce chantier en recourant à la langue naturelle pour formaliser. La logique est aussi universelle dans son but : aboutir à une proposition affirmative universelle vraie, atemporelle et nécessaire. L'on peut aussi faire remarquer que la manière dont naît l'universel, que l'universalisation de la science elle-même, n'est pas sans implication politique. Il ne s'agit pas là de paroles vides : rien n'a autant favorisé ni encouragé l'échange et la communication interculturelle que l'établissement d'une grammaire universelle pour la pensée scientifique.

La double dimension, universelle/particulière, se retrouve également dans sa physique et sa biologie, surtout dans les *Parties des Animaux*, en lien par exemple avec les questions de méthode : d'abord aborder ce qui est le plus commun, les fonctions ; et ensuite leur particularisation dans les genres ou les espèces.

Le même souci s'affiche dans le domaine politique, dans la mesure où l'enquête poursuivie sur le passage de l'individu à la famille, de la famille au village puis à la cité proprement dite, vise la vie humaine considérée globalement et sous tous ses aspects, sans oublier la considération dans le tableau d'ensemble des peuplades et des mœurs les plus exotiques. Surtout, dans sa

définition de ce qui représente l'essence même du citoyen et de ce qui constitue la nature propre d'une cité, il est bien clair qu'Aristote entend parler de toutes les communautés humaines et cela pour tous les temps.

Dans l'ordre du *poétique* ou du *poiétique*, bref du faire, du créer ou du concevoir, l'on voit aussi Aristote tenter de remonter au principe originel de tous les arts, qu'il s'agisse de la poésie au sens étroit ou de la musique, de la peinture, sculpture, danse, etc. Non seulement l'enquête sur le ποιῆν dans ses différentes manifestations ne connaît pas de frontières, mais elle est mise en rapport sur le plan épistémologique avec les autres facultés humaines, théorétiques et pratiques, dans la volonté de poser les choses telles qu'elles sont en elles-mêmes dans leur universalité la plus absolue.

De là l'intérêt d'un *Call for Papers* pouvant mettre en évidence des axes de recherche convergents et communs pour les aristotélisants du XXI<sup>e</sup> siècle. Les contributions en vue auront à cœur d'attirer l'attention sur les aspects les plus généraux et les plus universels de la pensée aristotélicienne, quel que soit le domaine spécifique visé.

Talking Point: Aristotle across Boundaries  
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GOTTFRIED HEINEMANN

**ARISTOTLE ON CONTINUITY:  
CONTINUOUS CONNECTION IN *PHYS.* V 3  
AND THE MATHEMATICAL ACCOUNT OF  
MOTION AND TIME IN *PHYS.* VI**

**Abstract**

Wholes have parts, and wholes are prior to parts according to Aristotle. Aristotle's accounts of continuity, in *Phys.* V 3 (plus sections in *Metaph.* Δ 6 and I 1) on the one hand and in *Phys.* VI on the other, are specified in terms of ways in which wholes are related to parts. The *synthesis* account in *Phys.* V 3 etc. applies primarily to bodies (in, e.g., anatomy). It indicates a variety of ways in which parts of a body are kept together by a common boundary and are thereby combined into a mostly inhomogeneous, functional whole. Only the *analysis* account in *Phys.* VI applies primarily to linear continua such as movements, paths of movements, and time. The structure it indicates is only superficially described as indefinite divisibility: what matters is the transfer of potential divisions from path to movement and time (and conversely) which, surprisingly, requires an equivalent to Dedekind's continuity principle to be tacitly presupposed. – In the present paper, my agenda will focus on the exposition of the relevant theories offered by Aristotle in *Phys.* V 3 and *Phys.* VI 1-2, respectively, with a view to the applications envisaged by Aristotle and to the mathematics involved.

**Keywords**

Continuity, Motion and Time, Dedekind's Continuity Principle,  
Homogeneous and Inhomogeneous Bodies

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1. Introduction\*

Aristotle offers two accounts of continuity. The *synthesis* account in *Phys.* V 3 (plus sections in *Metaph.* Δ 6 and I 1) indicates a variety of ways in which parts of a body are kept together by a common boundary and are thereby combined into a mostly inhomogeneous, functional whole. Only the *analysis* account in *Phys.* VI applies primarily to linear continua such as movements, paths of movements, and time.

For limitations of space, I will confine my exposition to what I think are the essentials of the theories offered by Aristotle in *Phys.* V 3 and in *Phys.* VI 1-2 (up to 233a12, leaving aside the subsequent “traditionalist” rest of the chapter). The backlink at the beginning of *Phys.* VI (see T19 below) suggests that ch. VI 1 is in a way based on ch. V 3 and, in turn, the latter chapter is meant to provide a basis for the argument in the former. I will argue that this is misleading. On the one hand, the teleological reading implied turns out to be an impediment to understanding that chapter in its own terms and, particularly, to make sense of its metaphors and examples. Neither is the account of continuity in *Phys.* V 3, taken by itself, about motion, nor does the chapter offer any hint at the transfer to motion which occurs only later in *Phys.* V 4 (see T9 and T10 below) and subsequently in *Phys.* VI. On the other hand, *Phys.* VI 1 is only superficially linked to *Phys.* V 3. The definition therefrom transferred fails to explain what, in the first theorem of *Phys.* VI 1, “a continuum” is and what, therefore, the subsequent argument is about (see section 4.1 below). The analysis of *Phys.* VI 1-2 requires a method different from my method in the study of *Phys.* V 3. My leading question concerning *Phys.* VI 1-2 is, How to get the mathematics right? That is to say, I seek a sound mathematical argument which, I assume, the text indicates (see also section 4.2 below).

Of Aristotle’s two definitions of continuity, one is in terms of **division** (T1), the other in terms of **connection** (T2).

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\* A preliminary version was presented at *Aristotle across Boundaries* (Verbania, June 8-9, 2023). I am grateful to Silvia Fazzo for the invitation to that conference, to the participants in the discussion and, particularly, to an anonymous reader who pointed to a host of desiderata which, I hope, will be stuff for further discussion.

**T1.** (Df. **Divi**) I call continuous what is divisible into again and again divisibles.

(*Phys.* VI 2.232b24-25: λέγω δὲ συνεχῆς τὸ | διαιρετὸν εἰς αἰεὶ διαιρετά)

**T2.** (Df. **Conn**) Continuous[ly connected] are items of which the extremities are one; and in contact are items of which [the extremities] are together.

(*Phys.* VI 1.231a22-23: συνεχῆ μὲν ὧν τὰ ἔσχατα ἓν, ἀπτόμενα δ' ὧν ἅμα.)

Note that ‘continuous’ is a one-place predicate according to **Divi**, but a two-place predicate (i.e., a relation) according to **Conn**.<sup>1</sup> Correspondingly, in Aristotle’s account of motion, **Divi** is a matter of analysis, **Conn** of synthesis.

I will argue that

- Sections 2 and 3: As defined in *Phys.* V 3 (and in *Metaph.* Δ 6 and I 1), **Conn** pertains primarily to the connection of bodies, and is only later transferred to motion in passages of *Phys.* V 4 (with applications in *Phys.* VIII) and of VI 1.

- Section 4.1: In the first part of *Phys.* VI 1 (231a21-b18), Aristotle points out that division into continuously connected parts never comes to an end and that, therefore **Divi** can be derived from **Conn** in a way. Lacking starting points, **Conn** fails to account for the structure of linear continua in terms of synthesis, whereas **Divi** does in terms of analysis.

- Sections 4.2 and 4.3: According to **Divi**, the potential divisions of linear continua are dense. But in addition to **Divi**, crucial features in Aristotle’s account are (i) the isomorphism established by straightforward motion between path, and movement, and time, and (ii) a continuity principle which secures that the isomorphism is not just part by part (as required by the argument in the second part of *Phys.* VI 1.231b18-232a22), but limit by limit (as required by the argument in the first part of *Phys.* VI 2 (232a23-233a12)).

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<sup>1</sup> Cf. Sattler (2020) pp. 295-6, (2021) p. 16. Similarly, Glasner (2020) p. 29 (see below 3.1.3).

## 2. Areas of Application

### 2.1. *Divi*

Standard applications of **Divi** belong to the mathematical account of motion offered in *Phys.* VI (see below section 4) and are adumbrated in the preliminaries to *Phys.* III 1. Motion traverses a path during a period of time. According to *Phys.* IV 11, both linear order and continuity transfer from the path to the motion, and from the motion to time. The same isomorphism is described in *Phys.* VI 1 (T26) and applied throughout *Phys.* VI. That **Divi** holds of magnitudes and, in particular, of the path of a movement, is implied at the beginning of *Phys.* VI 2. For, assuming that

**T3.** every magnitude is divisible into magnitudes,<sup>2</sup>

the magnitudes into which a magnitude is divided are again divisible, which is enough for **Divi** to hold. At the beginning of *Phys.* III 1, **Divi** is mentioned as a commonly assumed mark of continuity,<sup>3</sup> and applied to motion. That **Divi** holds of time, is the outcome of the refined isomorphism argument in *Phys.* VI 2,<sup>4</sup> on which see section 4.3 below.

As another candidate, homogeneous stuffs and bodies (*homoiomere*) suggest themselves. But as far as I can see, continuity of bodies is rather described by Aristotle in terms of **Conn.** There may be also a concern about minima naturalia.<sup>5</sup> That body in general is indefinitely divisible belongs to its having magnitude and is, therefore, just another application of T3.

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<sup>2</sup> *Phys.* VI 12.232a23: πᾶν μέγεθος εἰς μεγέθη διαιρετόν.

<sup>3</sup> *Phys.* III 1.200b18-20: "... those who try to define the continuous often find themselves making use of the definition of the infinite as an auxiliary, the supposition being that what is divisible ad infinitum is continuous." (... τοῖς ὀρίζομένοις τὸ συνεχές συμβαίνει προσχρησασθαι πολλάκις τῷ λόγῳ τῷ τοῦ ἀπείρου, | ὡς τὸ εἰς ἄπειρον διαιρετόν συνεχές ὄν, tr. Hussey).

<sup>4</sup> *Phys.* VI 2.232b24-26: "... it is necessary that time, too, is continuous. I call continuous what is divisible into again and again divisibles. On the basis of this [account of the] continuous, it is necessary that time is continuous." (... ἀνάγκη καὶ τὸν χρόνον συνεχῆ εἶναι. λέγω δὲ συνεχές τὸ | διαιρετόν εἰς αἰεὶ διαιρέτα· τούτου γὰρ ὑποκειμένου τοῦ συνεχῆ, ἀνάγκη συνεχῆ εἶναι τὸν χρόνον).

<sup>5</sup> See my note on *Phys.* I 4.187b13-188a2 in Heinemann (2021) pp. 219-21.



2.2. *Conn*

In a way, the distinction between contact and continuity applies to Aristotle's account of place. In *Phys.* IV 4, place is defined in terms of contact. Extremities being just together, the edge of the surrounding body is what the body surrounded is primarily in, i.e., its place. By contrast, bodies which are continuously connected so as to form a homogeneous whole are not distinguished by place but only as parts:

**T4.** So when that which surrounds is not divided from, but continuous with, [the thing surrounded], the latter is said to be in the former not as in a place but as the part is in the whole; but when that which surrounds is divided from and in contact with [the thing surrounded], the latter is in the extreme of the surrounding thing primarily {i.e., as in its primary place (GH)}; and this extreme is neither a part of that which is in it, nor is it greater than the extension [of the thing surrounded] but equal to it, since the extremes of things which are in contact are in the same [spot].<sup>6</sup>

Aristotle's claim that, in the latter case, the parts are potentially in a place

**T5.** ... when a homogeneous thing is continuous, the parts are potentially in place; when, by contrast, they are separate but in contact, as in a heap, they are actually so<sup>7</sup>

must be qualified. If a homogeneous body is continuous, there is nothing internal to the body to mark off a part of it. Hence, there is no question of given parts being potentially in a place but, rather, of there being potential parts which, when specified in an appropriate way, may be also attributed places. In his account of the formation of hailstones, Aristotle explains that, in clouds, small portions of water join to form raindrops, but hailstones cannot come to be analogously since

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<sup>6</sup> *Phys.* IV 4.211b29-34: ὅταν μὲν οὖν μὴ διηρημένον ἢ τὸ περιέχον ἀλλὰ | συνεχές, οὐχ ὡς ἐν τόπῳ λέγεται εἶναι ἐν ἐκείνῳ, ἀλλ' | ὡς μέρος ἐν ὅλῳ· ὅταν δὲ διηρημένον ἢ καὶ ἀπτόμενον, ἐν | πρώτῳ ἐστὶ τῷ ἐσχάτῳ τοῦ περιέχοντος, ὃ οὔτε ἐστὶ μέρος | τοῦ ἐν αὐτῷ οὔτε μείζον τοῦ διαστήματος ἀλλ' ἴσον· ἐν | γὰρ τῷ αὐτῷ τὰ ἐσχατα τῶν ἀπτομένων (tr. Hussey, modified).

<sup>7</sup> *Phys.* IV 5.212b4-6: ὅταν μὲν | συνεχές ἢ τὸ ὁμοιομερές, κατὰ δύναμιν ἐν τόπῳ τὰ μέρη, | ὅταν δὲ χωρισθῇ μὲν ἀπτηται δ' ὡσπερ σωρός, κατ' ἐνέργειαν (tr. Hussey, modified).

**T6.** frozen [bodies] do not grow together like liquids.<sup>8</sup>

When drops of water merge and a bigger drop comes into being, there is no way to trace back part of the latter to one of the former – unless a difference in contamination or quality is retained in the fusion, which is not generally the case. As a consequence, there seems to be an obstacle to the application of **Conn** since, on the one hand, **Conn** suggests that a common boundary of continuously connected bodies persist whereas, on the other hand, boundaries vanish when portions of fluid stuff merge.<sup>9</sup>

In a way, the claims by Furley and White, approvingly quoted by Glasner (2020, p. 30 n. 99), are therefore misleading. Furley (1982, p. 30) claims that Aristotle, when discussing continuous connection,

thinks primarily of homogenous natural substances, such as air and water. The distinction between *in contact* and *continuous* is primarily to distinguish a case such as the junction of the upper surface of the sea with the lower surface of the air from the junction of two bodies of water.

White (1992, p. 27) agrees, adding that, as T5 makes it explicit,

continuity pertains to what is homoeomerous, while contiguity pertains to parts which are spatially joined but essentially different.

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<sup>8</sup> *Meteor.* I 12.348a12-13: ... οὐ γὰρ συμφύεται τὰ | πεπηγότα ὡσπερ τὰ ὑγρά. – Note that “growing together” (*sumphusis*) = continuous connection at *Phys.* V 3.227a23-27 (T16 below).

<sup>9</sup> I thus agree with Katz who (2021, p. 255 *contra* Pfeiffer 2017, pp. 178 ff.) also denies that, when fluids merge, boundaries persist who according to Aristotle. But I do not agree with the explanation she adduces from Aristotle. As far as I can see, his explanation derives from the characteristic way moist stuffs adapt their limits to the body which is around (*GC* II 2.329b29-330a1): if both bodies are moist, the common limit is blurred. By contrast, Katz adduces another characteristic: that, under pressure, liquids do not decrease but recede (*GC* II 2.330a8-9 and *Meteor.* IV 4.382a11-14). I do not see how the blurring of the boundaries is thereby achieved. Clearly, this cannot be the whole story since even for a fully homogeneous liquid there is a difference between, e.g., rotation and rest. But I doubt that Aristotle can account for this difference in terms of boundaries (and, hence, places) of parts. (I am grateful to my anonymous reader who urged me to make this explicit.)

Glasner (*loc. cit.*) mentions “two celestial spheres” as an example of “two distinct objects” which “cannot be continuous”, but “can be contiguous.” This suggests that White’s link of contiguity with essential difference is confined to fluids (such as water and air), whereas solids of the same kind may be either contiguous or continuously connected. It should be added that the language employed in *Phys.* V 3 and in the parallel passages in *Δ* 4 and 6 also suggests that, in general, continuously connected components are different in quality and may be even different in kind, key examples being taken from animal parts (see sect. 3.1.4 below). In particular, Aristotle’s account of continuity in *Phys.* V 3 is consistent with the doctrine in *Metaph.* *Δ* 6 and I 1 that kinematic unity is the mark of continuous connection (T17 and T18, see below section 3.2). By contrast, Aristotle’s account of place in *Phys.* IV 1-5 does not seem to provide the best examples of the distinction indicated by **Conn**.<sup>10</sup>

There are obvious applications of **Conn** to time: periods of time are continuously connected at instants. Instants follow the pattern of a point which

**T7.** keeps the length together and marks it off; for it is the beginning of one part and the end of another.<sup>11</sup>

Hence,

**T8.** the now is the connectedness of time, ... for it connects the past and future time, and is a limit of time, since it is the beginning of one and the end of the other.<sup>12</sup>

Further, successive movements may be continuously connected or not, see, e.g.,

**T9.** Since every movement is continuous, a movement that is unconditionally one must (if indeed every movement is divisible) be continuous, and a continuous movement must be one. For not every movement could become continuous[ly connected] with every other

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<sup>10</sup> See also section 3.1.1 concerning an inconsistency which suggests that *Phys.* IV 1-5 must not be taken as presupposed in *Phys.* V 3.

<sup>11</sup> *Phys.* IV 11.220a10-11: ... συνέχει | τὸ μήκος καὶ ὀρίζει· ἔστι γὰρ τοῦ μὲν ἀρχῆ τοῦ δὲ τελευτῆ.

<sup>12</sup> *Phys.* IV 13.222a10-12: τὸ δὲ νῦν ἔστιν συνέχεια χρόνου ... · συνέχει | γὰρ τὸν χρόνον τὸν παρεληλυθότα καὶ ἐσόμενον, καὶ | ὅλως πέρας χρόνου ἔστιν· ἔστι γὰρ τοῦ μὲν ἀρχῆ, τοῦ δὲ τελευτῆ. (tr. Hussey, modified). – See also Strobach (forthcoming) on bar lines in musical notation.

movement, any more than a random thing with any other random thing, but rather those in which the extremities are one.<sup>13</sup>

and

**T10.** It has been established [in *Phys.* V 3, GH] that items are continuous[ly connected] of which the extremities are one. So, movements are contiguous and successive in virtue of time being continuous, but [time is something] continuous in virtue of the movements being continuous, and this is when the extremity becomes one for both. That is why a movement that is unconditionally continuous and one must be the same in species, of one thing, and in one time.<sup>14</sup>

In particular, since eternal motion must be periodic, turning from one intermediate position to another and back, it is a requirement of its unity that every recurrent section is continuously connected with its immediately successor.<sup>15</sup>

Doubtlessly, **Conn** does apply to linear continua such as path, motion, and time. But I will argue, *first*, that linear continua are alien to Aristotle's

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<sup>13</sup> *Phys.* V 4.228a20-24: ἐπεὶ δὲ συνεχῆς πᾶσα κίνησις, τὴν τε ἀπλῶς | μίαν ἀνάγκη καὶ συνεχῆ εἶναι, εἴπερ πᾶσα διαιρετὴ, καὶ | εἰ συνεχῆς, μίαν. οὐ γὰρ πᾶσα γένοιτ' ἂν συνεχῆς πάση, | ὥσπερ οὐδ' ἄλλο οὐδὲν τῷ τυχόντι τὸ τυχόν, ἀλλ' ὅσων ἐν | τὰ ἔσχατα (tr. Reeve, modified).

<sup>14</sup> *Phys.* V 4.228a29-b3: κεῖται γὰρ τὸ συνεχές, ὧν | τὰ ἔσχατα ἔν. ὥστ' ἐχόμενα καὶ ἐφεξῆς εἰσι τῷ τὸν χρόνον εἶναι συνεχῆ, συνεχές δὲ τῷ τὰς κινήσεις. τοῦτο δ', | ὅταν ἐν τὸ ἔσχατον γένηται ἀμφοῖν. διὸ ἀνάγκη τὴν αὐτὴν | εἶναι τῷ εἶδει καὶ ἐνὸς καὶ ἐν ἐνὶ χρόνῳ τὴν ἀπλῶς συνεχῆ | κίνησιν καὶ μίαν ... – text at a31: Pellegrin (2002) p. 293 n. 2 (tr. Reeve, modified).

<sup>15</sup> *Phys.* VIII 6.259a15-20: "... it has been demonstrated that there must always be motion. But if always, it must be continuous, for what is everlasting is continuous, while what is successive is not continuous. But if continuous, it is one. But motion is one if it is the by one mover and of one moved thing. For if now one thing is the mover, and now another, the whole movement will not be continuous but successive." (δέδεικται γὰρ ὅτι ἀνάγκη αἰεὶ κίνησιν εἶναι. | εἰ δὲ αἰεὶ, ἀνάγκη συνεχῆ εἶναι. καὶ γὰρ τὸ αἰεὶ συνεχές, τὸ δ' ἐφεξῆς οὐ συνεχές. ἀλλὰ μὴν εἴ γε συνεχῆς, | μία. μία δ' ἢ ὑφ' ἐνὸς τε τοῦ κινούντος καὶ ἐνὸς τοῦ κινουμένου. εἰ γὰρ ἄλλο καὶ ἄλλο κινήσει, οὐ συνεχῆς ἢ | ὅλη κίνησις, ἀλλ' ἐφεξῆς – tr. Graham, modified). *Phys.* VIII 8.261b31-262a5: "Clearly, what travels with a straight and bounded motion does not travel continuously. For it turns back, and what turns back on a straight line undergoes contrary motions. ...We have already determined what is the single and continuous motion, that it is the motion of a single subject in a single time and in respect to an indistinguishable form... Contraries differ in form and are not one." (ὅτι δὲ τὸ φερόμενον τὴν εὐθείαν καὶ | πεπερασμένην οὐ φέρεται συνεχῶς, δῆλον. ἀνακάμπτει | γὰρ, τὸ δ' ἀνακάμπτον τὴν εὐθείαν τὰς ἐναντίας κινεῖται | κινήσεις. ...<sup>(b36)</sup> τίς δ' ἐστὶν ἢ μία καὶ |<sup>(a1)</sup> συνεχῆς κίνησις, διῶριται πρότερον, ὅτι ἢ τοῦ ἐνὸς καὶ ἐν | ἐνὶ χρόνῳ καὶ ἐν ἀδιαφόρῳ κατ' εἶδος...<sup>(a5)</sup> τὰ δ' ἐναντία διαφέρει τῷ εἶδει, καὶ οὐχ ἔν – tr. Graham, modified).

account of continuous connection in *Phys.* V 3 and, *second*, that for the mathematical account of the linear continua Aristotle offers in *Phys.* VI, **Conn** is just a starting point. See sections 3.1 and 4.1 below.

### 3. Aristotle's Accounts of Continuous Connection in *Phys.* V 3, *Metaph.* Δ 6 and I 1

#### 3.1. *Phys.* V 3

The first sentence in *Phys.* VI (T19, see below), featuring **Conn** as quoted above (T2), suggests that *Phys.* VI is continuous with the account of continuous connection in *Phys.* V 3. But I don't think that there is any such continuity. Arguably, *Phys.* V 3 is not about motion at all.

3.1.1. *Phys.* V 3 describes five kinds of relation – in contact (*haptomena*),<sup>16</sup> between (*metaxu*), successive (*ephexēs*), contiguous (*echomena*), and continuously connected (*sunechē*) – which may obtain between bodies or other kinds of components. The pair of concepts introduced at the beginning of the chapter, together (*hama*) and separate (*chōris*), refer explicitly to place, and so does therefore the subsequent definition of contact (T11) which, in turn, is presupposed in the definition of continuous connection (T14 below). This suggests that the definitions offered in *Phys.* V 3 are primarily meant to apply to bodies and places.<sup>17</sup> I will argue that this is confirmed both by the metaphors and examples in *Phys.* V 3 and by the parallels in the *Metaphysics*.

The definition of “together”, “separate”, and “in contact” is this.

T11. I say things are together in place (*hama ... kata topon*) when they are in one primary place and to be apart when they are in different places. Things are said to be in contact when their extremities are together (*hama*).<sup>18</sup>

Two remarks are in order. *First*. In T11, the concept of primary place is employed to define contact. Conversely, *Phys.* IV 4 employs the concept of

<sup>16</sup> In this list, I am giving the Greek adjectives in neuter plural, to apply to any pair of items, including bodies (*sōmata*). Note that both *metaxu* and *ephexēs* are adverbs.

<sup>17</sup> See Furley (1982) p. 31: “Aristotle's doctrine [*sc.* in *Phys.* V 3] is formulated with reference to physical bodies.” Similarly, Waschkies (1977) p. 168 and *passim*.

<sup>18</sup> *Phys.* V 3.226b21-23: ἅμα μὲν οὖν λέγω ταῦτ' εἶναι | κατὰ τόπον, ὅσα ἐν ἐνὶ τόπῳ ἐστὶ πρῶτῳ, χωρὶς δὲ ὅσα | ἐν ἐτέρῳ, ἀπτεσθαι δὲ ὧν τὰ ἄκρα ἅμα (ττ. ROT).

contact to define primary place.<sup>19</sup> *Second*, T11 is incoherent unless the second occurrence of “together” echoes the first.<sup>20</sup> Hence, the “extremities” (*akra*) mentioned in the definition of “in contact” are supposed to be “in a primary place” (*en ... topōi ... prōtōi*). But the definition at *Phys.* IV 4.212a6 equates the primary place of an entity with “the edge (*peras*) of the surrounding body” and thereby precludes extremities (*eschata*) such as points, lines and surfaces from being in a primary place.<sup>21</sup> I agree with Pfeiffer (2018, pp. 152-3 and 155) that, therefore, T11 does not presuppose the definition offered in *Phys.* IV 4.

Even more conspicuous is the inconsistency between the account of change (*metabolē*) in *Phys.* V 1 and the account of motion (*kinēsis*) in *Phys.* III 1 which, in turn, relies on the account of becoming (*genesis*) in *Phys.* I 7. In *Phys.* III 1, changes in all categories count as movements, whereas only changes in the subordinate categories (quality, quantity, place) are so classified in the second part of *Phys.* V 1. Arguably, the issue is not just classification. Rather, the author of that section in *Phys.* V is unaware of the analysis of unqualified becoming in *Phys.* I 7 where portions of stuff are allowed to substitute substances as subjects. As a consequence, becoming is from just not-being in *Phys.* V 1 – which amounts to the very doctrine the argument in *Phys.* I 7-9 is designed to refute.

That in both cases, the relevant passages in *Phys.* V – ch. 3 and ch. 1 from 224b35 onwards – are earlier than *Phys.* I-IV is quite a safe guess. But it should be added that this does not apply to the whole of *Phys.* V. There are also passages in *Phys.* V which presuppose *Phys.* I-IV – e.g.

- the first part of ch. 1 (up to 224b35) where *Phys.* III 1 seems to be cited (224b10-11),<sup>22</sup> while the classification offered in the second part of the chapter is conspicuously absent, and

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<sup>19</sup> *Phys.* IV 4.211a29-34 and 212a5-6a; see Heinemann (2021) pp. 298-300 (note on 211a23-34).

<sup>20</sup> Differently, Alexander (*In Phys.* fr. 254 Rashed, cf. Simplicius, *In Phys.* 870.10-871.15) and Katz (2021) pp. 245 ff.

<sup>21</sup> Aristotle is explicit about points (see *Phys.* IV 1.209a11-13 and 5.212b24-25). That the argument extends to lines and surfaces is hard to deny.

<sup>22</sup> See Ross (1936) p. 8; Wagner (1979) p. 591; Odzuck (2014) p. 26 n. 48.

- the excursus on changes of changes in ch. 2 where *Phys.* I 7 is quoted.<sup>23</sup>

In sum, it is wise to consider the possibility that *Phys.* V is just patchwork and, therefore, to interpret the main sections independently of each other. If chapters 1-2 and 4-6 are, in their respective ways, about motion there is no warrant to conclude from this that ch. 3, too, was written with a view to the analysis of motion. There is, of course, no denying that *Phys.* V as a whole is about motion and so is derivatively ch. 3, as a section inserted into the book.

3.1.2. A crucial passage in *Phys.* V 3 is the definition of betweenness.

**T12. (a)** That item is between, which the changing thing, changing continuously, naturally reaches before the item to which it naturally changes at the end. ... **(b)** And a thing moves continuously if it leaves no, or just the minimal, gap in the matter (*tou pragmatos*) – not in the time (for, on the one hand, there is no objection to leaving a gap in time [and making a break], but, on the other hand, [the condition that no gap in time is left does not preclude] the highest note sounding immediately after the lowest) but in the matter, [i.e. the dimension] in which the movement takes place.<sup>24</sup>

**Ad (a).** The definition of betweenness is in terms of linear order (b24: *proteron*, b25: *eschaton*). But linear order is in quite an artificial way imposed on the underlying realm, viz., via itineraries being “natural” (b24: *pephuke*, b25: *kata phusin*) or not.<sup>25</sup> That the relata of betweenness are meant to be 2- or 3-

<sup>23</sup> At *Phys.* V 2.226a17 *hupokeimenē phusis* is a verbatim quotation of *Phys.* I 7.191a8. Throughout the excursus (225b16-226a23), the term *hupokeimenon* is used in the same way as in I 7-9. The special meaning of *hupokeimenon* presupposed in the second part of V 1 (“the state indicated by an affirmative predication”: *to anaphase deloumenon*, 225a6-7; see *Int.* 6.17a25 and my note on 225a3-7 in Heinemann, forthcoming) reappears only in *Phys.* V 5-6 (229a31-32 and b30, but not 230a11). – See the introduction and notes in Heinemann (forthcoming) for a fuller account, and discussion, of the incoherences mentioned.

<sup>24</sup> *Phys.* V 3.226b23-25, 27-31: μεταξὺ δὲ | εἰς ὃ πέφυκε πρότερον ἀφικνεῖσθαι τὸ μεταβάλλον ἢ εἰς ὃ | ἔσχατον μεταβάλλει κατὰ φύσιν συνεχῶς μεταβάλλον, ...<sup>(b27)</sup> συνεχῶς δὲ κινεῖται τὸ μη|θὲν ἢ ὅτι ὀλίγιστον διαλείπον τοῦ πράγματος – μὴ τοῦ χρόνου | (οὐδὲν γὰρ κωλύει διαλείποντα, καὶ εὐθὺς δὲ μετὰ τὴν ὑπάρ|την φθέγγασθαι τὴν νεάτην) ἀλλὰ τοῦ πράγματος ἐν ᾧ | κινεῖται. Concerning the passage in parentheses (*ou gar koluei ...*, b29-30), I try to follow the proposal offered by Ross (1936) pp. 627-8. – Note that the “highest” string (*hupate*) is lowest in pitch (LSJ *s.v.*).

<sup>25</sup> Differently, Pfeiffer (2018) p. 148 n. 4: “‘between’ ... is a notion that is most explicitly linked to the analysis of change”; Mendell (2019, Supplement on § 9: “Place and Continuity of Magnitudes”): “Between (*metaxu*) pertains to continuous change: what is between is that

dimensional regions, e.g., cities, is quite a safe guess. Verona is between Venezia and Milano, because it is “natural” to travel from Venezia to Milano via Verona. But Milano is not between Venezia and Verona, because it is unnatural to travel from Venezia to Verona via (e.g., Bologna and) Milano. Note that this is not just a matter of straight lines (try to travel a straight line from Torino to Grenoble). True, in the context (226b32-34) Aristotle also adumbrates an account of betweenness in terms of straight lines and distances. But he would insist that Lamia is between Athens and Larisa, and that my elbow is between my hand and my shoulder, whether I bend the arm or not. In neither field, consideration of straight lines is to the point.

**Ad (b).** The change involved in the itinerary account of betweenness is required to be “continuous” (b25: *sunechōs*) – which is said to mean that jumps are confined to a minimum, whereas breaks are explicitly allowed (cf. b28: *mē tou chronou*). For instance, to perform a full scale on a harp counts as a continuous movement, the continuity is only disrupted if a note is omitted (or if the highest note follows the lowest (b29-30). Clearly, the performance satisfies neither **Divi** nor **Conn.** Neither definition of continuity applies; and nothing suggests that the change, which is involved in the definition of betweenness, is meant to instantiate either of them. Rather, “continuously” (b25: *sunechōs*) is common language in T12.<sup>26</sup>

3.1.3. According to Glasner (2020, p. 29), “whereas in *Physics* VI continuity is an attribute of a magnitude, in V.3 it is a binary relation and applies to physical entities as well.” This suggests that in V 3, continuity also applies to magnitude according to Glasner. To substantiate, she adds (*ibid.*, n. 95) that, in *Phys.* V 3, “Aristotle uses mathematical examples (lines, units) as well as physical examples (houses in a row, rivets, glue).” Rivets (my “nail”: *gomphos*, 227a17, see T15 below) and glue are mentioned by Aristotle as ways to establish a continuous connection of bodies (T14, cf. T 17 below). The other examples pertain to succession:

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which a continuous changer arrives at before it arrives at the end of the change.” – In my interpretation, change is just auxiliary here: betweenness transfers from change (where the definition is obvious) to the realm at issue via itineraries (similarly, Dehn 1936, pp. 14-5 and 1975, pp. 202-3 and Waschkie 1977, pp. 162-3).

<sup>26</sup> Similarly, Waschkie (1977) pp. 168-9 and Sattler (2020) p. 303 n. 86.



**T13.** An item is next in succession when (i) it is after the beginning in position, in kind, or by some other criterion, and when (ii) there is nothing of the same genus between it and that to which it is next in succession, e.g. a line or lines if it is a line, unit or units if it is a unit, a house if it is a house.<sup>27</sup>

Examples added in *Phys.* V 3 to this are numbers and calendar dates on the one hand (227a5-6) and points on the other (a27-32); numbers reappear at a20 and a32, units (a2-3) at a27-32. All of this pertains to succession, but in the latter passage, contact is also mentioned. The passage is probably meant to bring out a difference between units (as employed in the definition of numbers) and points.<sup>28</sup> If nothing is between them, units are in succession, but points are in touch. If points are separate, a line is between, but separate units may be successive and, in this case, have nothing between them. If so, the message is a negative one: The definition of succession is not primarily meant to apply to points.

In sum, the mathematical examples in *Phys.* V 3 pertain to succession only. None of them pertains to continuous connection. Glasner's remark, as quoted above, is misleading. She should have said that, as a rule, Aristotle's examples in *Phys.* V 3 are physical, but in one of the cases, succession, he uses mathematical examples as well.

3.1.4. The definition of continuous connection offered in the sequel is this.

**T14.** An item is contiguous when it is next in succession and in contact. Continuity (*to suneches*) is a special case of contiguity: I say there is continuous connection when the limits of each, by which they are in contact, have become one and the same and are, as the word implies, kept together: which is impossible if the extremities are two.<sup>29</sup>

<sup>27</sup> *Phys.* V 3.226b34-227a3: ἐφεξῆς δὲ οὐ μετὰ τὴν ἀρχὴν | ὄντος ἢ θέσει ἢ εἶδει ἢ ἄλλω τινὶ οὕτως ἀφορισθέντος | μηδὲν μεταξύ ἐστὶ τῶν ἐν ταύτῳ γένει καὶ οὐ ἐφεξῆς ἐστὶν | (λέγω δ' οἷον γραμμὴ γραμμῆς ἢ γραμμαί, ἢ μονάδος μονάδας ἢ μονάδες, ἢ οἰκίας οἰκία· ...) (tr. ROT, modified)

<sup>28</sup> See Waschkies (1977) pp. 221 ff. (particularly pp. 231-2).

<sup>29</sup> *Phys.* V 3.227a6-7, 10-13: ἐχόμενον δὲ ὃ ἂν ἐφεξῆς | ὄν ἄπτηται. <sup>(a10)</sup> τὸ δὲ συνεχές ἐστὶ μὲν ὅπερ ἐχόμενον τι, | λέγω δ' εἶναι συνεχές ὅταν ταύτῳ γένηται καὶ ἐν τὸ ἑκατέρου | πέρασ οἷς ἄπτονται, καὶ ὥσπερ σημαίνει τοῦνομα, συνέχηται. τοῦτο δ' οὐχ οἷον τε δυοῖν ὄντων εἶναι τοῖν ἐσχάτων (tr. ROT, modified).

The crucial concepts involved in this are becoming and activity: limits *become* one and, thereby, acquire a *causal* role in the connection. In the sequel, Aristotle leaves no doubt that this is not just a matter of metaphor, as it arguably is in T7-T10. – An addition to T14 distinguishes natural from artificial unity and explains what they have in common.

**T15.** This definition makes it plain that continuity belongs to things from which a unity is naturally created (*pephuke gignesthai*) at their junction. And in whatever way that which keeps them together becomes (*gignetai*) one, so too will the whole be one, e.g., by nail or glue or contact (i.e., fit and/or clamp) or ongrowth.<sup>30</sup>

The distinction (which *Metaph.* Δ 6 brings out more clearly, see T17 below) is again in terms of becoming. Examples of artificial unity are described by the causal factor which accounts for the unity and which in all three cases may be assumed to reside at the junction of the parts:<sup>31</sup> evidently so in the case of the glue, whereas both nail and clamp need fitting surfaces to fix the parts in their relative positions. By contrast, “ongrowth” (*prospuomai / prospubusis*) is a technical term adopted by Aristotle from medicine.<sup>32</sup> Aristotelian examples include: the embryo, cord, and egg, in the uterus;<sup>33</sup> inner and outside parts of the animal body;<sup>34</sup> univalves on a rock;<sup>35</sup> the cohesion of materials.<sup>36</sup> More examples may be adduced from the use of *prospuēs* and

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<sup>30</sup> *Phys.* V 3.227a13-17: τούτου | δὲ διωρισμένου φανερόν ὅτι ἐν τούτοις ἐστὶ τὸ συνεχές, ἐξ | ὧν ἐν τι πέφυκε γίνεσθαι κατὰ τὴν σύναψιν. καὶ ὡς ποτε | γίγνεται τὸ συνέχον ἐν, οὕτω καὶ τὸ ὅλον ἔσται ἐν, οἷον ἦ | γόμφω ἢ κόλλῃ ἢ ἀφῆ ἢ προσφύσει (tr. *ROT*, modified). – I am taking *kata* (a15) in the local sense, but a causal sense cannot be ruled out (on which see footnote 31 below). Concerning “by ... contact” (*baphē*, a17) see Simplicius, *In Phys.* 878.20-21: “by fitting together like a ship” (tr. Urmson).

<sup>31</sup> The *ROT* takes *kata* (227a15) in the causal sense. If this is correct, the causal claim is explicit in T15. Otherwise, inspection of the examples must do.

<sup>32</sup> [Hippocrates], *Artic.* 41 and 45; *Epid.* VII 1, 57 and 92; *Morb.* IV 17 (48 L.) and *passim*; cf. *prospephuka* at *Epid.* II 4, 1 and *passim*. Diogenes of Apollonia, DK 64 B 6 (VS II, 64.1).

<sup>33</sup> *Metaph.* Δ 4.1014b22; cf. *GA* II 7.745b24 and b33-33a; *GA* III 3.754b12 ff. and *passim*.

<sup>34</sup> *HAI* I 17.496b29; *HAI* III 9.517a21; *Inc.* ch. 16.

<sup>35</sup> *PA* IV 4.679b23; cf. *GAI* .715a17.

<sup>36</sup> *Meteor.* IV 9.377a3.

*prosphus* in Homer: a bench is “attached” to a chair, Odysseus is “attached” like a bat to a tree, and Hekabe wishes to devour Achilles’ liver, “attached to it.”<sup>37</sup>

In the sequel, the “genetic” account (*kata tēn genesin*) equates continuous connection with “natural unity” (*sumphusis*) resulting from “growing together” (*sumphuomai*):

**T16.** So natural union is last in coming to be; for the extremities must necessarily come into contact if they are to grow together; but things that are in contact are not all grown together, while where there is no contact clearly there is no natural union either.<sup>38</sup>

Examples of *sumphusis* include liquids (see T6 above), but *sumphuomai* / *sumphusis* is mainly a more or less technical term with applications in (comparative) anatomy,<sup>39</sup> embryology,<sup>40</sup> and medicine.<sup>41</sup> There is also a prehistory of the term in Empedocles, with connotations from botany,<sup>42</sup> to which, however, Aristotle does not seem to allude.

In *Phys.* V 3, there is nothing to suggest that the account of continuous connection is meant to apply to linear continua such as path, motion, and time. The transfer to the latter realm is confined to a section of *Phys.* V 4 (228a20-b11, see T9 and T10 above), and to the beginning of *Phys.* VI (see T19 below). In both cases, the shorthand indicating the account in V 3 is **Conn.**<sup>43</sup>

<sup>37</sup> My “attached” corresponds to *prospheu*’ = *prospheua* at *Od.* XIX 58, *prosphus* at *Od.* XII 433, and *prosphusa* at *Il.* XXIV 213. – Note that *phu-* connotes firm connection rather growth here.

<sup>38</sup> *Phys.* V 3.227a23-27: ὥστε ἢ σύμφυσις ὑστάτη κατὰ τὴν γένεσιν· ἀνάγκη γὰρ ἀψασθαι εἰ | συμφύσεται τὰ ἄκρα, τὰ δὲ ἀπτόμενα οὐ πάντα συμπέφυκεν· ἐν οἷς δὲ μὴ ἔστιν ἀφή, δῆλον ὅτι οὐκ ἔστιν οὐδὲ | σύμφυσις ἐν τούτοις (tr. *ROT*, modified).

<sup>39</sup> Paired limbs connected at the spine: *Inc.* 6.706b26; similarly, [*Hippocrates*], *Art.* 34, IV 154.12 L. etc.; *Fract.* 37, III 542.4 L. In cycads, mouth and tongue are grown together to form a sucking tube (*PA* IV 5.682a20). Similarly, beaks may be imagined as being formed from teeth (*PA* II 16.659b24). See Kullmann (2007) p. 660 and p. 479, respectively.

<sup>40</sup> See, e.g., *GA* IV 4.769b33, 773a3, etc. on the formation of monstrosities.

<sup>41</sup> See, e.g., *HA* III 515b19 where *ou sumphuetai* indicates that a cut does not heal. Similarly, [*Hippocrates*], *Fract.* 24, III 496.4-5 L. and *Art.* 14, IV 120.1 L.

<sup>42</sup> DK 31 B 26.7/9: *sumphuomai* / *diaphuomai*. Similarly, B 17.7/10 etc.; B 95. Clearly, the description of the elements as “roots” (*rhizōmata*, B 6.1) connotes herbally.

<sup>43</sup> In T10, “has been established” (*keitai*, 228a29), may refer to T14, but the final clause in T9 (... *hosōn hen ta eschata*, 228a23-24: “... of which the extremities are one”) would also do.

### 3.2. *Metaph.* Δ 6 and I 1

Again, continuity is clearly conceived as continuous connection. The relevant passage in *Metaph.* Δ 6 is this.

**T17. (1)** Of things called one in their own right some are so called because they are continuous, e.g. a bundle by a band, and pieces of wood by glue; and a line, even if it is bent, is called one if it is continuous, as each part [of the body] is, e.g. a leg or an arm. Among these, what is the continuous by nature is more one than what is continuous by art. **(2)** A thing is called continuous whose movement in its own right is one and cannot be otherwise; and the movement is one when it is indivisible, i.e., temporally indivisible. And those things are continuous in their own right which are one not [sc. merely] by contact.<sup>44</sup>

To the account in *Phys.* V 3, four claims are added. (i) Continuity is a special case of oneness; (ii) kinematic unity is the mark of continuity; (iii) the bundle is an example; (iv) continuity admits of degrees of oneness: what is continuous by nature is more one (*mallon hen*, a4) than what is continuous by art. The crucial addition, that kinematic unity is the mark of continuity, is evidently confirmed by the examples adduced in T15: nail, glue, fit (and/or clamp), and ongrowth. It is quite a safe guess that the accounts of continuity in *Phys.* V 3 and in *Metaph.* Δ 6 complement each other.

In *Metaph.* I 1, still another amendment is (v) the distinction between kinematic unity (i.e., continuity in the sense of T17) and unity “in account” (*ton logon*). In the relevant passage (1052a16-b1), four meanings of ‘one’ are distinguished: “the naturally continuous, the whole, the individual, and the universal” (a34-36), which reduce to two cases as follows.

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<sup>44</sup> *Metaph.* Δ 6.1015b36-1016a7: τῶν δὲ καθ’ ἑαυτὰ ἐν λεγομένων τὰ μὲν λέγεται τῷ<sup>(a1)</sup> συνεχῆ εἶναι, οἷον φάκελος δεσμῷ καὶ ξύλα κόλλῃ· καὶ γραμμῆ, καὶ κεκαμμένη ἤ, συνεχῆς δὲ, μία λέγεται, ὡσπερ καὶ τῶν μερῶν ἕκαστον, οἷον σκέλος καὶ βραχίον. | αὐτῶν δὲ τούτων μάλλον ἐν τὰ φύσει συνεχῆ ἢ τέχνῃ. |<sup>(a5)</sup> συνεχῆς δὲ λέγεται οὐ κίνησις μία καθ’ αὐτὸ καὶ μὴ οἷον | τε ἄλλως· μία δ’ οὐ ἀδιαίρετος, ἀδιαίρετος δὲ κατὰ χρόνον. | καθ’ αὐτὰ δὲ συνεχῆ ὅσα μὴ ἀφῆ ἐν· (tr. adopting features from *ROT* and Kirwan). “Temporally indivisible” – that is, parts move all at once, not one after another (“i.e.”: *de*, a6). Note that in T17, section (1) is about oneness; only section (2) is explicitly about continuity.

**T18.** And all these are one because in some cases the movement, in others the thought or the account, is indivisible.<sup>45</sup>

Whether T18 denies that unity in account may also feature in **Conn**, be it as a ground of natural unity (*phusei, ibid.*, a20) or as an addition to it, is hard to say. On the one hand, for movements to be continuously connected, sameness in account (which secures that the composite whole be one in account) is a requirement according to *Phys.* V 4 and *Phys.* VIII 8.<sup>46</sup> Yet, on the other hand, both *Phys.* V 3 (T14-T16) and *Metaph.* Δ 6 (T17) suggest that the limits of heterogeneous bodies may be one, and the bodies be continuously connected by this.<sup>47</sup> This is just the case with the examples mentioned in T15 and T17. In particular, heterogeneous bodies which share one common limit meet the requirement which in the *Metaphysics* (T17, T18) is the mark of continuity: if the limits are together, but two, the bodies are movable against each other, and the limit of one of them may serve as the place of the other (see T4; note that a place can be left, see, e.g., *Phys.* IV 4.211a2-3); but if the bodies share one common limit, they also share one common place and, hence, neither of them moves without the other moving simultaneously.

Both *Phys.* V 3 and the parallels in *Metaph.* Δ 6 and I 1 attribute continuity to composite wholes which, as a rule, fail to be one in account. Hence, it is quite a safe guess that the cases distinguished in T18 are meant to be disjoint. – It goes without saying that continuity of motion is not at issue in *Metaph.* Δ 6 and I 1. Kinematic unity is the mark of continuity here. But according to Aristotle (*Phys.* V 2.225b13-226a23), movements don't move in any conceivable way.<sup>48</sup> Hence, kinematic unity of movements is a contradiction in terms.

It may be argued that, by contrast, **Divi** presupposes unity (so as to have something to divide), and that unity in account is a strong candidate. The argument would refer to the account of motion in *Phys.* III 1-3 as follows.

<sup>45</sup> *Metaph.* I 1.1052a36-b1: πάντα δὲ ταῦτα ἐν τῷ ἀδιαίρετον εἶναι τῶν μὲν | τὴν κίνησιν τῶν δὲ τὴν νόησιν ἢ τὸν λόγον (tr. ROT, modified). – Note that *logos* (b1) corresponds to *eidos, ibid.*, a23.

<sup>46</sup> *Phys.* V 4.228b2: *tō; eidei* (see T10 above); *Phys.* VIII 8.262a2: *kat' eidos = tō; eidei* (a5) = *tō; logō;* (a21), see footnote 15 above.

<sup>47</sup> See also the remark at *Metaph.* Δ 4.1014b26 that diversity in quality (*kata to poion*) is compatible with having grown together (*sumpephukenai, ibid.*, b25).

<sup>48</sup> Except per accidens (*Phys.* V 2.226a19-23), which no option here.

Aristotle's definition of motion – “fulfilment (*entelecheia*) of the thing which is potentially [sc. in the final state] qua such [i.e., qua being potentially in the final state]” (ch. 1.201a10-11) – refers to a final state which, in general, is specified externally as follows. Next to the thing moved (*to kinoumenon*), there is also a mover (*to kinoun*) which “will introduce a form” (*eidōs ti oisetai*) which, in turn “will be the principle and cause of the movement” (ch. 2.202a9-11). Insofar as the movement derives its unity from that form, it is one “by form” (*eidēi*) and hence “in account” (*ton logon*).

#### 4. Continuity in *Phys. VI* 1-2

In *Phys. VI* 1, **Conn** is the just a starting point, to be dismissed as a definition of continuity after **Divi** is derived in the middle of the chapter (231b16, see T25 below). In the rest of the book, Aristotle's account of continuity is in terms of **Divi** rather than **Conn**.

##### 4.1

The first part of *Phys. VI* 1 (up to 231b18) is quite a mess. Leaving a fuller discussion to another occasion,<sup>49</sup> I will confine myself to a proposal and some sketchy remarks. – The opening sentence refers **Conn** back to *Phys. V* 3.

**T19** (>T2). If continuous[ly connected], in contact, and next in succession are these, as defined earlier,

- continuous[ly connected]: items of which the extremities are one,
  - in contact: items of which [the extremities] are together,
  - next in succession: items with nothing of the same genus between,
- something continuous cannot be composed of indivisible items, e.g., a line of points, if indeed the line is [something] continuous, and the point is [something] indivisible.<sup>50</sup>

The statement in T19 of the theorem that “a continuum (*ti suneches*) cannot be composed of indivisibles” (a24) leaves it open (a) what a continuum is, and (b) what it is to be composed of something.

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<sup>49</sup> See my introduction and notes in Heinemann (forthcoming).

<sup>50</sup> *Phys. VI* 1.231a21-26: Εἰ δ' ἐστὶ συνεχὲς καὶ ἀπτόμενον καὶ ἐφεξῆς, ὡς | διώρισται πρότερον, συνεχῆ μὲν ὧν τὰ ἔσχατα ἓν, ἀπτόμενα δ' ὧν ἅμα, ἐφεξῆς δ' ὧν μηδὲν μεταξύ συγγενές, | ἀδύνατον ἐξ ἀδιαίρετων εἶναι τι συνεχές, οἷον γραμμὴν ἐκ | στιγμῶν, εἴπερ ἢ γραμμὴ μὲν συνεχές, ἢ στιγμὴ δὲ ἀδιαίρετον.

**Ad (a).** The definition offered at the beginning (a22) does not apply since in both the theorem (a24) and the subsequent example, “continuous” (*suneches*) is a one-place predicate whereas the definition is of a two-place predicate (viz. **Conn**). Aristotle nowhere explains the former in terms of a latter.<sup>51</sup> The example is all he offers: lines are continua, and points are indivisibles. In order to make sense of the sequel (231a26-b18), it is wise to assume Aristotle is talking just about lines and points (or periods and instants, b6 ff.), but not about continua in general.

**Ad (b).** I propose that a parallel passage in *GC I 2* may be adduced which requires that composition be of, and division be into, contiguous parts:

**T20.** ... for point is not contiguous with point. But this [i.e., into or out of contiguous items, respectively] is division or composition.<sup>52</sup>

As a consequence, both composition and division are at a point which is the common limit (*eschaton*, 232a22) of the parts (or at a junction where the limits coincide, if coincidence of points is allowed, cf. T22). Thus, the initial claim (T19) boils down to the observation that a line cannot be composed of points for one of two reasons: either because points are not contiguous, see

**T21.** Neither is it the case that the extremities of the points are one, since the indivisible fails to have both an extremity and a part which is distinct [from the extremity]. Nor is it

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<sup>51</sup> Waschkies (1977, p. 7) claims that “am Anfang von *Phys.* VI 1”, Aristotle “charakterisiert ... die Kontinua als diejenigen Gesamtheiten, bei denen die Enden benachbart liegender Teilstücke in eins zusammenfallen.” According to Bostock (2006, pp. 161-2), “the (unstated) definition of what a continuum is”, presupposed by the argument at 231a24-b18 is this: “a continuum is anything which (i) can be divided into two parts, and (ii) is such that any two parts into which it is divided must share a limit” – i.e. are continuously connected (GH). Bostock adds that the definition fails to exclude such pathological examples as a half-open interval being continuously connected with its missing edge – which, on the one hand, would beg the question but, on the other hand, is required to save the definition from emptiness (*ibid.*, pp. 162-3). By contrast, I don’t see any definition of a relevant one-place predicate being presupposed here.

<sup>52</sup> *GCI* 2.317a11-12: ... οὐ γὰρ ἔστιν ἐχόμενον σημεῖον σημείου ἢ | στιγμὴ στιγμῆς. Τοῦτο δ’ ἐστὶ διαίρεσις ἢ σύνθεσις. – Following Sedley (2004, p. 78 n. 27), I take *semeion* and *stigmē* to be synonyms: *ē stigma stigmēs* is just a repetition and is skipped in my translation.

the case that the extremities are together, since the partless fails to have an extremity at all; for the extremity and the thing of which it is the extremity are distinct.<sup>53</sup>

or, if points are allowed to be contiguous, because contiguous points are together and therefore fail to make up a line in which points are apart, see

**T22.** Things are in contact either whole with whole, or part with part, or whole with part. Since the indivisible is partless, it must be in contact whole with whole. But what is in contact whole with whole, does not make up a continuum. For a continuum has parts which are distinct from each other and is correspondingly divided into distinct parts which are spaced apart.<sup>54</sup>

As an aside, the theorem stated in T19, that “something continuous cannot be composed of indivisible items”, may be also understood in a more general sense: that indivisibles are (i) limits, but (ii) not parts. While (i) is argued for in *Phys.* VI 3, a proof of (ii) is offered in the second half of VI 1 (see below section 4.2).

In the sequel (T23-T25), the leading question pertains no longer to the composition of lines out of points, but to the way in which the points which occur in a line (or the instants which occur in a period of time) are arranged. Atomism considers two kinds of arrangement: succession (i.e., separation by void) and contact. For points (and equivalently, instants), contact was ruled out by T21 and T22. Concerning succession, points (and instants) are different from atoms in that between Democritean atoms, there is nothing,

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<sup>53</sup> *Phys.* VI 1.231a26-29: οὔτε γὰρ ἐν τὰ ἔσχατα τῶν στιγμῶν (οὐ γὰρ ἐστὶ τὸ | μὲν ἔσχατον τὸ δ' ἄλλο τι μόριον τοῦ ἀδιαίρετου), οὐδ' ἅμα | τὰ ἔσχατα (οὐ γὰρ ἐστὶν ἔσχατον τοῦ ἀμεροῦς οὐδὲν ἕτερον | γὰρ τὸ ἔσχατον καὶ οὐ ἔσχατον). Remark: Democritean atoms are extended and therefore mathematically divisible. Hence, extremities may count as parts in the mathematical sense, whereas the atom is still indivisible in the physical sense. But this distinction does not transfer from physical atoms to points. That's why Aristotle oddly presupposes that (i) extremities are parts (cf. a27: *morion*) and that, equivalently, (ii) something which is indivisible (*to ameres*, a28) admits of no distinction of an extremity from the thing of which it is an extremity. As an alternative, he will assume in T22, that (iii) a point and its extremity are the same.

<sup>54</sup> *Phys.* VI 1.231b2-6: ἀπτεται δ' ἅπαν ἢ ὅλον ὅλου ἢ μέρος μέρους ἢ ὅλου μέρος. | ἐπεὶ δ' ἀμερές τὸ ἀδιαίρετον, ἀνάγκη ὅλον ὅλου ἀπτεσθαι. | ὅλον δ' ὅλου ἀπτόμενον οὐκ ἔσται συνεχές, τὸ γὰρ συνεχές | ἔχει τὸ μὲν ἄλλο τὸ δ' ἄλλο μέρος, καὶ διαίρεται εἰς | οὕτως ἕτερα καὶ τόπων κεχωρισμένα.



whereas in the case of points, “what is between is always a line” (and a period of time between instants) according to Aristotle, see

**T23.** But neither is point successive to point or now to now in such a way that length or time are composed of these. For things are in succession which have nothing of the same genus is between them; but in the case of points, what is between is always a line, and in the case of nows, [a period of] time.<sup>55</sup>

On the one hand, points are in succession, iff no points are between. As a consequence, the line which separates a point from its successor must be indivisible. For T20 requires that division be at a point, and that at every point there can be a division. Hence, on the other hand, a line in which the points are in succession must be composed of the indivisible lines between those points, see

**T24.** Further [if length and time are composed of successive points or nows, respectively (b6-8)], both would be divided into indivisible parts [i.e. (?), indivisible lines between successive points (b9), or indivisible periods between successive instants (b10), respectively], assuming that each of the two [i.e. length and time] is divided into the items of which it is composed [i.e. (?), the lines or periods between the successive points (b9) or instants (b10), respectively]. But none of the [two (?)] continua were divisible into indivisibles.<sup>56</sup>

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<sup>55</sup> *Phys.* VI 1.231b6-10: ἀλλὰ μὴν οὐδὲ ἐφεξῆς | ἔσται στιγμή στιγμή ἢ τὸ νῦν τῶ νῦν, ὥστ' ἐκ τούτων εἶναι τὸ | μῆκος ἢ τὸν χρόνον· ἐφεξῆς μὲν γὰρ ἔστιν ὧν μηθὲν ἔστι μεταξύ συγγενές, στιγμήν δ' αἰεὶ τὸ μεταξύ γραμμῆ καὶ τῶν | νῦν χρόνος (text: Ross deletes τὸ before μεταξύ, b9). Remark. Aristotle may presuppose here that points and lines (and instants and periods) are same in *genos*, the doctrine that in geometry, dimensions are *genē* (*Top.* VI 6.143b11 ff.; *Cael.* I 1.268b1; *Metaph.* Δ 28.1024b1) being no to the point here. Otherwise, the relevant argument will only follow in the sequel (T24, T25). – See also remark (b) on T25 below.

<sup>56</sup> *Phys.* VI 1.231b10-12: ἔτι διαιροῖτ' ἂν εἰς ἀδιαιρετα, εἴπερ ἐξ ὧν ἔστιν | ἐκάτερον, εἰς ταῦτα διαιρεῖται· ἀλλ' οὐθὲν ἦν τῶν συνεχῶν | εἰς ἀμερῆ διαιρετόν. Remarks: (a) My additions are meant to make sense of the argument. The reference to b6-8 is in Simplicius and Ross. The reference to b9-10 is a tentative proposal of mine. (b) Is “none of the continua ...” (b11-12) a universal statement, as “something continuous ...” (*it suneches*, a24, see T19 above) and “all continua ...” (b16) clearly are? At. b11-12, “none of the two” might make a better sense. But Ar. writes *outhen* rather than *oudeteron*. (c) Where is the argument for the denial of “divisible into indivisibles” (b11-12)? The past tense suggests: earlier. But the argument at a26-b6 is about composition, not division. Note that a relevant argument is offered at b16-18, which draws on a26-b6. Accordingly, I suppose that, again, (T20) applies.

But since the line, which separates a point from its predecessor, and the line, which separates the same a point from its successor, are contiguous, the argument in T21 applies: neither line can be indivisible. In sum, it is thereby demonstrated that the points in a line (and equivalently, the instants in a period of time) are dense rather than successive, and **Divi** is satisfied), see

**T25.** And there can be no other genus between the points and the news. For, otherwise, it is clearly either indivisible or divisible, and if divisible, either into indivisibles or into again and again divisibles. But this [i.e. (?), the line or period between successive points (b9) or instants (b10), respectively] is a continuum. And it is also evident that every continuum is divisible into again and again divisibles – for, if into indivisibles, indivisible is in contact with indivisible, since the extremity of continuous[lee connected] items is one and in contact.<sup>57</sup>

While **Conn** is a principle of composition, **Divi** is a feature which occurs in *analysis*. T24 indicates a stepwise correspondence between *synthesis* and *analysis* (b10-11). But **Divi** entails that *analysis* is never completed and therefore provides no starting point for *synthesis*. That's why *synthesis* via **Conn** fails to fully account for the structure of continua and, in particular, provides no definition of “a continuum” (*ti suneches*, 232a24, T19), see above ad (a).<sup>58</sup> In the sequel, Aristotle's account of continuity is in terms of **Divi** (*analysis*) rather than **Conn** (*synthesis*).

I have offered quite a benevolent interpretation of *Phys.* VI 1.231a21-b18 (i.e., T19-T25). If, as I believe, my proposal is consistent with the text, Aristotle's argument in the initial section of *Phys.* VI is still hard to follow but not hopelessly confused. But the real stuff is yet to come. I will confine myself to the isomorphism exhibited in the second part of ch. 1 (231b18 ff.)

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<sup>57</sup> *Phys.* VI 1.231b12-18: ἄλλο δὲ γένος οὐχ οἶόν τ' εἶναι μεταξύ | τῶν στιγμῶν καὶ τῶν νῦν οὐθέν. εἰ γὰρ ἔσται, δῆλον ὡς ἦτοι | ἀδιαίρετον ἔσται ἢ διαίρετόν, καὶ εἰ διαίρετόν, ἢ εἰς ἀδιαίρετα ἢ εἰς αἰεὶ διαίρετά· τοῦτο δὲ συνεχές. φανερόν δὲ καὶ | ὅτι πᾶν συνεχές διαίρετόν εἰς αἰεὶ διαίρετά· εἰ γὰρ εἰς ἀδιαίρετα, ἔσται ἀδιαίρετον ἀδιαίρετου ἀπτόμενον· ἐν γὰρ τὸ | ἔσχατον καὶ ἀπτεται τῶν συνεχῶν. Remarks: (a) *de* (“and”, b12) – indicates an additional argument. (b) “another genus” (b12): i.e., a line in which no points, or period of time in which no instants, occur (assuming that lines and points are different in genus, and so are periods and instants). Aristotle seems to assume that lines are divided by points, and periods by instants – which is also suggested by (T20). (c) Note that “divisible into” (b16) = composed of (thus securing that T21 and T22 apply).

<sup>58</sup> According to Sattler (2020) p. 296, definition by **Conn** is therefore nominal (and real only by **Divi**).

and to the expansion of it which informs the argument in the first part of ch. 2 (up to 233a12).

The introduction of the isomorphism at 231b18 (see below T26) amounts to a new start. As *Phys.* V is arguably patchwork (see above 3.1.1), so is the whole of *Phys.* V-VI. The **Conn**+sumphusis account of continuity in V 3 and the **Divi**+isomorphism account in VI 1-2 pertain to distinct classes of phenomena and are, therefore, essentially disconnected.

#### 4.2

The primary topic in *Phys.* VI (from 231b18 on) is motion. – The initial phrase in

**T26.** It is in corresponding ways (*του αυτου λογου*) that path, time, and movement [are] composed of indivisibles, and are divided into indivisibles, or none<sup>59</sup>

indicates that the same *logos* applies to the composition / division of a “magnitude” (*megethos*, b19 – viz., the path of a movement), of the movement, and of the time the movement takes. I disagree with the prevalent rendering of *logos* by “argument” here: *logos* is the proportion or regularity which obtains in the composition / division. The claim that the *logos* is the same for path, movement, and time amounts to claiming that motion establishes an isomorphism between the three.<sup>60</sup> Aristotle’s proof of T26 involves an obvious transfer of structure from path to movement and back (231a21-22, 26-28) and from path to time and back (232a18-22). The description of the transfer involves indivisibles which, however, are not essential to the isomorphism as such. With divisible parts, the construction of the isomorphism

<sup>59</sup> *Phys.* VI 1.231b18-20: τοῦ δ’ αὐτοῦ λόγου | μέγεθος καὶ χρόνον καὶ κίνησιν ἐξ ἀδιαίρετων συγκείσθαι, | καὶ διαιρεῖσθαι εἰς ἀδιαίρετα, ἢ μηθέν.

<sup>60</sup> Similarly, Miller (1982) pp. 102 ff., Newstead (2001) p. 117. But I disagree with Miller in some points. (i) His suggestion (*ibid.*, p. 103) that the isomorphism theorem at 231b18-20 presupposes indefinite divisibility, as stated at 231b16, is misleading. (ii) Miller (pp. 106-9) conflates the refutation of indivisibility for path, movement, and time (231b28-232a17) with the refutation of indivisibility for moving bodies in chap. 10.240b8-241a26. (iii) Miller (pp. 104-6) conflates the part-by-part isomorphism established in ch. 1.231b18-28 and 232a18-22 with the limit-by-limit isomorphism assumed in ch. 2.232a31-b5 (and *passim*) which – in my interpretation – is only secured by a tacit application of the continuity principle (see section 4.3 below).

would be just the same. The essential assumption is that a path is composed of, and divided into, paths (T3),<sup>61</sup> from which it follows that so are motion and time.<sup>62</sup>

The correspondence thus established is between the parts into which path, movement, and time are divided. Differently from both the first half of the chapter and the chapters to follow, points dividing a line (etc.) play no role here. Parts are just parts; the mereological approach is only supplemented by a linear ordering of the parts; hence the movement which establishes the isomorphism must be straightforward, that is, without turns, loops, jumps, and breaks.

It is sometimes assumed that uniformity of motion, so as to transfer metric properties, is another requirement. But metric properties have no role to play here – that is, in most of *Phys.* VI. The “traditional account” (cf. 233a13: *ek tōn eiōthotōn logōn*), which employs uniform motion and the so-called Archimedean property and thus presupposes a time metric, prevails only in the second part of chap. 2 (233a13 ff.) and in chap. 7.<sup>63</sup> Arguably, Aristotle’s innovative (in modern terms: mereotopological) account is motivated by the notorious circularity in the definition of uniformity: motion is uniform iff<sub>DF</sub> equal distances are travelled in equal times; and times are equal iff<sub>DF</sub> the distances travelled by uniform motion are equal. The circularity will be resolved by Aristotle’s account in *Phys.* VIII of the primary movement, which is uniform since its drive is unchanging; in *De caelo*, Aristotle adds that another requirement, homogeneity of the path, is in the case of the

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<sup>61</sup> Aristotle’s notation at 231a22-28 suggest a division into just three parts. But nothing in his argument presupposes that the division is into even a finite number of parts. See my note on 231b20-25 in Heinemann (forthcoming).

<sup>62</sup> Only at *Phys.* IV 11.219a16-19, the transfer of order (*akolouthēin*, a19) is explicitly mentioned and described as an isomorphism (*analogon*, a18).

<sup>63</sup> In both sections mentioned, VI 2.233a13-b32 and VI 7, infinity is at issue. The mereotopological approach which prevails in the rest of *Phys.* VI does not distinguish “unlimited” from “open” – and rightly so since, for instance, the part of a line which is between *A* and *B* satisfies Aristotle’s definition of “unlimited” (*apeiron*, i.e. *hou aei ti exō esti*, *Phys.* III 6.207a1: “part of which is always outside”). Strictly speaking, the distinction is unnecessary for the theorems to be proved in VI 2 (2<sup>nd</sup> part) and VI 7; see, in particular, the corrected proofs in VI 10. But the lack of distinction between “unlimited” and “open” may be confusing. Thus, the “traditional” way of argument appears as a didactic device – which, by the way, Aristotle fails in VI 7 to master (see, e.g., Hasper 2021, p. 57).

celestial motions also met.<sup>64</sup> Aristotle’s final account of uniform motion is devoid of circularity, but unavailable in *Phys.* VI.

Inserted into the proof of T26 is an argument which establishes that neither path, nor movement, nor time are composed of indivisible parts (231b29-232a17). The argument starts with the assumption that every movement involves two successive events: process and arrival.<sup>65</sup> Hence, the time an indivisible movement takes is divided, and so is its path and therefore, the movement which was assumed to be indivisible (231b28-232a11). – Two remarks are in order. (i) The argument described amounts to another proof that instantaneous motion is a contradiction in terms. (ii) On closer inspection, the argument requires that indivisible parts be densely ordered. It fails if, e.g., every indivisible part of the path has an immediate successor. If  $A'$  is the immediate successor of  $A$ , arrival at  $A$  may coincide with the process of moving towards  $A'$ . Think of climbing stairs: to be on the  $n$ th stair is to move to the  $(n+1)$ th stair.<sup>66</sup>

### 4.3

In the sequel, all division of path, motion, and time are by extremities of the parts, as **Conn** requires. Thus, **Divi** takes the form of a claim about points, instants, and intermediate states obtaining at instants. It has been rarely observed that the proof in **Divi** in *Phys.* VI 2 employs a version of the continuity principle which is explicitly stated in *Phys.* VII 4 (T27 below), but only tacitly presupposed in VI 2. Its application in the proof of a preliminary

<sup>64</sup> *Phys.* VIII 10.267b2-6; cf. 6.260a17-19; *Cael.* II 6.288a17-27.

<sup>65</sup> *Phys.* VI 1.231b28-232a1: “Something which moves from one place to another cannot simultaneously be travelling and have completed travelling to the place (*hou*) it travelled when it was travelling. For instance, if something [sic!] walks to Thebes, it cannot simultaneously be walking to Thebes and have completed walking to Thebes. Hence, ...” (εἰ | δὴ ἀνάγκη τὸ κινούμενον ποθὲν ποι μὴ ἅμα κινεῖσθαι καὶ | κεινῆσθαι οὐ ἐκινεῖτο ὅτε ἐκινεῖτο (οἶον εἰ Θῆβαζέ τι βαδίξει, ἀδύνατον ἅμα βαδίξειν Θῆβαζε καὶ βεβαδικέναι | Θῆβαζε), ...) Remark. If  $Z$  is the moving thing and  $A$  is a place on its path, my “process” is the event of  $Z$ ’s moving towards  $A$ , and “arrival” is the event of  $Z$ ’s having arrived at  $A$ . In the sequel, Aristotle emphasizes that  $Z$ , while moving (*hote diē,ei*, 232a3), was neither at  $A$  (*oute dieleluthēi, ibid.*) nor at a place from which it started to move towards  $A$  (*outer ēremēi, ibid.*). – Note that the moving thing is treated as unextended here (and throughout *Phys.* VI.1-3).

<sup>66</sup> See my note on 232a2-4 in Heinemann (forthcoming).

lemma at 232a31-b5, and subsequently in the conversion procedure described at 232b27-233a10, is as follows.

Two runners, *A* faster, *B* slower. That is, Aristotle explains, *A* arrives earlier than *B*.<sup>67</sup> Both *A* and *B* start simultaneously at the point *C* into the same direction; the movement of both is straightforward. When *A* arrives at the point *D*, *B* is not yet at *D*, but will be late (*apoleipsei*, 232a30-31). The crucial step, then, is this.<sup>68</sup> If *FG* is the time it takes for *A* to travel from *C* to *D* (232b1) and, hence, *G* is the instant at which *A* arrives at *D*, Aristotle assumes that there is a point *E*, such that *G* is also the instant at which *B* is at *E* (232a31).<sup>69</sup>

Similarly, in the sequel (note that the period *FG* is defined differently here):

If *FG* is the time it takes for *B* (the slower mover) to travel from *C* to *D* and, hence, *G* is the instant at which *B* arrives at *D* (232b28-29), there is an instant *H* earlier than *G* such that *FH* is the time it takes for *A* to travel from *C* to *D* (232b31). Again, Aristotle assumes that there is a point *K*, such that *H* is also the instant at which *B* is at *K* (232b32-233a1).

The existence of instants *G* and *H* is secured by the assumption that the movements are straightforward and, therefore, for every potential place on its path there is an instant at which it is taken in passing. By contrast, the existence of points *E* and *K* (which again represent places) is a matter of continuity.<sup>70</sup> The relevant argument is indifferent to the way in which the instant *G* (or *H*) is determined. What matters is this (similarly for *H* and *K*).

There are points to which *B* gets earlier than *G*, and points to which *B* gets later than *G*. Since the path is linearly ordered,<sup>71</sup> and the movement is

<sup>67</sup> *Phys.* VI 2.232a28-29: “Faster is what changes first.” (ἄττον ἐστὶν τὸ πρότερον μεταβάλλον.)

<sup>68</sup> *Phys.* VI 2.232a32-33: “In the time [viz., *FG*] it has taken for *A* to get to *D*, let *B*, which is faster, get to *E*.” (ἐν ᾧ γὰρ τὸ *A* γένηται | πρὸς τῷ *Δ* (i.e., ἐν ... τῷ *ZH* χρόνῳ, b1), τὸ *B* ἔστω πρὸς τῷ *E* τὸ βραδύτερον ὄν.)

<sup>69</sup> The passage is discussed by Miller (1982) pp. 105-6, Hasper (2003) p. 214 and Mendell (2007) pp. 16-8. Both Hasper and Mendell fail to address the question of how to secure the existence of divisions or limits. Miller does, but concerning time rather than path.

<sup>70</sup> In modern terms, the existence of *E* and *K* is established by an equivalent to Dedekind’s principle, viz., the intermediate value theorem, being applied to the function which assigns to each place the time at which it is taken in passing.

<sup>71</sup> Remember that “the before and after is first in place”, etc. (*Phys.* IV 11.219a14 ff.).

straightforward, the points of the first class are before the points of the second class. Hence, the continuity principle (T27) secures that there is a point  $E$  such that  $B$  gets to  $E$  at  $G$ .

My reconstruction of the argument corresponds to the version of the continuity principle in *Phys.* VII 4 mentioned earlier:

**T27.** There will be cases in which the circumference is larger than the straight line, and cases in which it is smaller. Hence, there will be also a case in which it is equal.<sup>72</sup>

In order to derive the application in *Phys.* VI 2, replace

- “cases” with  $X$  (i.e., a variable operating on points),
- “the circumference” with: the time it takes for  $B$  to get to  $X$ , and
- “the straight line” with  $FG$ .

In Dedekind’s version (1872/1965, 10 = 1872, 11),

Zerfallen alle Punkte der Geraden in zwei Klassen von der Art, daß jeder Punkt der ersten Klasse links von jedem Punkte der zweiten Klasse liegt, so existiert ein und nur ein Punkt, welcher diese Einteilung aller Punkte in zwei Klassen, diese Zerschneidung der Geraden in zwei Stücke hervorbringt.

all points in the first class are before  $E$ , and all points in the second class are after  $E$  – which, again, entails that  $B$  gets to  $E$  at  $G$ .<sup>73</sup>

As in the second part of chapter 1, the movements involved in the procedure must be straightforward. Since no time metric is presupposed, uniformity of motion is no option. – But it should be noted that only if (i) a time metric is presupposed and (ii) the movements involved are required to be uniform, the application of the continuity principle boils down to the postulation of a fourth proportional.<sup>74</sup>

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<sup>72</sup> *Phys.* VII 4.248a24-25: ἔσται γὰρ μειζων καὶ ἐλάττων ἢ περιφερῆς | τῆς εὐθείας, ὥστε καὶ ἴση.

<sup>73</sup> That the continuity principle is required to fill an alleged gap in the proof of Euclid, *Elem.* I 1 was (in my view, falsely) claimed by Heath (1926) pp. 235-6, 242 etc. But the principle is employed in Bryson’s quadrature of the circle (see Becker 1933, pp. 370 ff.; Mueller 1982, pp. 160 ff.; Hasper 2012, pp. 314-5). Aristotle’s criticism of Bryson’s proof (*SE* 11.71b13-18 etc.; *APo* I 9.75b37-76a3; on which Mueller 1982, pp. 150 ff. and Hasper 2012, pp. 307 ff.) amounts to disputing the value of the principle for geometry – but not, as it seems, for the mathematical account of motion, as in *Phys.* VI 2 and VII 4.

<sup>74</sup> For details and discussion, see again Heinemann (forthcoming).

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MONICA UGAGLIA

**DISCUSSING NATURAL MOTION:  
DEFINITION OF TIME AND VERBAL USAGE  
IN ARISTOTLE**

**Abstract**

Aristotle posits that time, as defined by the “number of motion in respect of before and after” (*Physics* IV 11.219b1-2), is an inherent property of motion itself rather than a prerequisite. This implies the possibility of identifying time-independent properties of natural motions. One such critical feature, crucial to understanding the basic meaning of time, is the presence of an inherent order of before and after within motion, regardless of time. The concept of a non-temporal before and after within motion is now accepted or seriously considered in scholarly discussions. However, it remains one of the most confusing and difficult issues in the interpretation of Aristotle’s conception of time. How can we conceive of motion apart from time? Moreover, how does Aristotle seemingly take this aspect for granted? In order to address these issues, I propose to combine philosophical inquiry with grammatical and mathematical reflections. I will examine the analysis of motion alongside the verbs used to describe it, with a keen focus on aspect. Hence I will draw connections between the relationship of motion and time and that of physical and mathematical objects.

**Keywords**

Aristotle, *Physics*, Time, Motion, Number

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*Introduction*

In a groundbreaking article exploring the intricate relationship between philosophical discourse and grammatical analysis, Philippe Hoffmann delves into the correlation between verb description in grammar and the philosophical understanding of time.<sup>1</sup> Hoffmann’s study revolves around the observation that the grammatical differentiation between verb aspect and tense can be partially traced back to the Stoic philosophers’ examination of time.<sup>2</sup> Consequently, grammatical analysis exerted an influence on Neoplatonic philosophy. In particular this shaped the concept of time, that was defined by Damascius as the “measure of being’s extension (παράτασις)”.<sup>3</sup>

Considering Hoffmann’s standpoint, my intention is to put forth the reconstruction of a “zero” stage, showcasing how verbal aspect influenced the philosophical examination of time before the advent of the Stoics, even before being formalized through grammatical reflection. I especially concentrate on Aristotle’s conception of time and of its aspectual attributes as outlined in the *Physics* – a work that, it should be noted, Damascius identifies as a primary source.

My intention is not to claim that Aristotle’s exploration of time entails a formalization of the rules of the Greek verb; nor that it stems from a deliberate analysis of these rules. Rather, my observation relates to the fact that Aristotle engages in thought and writing within a language that displays sensitivity towards what would later be designated as the aspect of the verb, and that it is valuable to consider this aspect.<sup>4</sup>

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<sup>1</sup> Hoffmann (1983).

<sup>2</sup> *Ibid.*, pp. 2-6. It is worth noting that in this case, the term παράτασις itself, which lies at the heart of the definition, is borrowed from grammar, where it refers to the durative aspect of the verb.

<sup>3</sup> Μέτρον τῆς τοῦ εἶναι παρατάσεως.

<sup>4</sup> This work is heavily influenced by the discussions the author engaged in with Alberto Merzari over the years, especially concerning the aspect of Greek verbs. The idea was first introduced to him in a somewhat muddled state during a time that now feels almost remote. It was only through Alberto’s patient listening and reading, coupled with his remarkable ability to consistently ask the right questions – questions that challenged everything each time – that the idea finally took on a definite shape.

Dealing with research subjects, Aristotle pays special attention to the way they are expressed by ordinary language. As time is inherently connected to motion – it is, by definition, the “number of motion in respect of before and after” – and as language conveys motion through its verbal system, we have good reasons to suppose that the features of the verbal system might have influenced the outcome of the inquiry to some degree. In the subsequent discussion, I will adopt this assumption as a working hypothesis and explore its implications.<sup>5</sup>

My intention is to show how recognizing the significance of the aspectual component can help address some of the interpretive challenges associated with Aristotle’s conception of time. I especially refer to the fact that, according to Aristotle, time is a quality inherent in natural motion and not a prerequisite for it: ontologically, motion “precedes” time.

This implies that some attributes of motion, and some verbal aspects which are used to depict motion, do not depend on time. One of these attributes, one which is crucial to understand the very definition of time, is the inherent order of before and after within natural motion: this order is irrespective of time, as Aristotle says.<sup>6</sup>

The need to establish a non-temporal, or pre-temporal, concept of before and after within motion is currently acknowledged and extensively explored in scholarly works.<sup>7</sup> However, it still stands as one of the most

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<sup>5</sup> The relationship between language structure and Aristotle’s thinking has been and continues to be a subject of extensive debate. Given the ongoing nature of the discussion and the diversity of viewpoints, there are various working hypotheses that can be considered. The conclusions reached in this article are heavily influenced by the premise I have chosen to embrace and the specific position I adopt within the previously mentioned debate. For further insights on this matter, I recommend exploring the writings of Benveniste (1966), as well as the works of Wieland (1985) and Graham (1980), which provide valuable perspectives.

<sup>6</sup> I focus on natural motions, or rather, natural changes, as these alone constitute the subject matter of Aristotle’s physics. It is through them that we can truly grasp the essence of temporal structure, although this framework can also be extended to encompass other types of motion (as well as states and objects, see Section 3.3). Just as Aristotle uses the example of a sculptor shaping a statue to shed light on certain aspects of the theory of the four causes, even though it is not a natural example, he occasionally employs non-natural movements, like traveling from Athens to Thebes, to clarify certain aspects of the relationship between time and motion. It is important to recognize the strictly analogical role they play.

<sup>7</sup> For a more focused analysis, I recommend exploring White (1992), where the concept of “before and after” is described as a “directed linear dimension.” More recent contributions,

enigmatic and perplexing aspects of Aristotle's understanding of time. How can we conceive of motion separately from time? Moreover, how could Aristotle seemingly treat this notion as almost self-evident?

To tackle these inquiries, my proposition is to merge philosophical investigation with grammatical reflections. We can shed light on these questions by juxtaposing the analysis of motion with the linguistic elements used to convey it. Indeed, the primacy of motion over time is more readily embraced when situated within the framework of ancient Greek, a language in which the verb, as the vehicle for expressing motion, exhibits a heightened sensitivity to what we now refer to as the aspect.<sup>8</sup> However, the distinction between the concept of time and the order of motion may pose greater

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such as Coope (2005) on "before and after," Roark (2011) on "kinetic order," and Sentesy (2018) on "precedence structure," shed light on the topic. Referring specifically to Sentesy (2018), who revisits and comments on the earlier authors (except for White 1992, whose positions are, nonetheless, quite similar to those presented by Sentesy), it is important to note that I will deviate from the interpretation offered on two key points. Firstly, I disagree with the notion that Aristotle's definition refers solely to duration, specifically as a unit of measurement for the duration of motion. Sentesy (2018, p. 283) argues that "a unit of time is an extent that we abstract from a particular motion by marking off that motion," aligning with White (1992, p. 78), who suggests that "a time is an interval of motion that is limited or bounded in the prior and posterior 'direction' and is considered as a quantitative unit by which motion can be measured." In both cases, the "now" (*νῦν*) delineates and determines time in this sense. Counting the "nows" effectively involves measuring the units. While White acknowledges that Aristotle recognizes both metric and topological senses of time (a "continuous manifold of time"), Sentesy argues that the metric sense is the only one Aristotle employs. Essentially, according to Sentesy (pp. 282-3, 294-305), an object's extension coincides with (and is exhausted by) its measure. In the following discussion, I will endeavor to show that just as extension encompasses more than a specific quantity (e.g., a measured length of 7 meters), time also extends beyond a precise quantity (e.g., a measured duration of motion). Like extension, time is distinct from the measure of motion (although inseparable from it). To illustrate this, I will contrast the traditional interpretation of mathematics as abstraction with an interpretation based on "subtraction."

<sup>8</sup> I do not intend to dive into the extensively debated question of how aspect is formally expressed in Greek grammar and its possible dating. Instead, I would like to focus on the fact that the Greek verbal system exhibits certain characteristics, known as aspectual features in modern linguistic analysis, which are distinct from tense. For a deeper understanding of the relationship between aspect and tense in the Greek verbal system, I recommend consulting works such as Duhoux (1995, 2000), Rijksbaron (1989, 2011), and Boas et al. (2019). The issue of formalizing aspectual features is discussed in Lallot (1985) and Eco Conti (2009). Additionally, the presence or absence of aspectual categories among the Stoics is a topic explored in Manetti (2022).

challenges in our modern languages, where verbs predominantly signify time and have become less attuned to aspect in many cases.

Building upon this perspective, I will introduce a second assumption, concerning Aristotle's stance on mathematics and the interplay between mathematics and physics.<sup>9</sup> Specifically, I am referring to the fact that Aristotle believed mathematical objects do not exist separately from physical objects, but rather are derived from them through subtraction. For example, three-dimensional extension is always associated with a physical body and does not exist independently as what we would call space. It is not unreasonable to assume that just as Aristotle did not require a self-subsistent space to accommodate objects, he also did not need a self-subsistent time to accommodate movements.

In Section 1, I will investigate the concept of natural motion itself, exploring it as an undivided and purpose-driven whole. I will also discuss its connection to the structure of the present, along with the related ideas of *paratasis* and extended present.

Moving on to Section 2, I will follow Aristotle's logical path and demonstrate how we can uncover an internal structure within natural motion that is logically ordered but distinct from both motion and time. This structure, referred to by Aristotle as "the before and after in motion," will be referred to as the "successiveness" of motion.<sup>10</sup> I will also link it to the grammatical notion of the perfect tense and to the concept of the "now" as the boundary between what came before and what comes after, without any extension. Additionally, I will examine the relationship between motion and "successiveness" in the context of physical and mathematical objects.

Section 3 will focus on the interplay of the successiveness of different motions, leading to the commonly understood notions of time, number and "now" as the boundary between past and future. I will also explore the use of

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<sup>9</sup> The nature of mathematical objects is also subject to extensive debate, and various interpretations are possible, particularly due to the limited passages in which Aristotle directly addresses the topic. The interpretation I adopt in this work is discussed in Ugaglia (2017). The issue of mathematics in Aristotle is addressed in Mueller (1970), Lear (1982), Cleary (1995), and Mendell (2008).

<sup>10</sup> The term "successiveness" suggests the relationship that this structure shares with the notion of transition to the next in mathematical logic.

the perfect tense to denote temporal significance and contrast the unextended punctual “now” with the extended present. Furthermore, I will connect the unextended “now” to the definition of time as a number and the extended present to the notion of measurement.

Section 4 concludes discussing the unresolved question of the objectivity of time.

### *1. Movement without Time*

The notion of movement underlying classical physics is fundamentally different from Aristotle’s conception of movement,<sup>11</sup> and it ultimately boils down to a trajectory in space,<sup>12</sup> which presupposes not only the notion of space but also that of time.

In contrast, a natural movement as understood by Aristotle cannot be reduced to a trajectory alone. It encompasses more than just a trajectory; it has an essence beyond that. This is a crucial point for understanding the relationship between movement and time. For Aristotle, time is not a precondition but a property of movement, something that, as we shall see, relates to the “mathematical skeleton” of a natural movement.

It is immediately evident from the definitions themselves that, for Aristotle, time comes after movement in both logical and ontological senses. The definition of time includes the notion of movement – time is the *number of movement in respect of before and after*<sup>13</sup> – while the definition of movement – movement is the *actuality of what is potentially as such*<sup>14</sup> – does not in any way refer to time.<sup>15</sup>

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<sup>11</sup> I translate the term “κίνησις” as “movement,” which Aristotle uses in Books III and IV of the *Physics* to denote change in its broadest sense. Elsewhere, he uses the term “μεταβολή,” reserving “κίνησις” for change that does not involve substance. As mentioned in n. 6 above, I am referring to natural changes specifically.

<sup>12</sup> More accurately, we can say that motion can be described as a trajectory within a phase space.

<sup>13</sup> τοῦτο γὰρ ἐστὶν ὁ χρόνος, ἀριθμὸς κινήσεως κατὰ τὸ πρότερον καὶ ὕστερον (*Phys.* IV 11.219b1-2).

<sup>14</sup> ἢ τοῦ δυνάμει ὄντος ἐντελέχεια, ἢ τοιοῦτον, κινήσις ἐστὶν (*Phys.* III 1.201a10-11). The definition is then reformulated in terms of the movable and the mover: “the actuality of the movable qua movable” (ἐντελέχεια τοῦ κινητοῦ, ἢ κινητόν) or “the actuality of the movable by the mover” (ἐντελέχεια γὰρ ἐστὶ τοῦτου ὑπὸ τοῦ κινητικοῦ).

<sup>15</sup> For further discussion on this matter, see Roark (2011) pp. 80-1.



Based on this latter definition, in the following two Sections, I will highlight certain aspects of Aristotle's treatment of movement that are essential for the subsequent investigation of time.

### *1.1 Movement as a Relation between Mover and Movable*

Aristotle defines movement in terms of actuality (*εντελέχεια*): movement is the actuality of the movable insofar as a movable, meaning insofar as it is moved by a mover.<sup>16</sup> The mover possesses the actual form that the movable has only potentially. Thus, there is a hierarchy or, if you will, an ordering relationship between the mover and the movable, where the movable, or the privation of form, precedes the mover, or the possession of that form or purpose. However, as long as a natural movement is understood as a state of relation between the movable and its mover, this order does not manifest itself. Movement is a whole, undivided and indivisible, in which the privation and possession of form coexist.

This actuality, referring to the condition of relation between a movable object and its mover, is perceived by us as a process. In this perspective, the mover remains in the background, and movement appears to us as "something" encompassed between an initial state and a final state of the movable object.<sup>17</sup> Let us call the initial state A, which corresponds to the movable in a state of privation of form, and let us call the final state, now the purpose of the movement,  $\Omega$ , which corresponds to the moved object in a state of possessing the form.

The same hierarchy that connects the movable object (privation of form) and the mover (possession of form) in a relational perspective also connects the initial state of the movable object and the final state in a processual perspective. We can therefore say that, from a purely ontological

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<sup>16</sup> *εντελέχεια* τοῦ κινητοῦ, ἢ κινητόν (*Phys.* III 1.202a7-8) *εντελέχεια γὰρ ἐστὶ τούτου ὑπὸ τοῦ κινητικοῦ* (*Phys.* III 1.202a14).

<sup>17</sup> Although the mover may not be explicitly mentioned, it remains an indispensable element in Aristotle's understanding of motion. Even when examined from the perspective of the movable object, motion is shaped by its connection to a mover that brings forth the actualization of form and the purpose behind the motion. The significance of the mover's presence is explored in Aristotle's *Physics* III (where motion is defined), IV, and VIII. The issues arising from the omission of the movable-mover relationship in the definition of motion are discussed in Ugaglia (2016).

point of view, even the beginning and end of a natural movement are in a specific ordering relationship: A comes before, Ω comes after, and the movement, let us call it m, is what lies in between. However, this order is internal to the action, an order we can call teleological, and it reflects, at the level of individual movement, the teleologically oriented structure of Aristotle's cosmos. This order is not (yet) related to time.

According to Aristotle, the before and after are primarily in place, then in movement, and finally in time.<sup>18</sup> This clarification is crucial: without an external orienting structure to refer to – specifically when interpreting movements not within Aristotle's cosmos but within the space of our physics – it would be impossible to understand the before/after of movement independent of that of time. This would render the definition of time inevitably circular.<sup>19</sup> The same holds true when considering any type of movement, not just natural ones. In such cases, the concept of before/after becomes solely a matter of relative position – that is, of geometry – rather than an absolute one as seen in the context of natural movement.

Let us not forget that for Aristotle, place is not a geometric entity but a physical object. It is the surface of separation between two physical bodies that are part of the cosmos. However, the cosmos is oriented, and consequently, so are the places: the low, or center, is the place of heavy bodies, while the high, or periphery, is the place of light bodies.<sup>20</sup> This allows for the establishment of an absolute ordering relationship and enables us to

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<sup>18</sup> τὸ δὴ πρότερον καὶ ὕστερον ἐν τόπῳ πρῶτόν ἐστιν. ἐνταῦθα μὲν δὴ τῇ θέσει· ἐπεὶ δ' ἐν τῷ μεγέθει ἔστι τὸ πρότερον καὶ ὕστερον, ἀνάγκη καὶ ἐν κινήσει εἶναι τὸ πρότερον καὶ ὕστερον, ἀνάλογον τοῖς ἐκεῖ. ἀλλὰ μὴν καὶ ἐν χρόνῳ ἔστιν τὸ πρότερον καὶ ὕστερον διὰ τὸ ἀκολουθεῖν αἰεὶ θατέρῳ θάτερον αὐτῶν (*Phys.* IV 11.219a14-19). The order of the cosmos plays a direct role in determining the before/after of local motion, but it also indirectly influences the before/after of other types of motion. Here, the order is not established between the beginning and the end as locations within the cosmos, but rather between the movable object and the mover as physical entities belonging to the cosmos, and thus linked by an ontological ordering relationship.

<sup>19</sup> The definition of motion exhibits a similar circularity when attempting to interpret potentiality solely in terms of the potentiality of the movable, disregarding the role of the mover.

<sup>20</sup> According to Aristotle, a place is not a portion of space, nor is it merely a surface located within space. It is always the boundary of a body, much like how an extension is always the extension of a body. For more insights on this topic, see Section 2.1 below.

interpret movements naturally occurring in the cosmos as movements which are always oriented, regardless of temporal considerations.<sup>21</sup> There is a hierarchy among the physical substances that constitute the cosmos, and that means there is a hierarchy among the mover/movable pairs that define a movement in a relational sense. Consequently, there is a hierarchy among the places in the cosmos, and that means there is a hierarchy among the purpose/initial pairs that characterize a natural movement in a processual sense.

### *1.2 Movement and the Structure of the Present*

It is interesting to note how this type of internal, non-chronological order within movement is naturally expressed in the Greek verbal system through what grammarians would call aspect. In the words of Yves Duhoux:

Il importe de ne pas confondre les notions de début – milieu – fin du procès, qui ressortissent à l'aspect, avec celles de procès passé – actuel – à venir, qui sont du domaine de la temporalité. La temporalité établit une relation chronologique entre le procès et un point de repère *extérieur* à ce dernier: l'action est présentée comme antérieure – contemporaine – postérieure à ce point de repère. L'aspect, par contre, établit un rapport entre le procès et les trois phases principales *de son propre développement* (début – milieu – fin). Il ne suppose intrinsèquement aucune temporalité extérieure au procès et est donc indépendant de la localisation chronologique de l'action.<sup>22</sup>

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<sup>21</sup> On the other hand, Roark (2011) pp. 80-101, proposes to arrange places based on movements. To do so, he introduces the distinction between telic properties and plastic properties (pp. 67-71) and describes the inherent directionality of movement as kinetic order (p. 93). Similarly, Senteny (2018) pp. 289-94, while initially appearing to accept that the before/after primarily resides in the cosmos, later seeks to demonstrate that magnitude is oriented by leveraging the orientation of movement itself (“What establishes the orientedness of a magnitude? [...] here, I aim to show, orientations derive from movement”). Movement derives its order from the movable, so that the before/after aligns with the potentiality of the movable (p. 292). This interpretation is acceptable, in my view, only if we replace the potentiality of the movable with the relationship between (the potentiality of) the movable and (the actuality) of the mover (see nn. 17-19 above for further details).

<sup>22</sup> Duhoux (2000) §123 (Author's original italics). Building on Duhoux's work, I use the term “aspect” to describe the morphological representation of the unfolding of a process: “Toute action peut être envisagée du point de vue de son *développement*, c'est à dire de la succession de phases diverses par lesquelles on peut se représenter son déroulement. Il est possible de considérer ce développement de multiples façons. On songera d'abord à trois étapes très évidentes de son évolution: début-milieu-fin. Cette tripartition s'applique de manière claire dans les verbes transformatifs” (§122).

In particular, the unfolding action is expressed by the verb in the present tense (or imperfect tense: imperfective aspect).<sup>23</sup> The present tense highlights the fact that the subject is in a certain state: if we consider the movement from a relational perspective, it is in relation to a mover; if we consider it from a processual perspective, it's situated between an initial and a final state. What matters is that we are describing the movement as observed “from within,” solely in terms of being prior to the purpose and in relation to it: I am growing (I am in the process of growing), the fruit was ripening (it was in the process of ripening), the pupil is learning (he is in the process of learning) and so on.

Although the beginning and the end have an order, just like the movable and the mover, what comes in between does not have that order, or at least not at this level of discourse. When expressed with an imperfective verb, the movement is considered as a whole: even if there is an internal order within the action, it is not explicitly stated. I will employ the locution “structure of the present” to refer to this level of discourse – that is, movement understood as a relationship and described as an indivisible whole, encompassing a beginning and an end and expressed in the present tense (or imperfect tense). It is clear that in this case, the present, in which I say “I am walking now,” does not refer to a specific instant (*νῦν*) but to an interval of movement,<sup>24</sup> what the Stoics called the “extended present” (*ἐνεστῶς παρατατικός*).<sup>25</sup>

This is the everyday present, but what does it mean to assert that something is happening “now”? What is the relationship between the present and the now (*νῦν*)?

### *1.2.1 Present and Now*

When we talk about movement from an internal perspective, referring to an action in its unfolding, we employ a present tense verb to indicate the

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<sup>23</sup> If not specified otherwise, I use the terminology proposed by Boas et al. (2019). For a more detailed discussion on the perfective aspect, see pp. 405-6.

<sup>24</sup> In *Phys.* VI 3 Aristotle shows that if the “now” is taken in its proper sense of a punctual limit, a phrase like “I am walking now” has no meaning. For saying that something is walking, or its moving in general, we need two nows. See n. 65 below.

<sup>25</sup> The term *παρατατικός* can also be translated as “continuative” or “imperfect,” and according to the Stoics, it denotes a contrast with the *συντελεστικός* (perfect, complete) aspect. For a discussion on the extended present and the extended past (*παρωχημένος παρατατικός*) within this perspective, see Hoffmann (1983).

relational state between the object in motion and its mover, capturing the movable object's condition of "being somewhere" before its purpose, regardless of the specific location. The term "now," used in this context, signifies this "extended" condition.

However, the situation changes when we shift our attention from the internal perspective of movement to the external observation of it. Let us imagine ourselves at the end of the action, at the extreme  $\Omega$ , and observe the movement. In this scenario, it is natural to employ a verb in the perfect (or pluperfect) tense, utilizing aspect to emphasize not the ongoing action, but rather the outcome or effect that has been achieved through its completion. The present tense and perfect tense are not distinguished according to chronological differences, but rather by their focus on different aspects of the same action: the present tense emphasizes the ongoing process, while the perfect tense denotes the fulfillment of the intended purpose. If we use the perfect tense in this context, the term "now" refers to a punctual state that aligns with the culmination of the movement at the extreme  $\Omega$ . The perfect tense needs a reference point from which we can observe and perceive the action as fully accomplished.

Hence, using the perfect tense to describe an internal point within a natural movement would be illogical. Employing the perfect tense would imply declaring the attainment of a specific purpose, effectively interrupting the ongoing action. However, interrupting a movement poses no issues in our context, where it can ultimately be reduced to a trajectory and is divisible at any point. We not only find it effortless to conceptualize movement as a composition of individual segments, but it is also challenging for us to imagine someone thinking otherwise.

Nevertheless, dividing the physical object's "natural movement" into distinct parts can be misleading within Aristotle's physics. According to Aristotle, a natural movement cannot be reduced solely to a trajectory; it encompasses more than that. Movement, in essence, is always directed towards a purpose, and its significance lies in being governed in its entirety by that purpose. In Newtonian physics, the direction of movement is relative, allowing for reversibility, and each segment of movement carries meaning on its own, independent of the whole. For instance, consider a falling stone or the

same stone thrown upward with the same speed that it hit the ground. In this context, we can easily divide the motion into distinct parts. Thus, representing movement as a segment feels intuitive to us.

However, this perspective no longer holds true when we consider a natural movement as conceived by Aristotle. Let us imagine representing a movement from an initial state  $A$  to its purpose  $\Omega$  using a segment  $A\Omega$ :



Figure 1

Since the segment can be divided anywhere, let us imagine dividing it at a point, call it  $B$ , between  $A$  and  $\Omega$ . Point  $B$  divides the  $A\Omega$  segment into two parts:  $AB$  and  $B\Omega$ , the former representing the “before” and the latter the “after”. The sum of these two parts gives us the original segment. But what about the movement itself? In this case, point  $B$ , being the endpoint of movement  $AB$ , also serves as its purpose. However, according to Aristotle, the purpose, which completely determines a movement, bestows a distinct ontological autonomy upon movement  $AB$ , setting it apart from movement  $A\Omega$ , even though they share the same starting point.<sup>26</sup> For Aristotle, a movement is not composed of discrete “pieces” of movement,<sup>27</sup> and the concept of a “state,” understood as an internal point within a movement or a division that separates the movement into pieces, lacks meaning. Therefore, the only states that truly matter are the initial and final extremes,  $A$  and  $\Omega$ .

Furthermore, it is worth noting that  $\Omega$ , despite being the ultimate goal of the movement – or perhaps precisely because it is the ultimate goal – does not belong to the movement itself, according to Aristotle. Instead, it belongs to the state to which the movement has brought the object, the state we previously referred to using the perfect tense.

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<sup>26</sup> Aristotle addresses the problem in *Phys.* VIII 8, specifically at 262a12-b8.

<sup>27</sup> As mentioned earlier, such considerations become meaningless in a context like contemporary physics, where motion has shed its qualitative aspects that were fundamental in Aristotle’s framework, and it has become a purely quantitative concept focused on distance covered, time elapsed, velocity, and variations in these variables.

A similar line of reasoning can be applied to the beginning; so, if we wish to continue representing the movement as a segment, we must emphasize that the segment is open-ended:<sup>28</sup>



Figure 2

Looking at movement “from within” as an open-ended interval fits well with the earlier observation that the Greek language only speaks of it in the present (or imperfect) tense. In this case, the imperfect aspect not only refers to the ongoing nature of the action but also highlights its boundlessness.<sup>29</sup>

However, once we turn our attention to the limit, specifically when we adopt the perspective of  $\Omega$ , movement is described using the perfect (or pluperfect) tense. This use of the perfect tense emphasizes that once the purpose has been achieved, the condition that justified the movement ceases to exist, and consequently, so too does the movement itself. It is important to note that  $\Omega$  does not belong to the movement but rather to the state that the movement has brought us to, or as Aristotelian philosophy suggests, to the movable object’s state of having already undergone motion. As we delve further, we will find it useful to represent this state as a closed interval.

Aristotle’s keen attention to the use of verbal forms, and specifically the primacy of aspectual characteristics over temporal ones, is aptly demonstrated in the following passage from Book VI of the *Physics*:

εἰ δὴ ἀνάγκη: τὸ κινούμενον ποθὲν ποι μὴ ἅμα κινεῖσθαι καὶ κεκινήσθαι οὐ ἐκινεῖτο ὅτε ἐκινεῖτο, οἷον εἰ Θῆβαζε τι βαδίζει, ἀδύνατον ἅμα βαδίζειν Θῆβαζε καὶ βεβαδικέναι Θῆβαζε, τὴν δὲ τὸ Α τὴν ἀμερῆ ἐκινεῖτο τὸ Ω, ἢ ἢ τὸ Δ κίνησις παρῆν (c) ὥστ’ εἰ μὲν ὕστερον διήλθεν\* (\*διήλθεν codd.: διεληλύθει Ross 1936) ἢ διήει διαιρετῆ ἂν εἶη (ὅτε γὰρ διήει, οὔτε ἡρέμει οὔτε διεληλύθει, ἀλλὰ μεταξύ ἦν). εἰ δ’ ἅμα διέρχεται καὶ διεληλύθε, τὸ βαδίζον, ὅτε βαδίζει, βεβαδικὸς ἐκεῖ ἔσται καὶ κεκινήμενον οὐ κινεῖται (*Phys.* VI 1.231b28-232a6).

Now a thing that is in motion from one place to another cannot at the moment when it was in motion both be in motion and at the same time have completed its motion at the place

<sup>28</sup> An interval is called open if it does not include its endpoints, and closed if it does. See Rijksbaron (1989) pp. 42-50, where analogous considerations are brought forward using the notion of “completeness”.

<sup>29</sup> The imperfective aspect is also referred to as unbounded (Boss et al. 2019, p. 406).

to which it was in motion (e.g. if a man is walking to Thebes, he cannot be walking to Thebes and at the same time have completed his walk to Thebes); and, as we saw, Z traverses the partless section A in virtue of the presence of the motion D. Consequently, if Z actually passed through A after being in process of passing through, the motion must be divisible; for at the time when Z was passing through, it neither was at rest nor had completed its passage but was in an intermediate state; while if it is passing through and has completed its passage at the same time, then that which is walking will at the moment when it is walking have completed its walk and will be in the place to which it is walking; that is to say, it will have completed its motion at the place to which it is in motion (Edition with a minor change to Ross 1936; Translation, here and elsewhere, with minor changes to Barnes 1984).

Given that the verbal system effectively conveys the concept of movement, and does so quite effectively, the presence of two distinct forms – one indicating completion [perfect] and the other denoting ongoing action [present] – necessarily reflects an inherent distinction within the movement itself, which the verb merely articulates. This distinction essentially suggests that movement encompasses both a mean and two ends (with a focus on the end  $\Omega$ ). By employing the perfect tense, we discuss the movement from the perspective of the end,  $\Omega$ , whereas the present tense provides a viewpoint from the mean, represented as *m*.

### *1.3 Movement without Purpose*

The statements made in the previous Section apply to what are commonly known as telic (goal-oriented) or transformative verbs, such as “go,” “build,” “learn.” These verbs refer to actions that represent what philosophy calls proper movements, characterized by a transition from an initial state A to a qualitatively different final state  $\Omega$ . In state A, the object lacks a certain form that it attains in state  $\Omega$ .

However, there are cases where a verb denotes a different kind of situation, where it is impossible to differentiate qualitatively between states A and  $\Omega$ . Consider verbs like “see,” “hear,” “experience pleasure” and so on. These situations do not involve a progression towards a particular form; rather, they indicate a state of possessing that form. To describe such situations, Aristotle occasionally uses the term *energeia*, while modern grammar refers to them as stative or atelic verbs.<sup>30</sup>

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<sup>30</sup> Although the passage from *Metaphysics* on which Graham’s analysis is based (*Metaph.*  $\Theta$  6.1048b18-36) has been reasonably questioned in terms of its placement and authenticity in



I will also adopt the term *energeia* and contrast it with *kinesis*. However, since the word has different meanings in Aristotelian texts, I want to clarify that here it will be used solely as an abbreviation of the phrase: “a situation that, like *kinesis*, is described by a verbal form but differs from proper movement because, unlike the latter, it contains its purpose.” Let us consider the difference between doing something and seeing it. Doing is a *kinesis*, while seeing is an *energeia*. While one can both see and have seen, one cannot simultaneously do and have done.<sup>31</sup>

“ἀρ’ ἐνδέχεται τὸ αὐτὸ ἅμα ποιεῖν τε καὶ πεποιηκέναι;” “οὐ.” “ἀλλὰ μὴν ὄρᾶν γέ τι ἅμα καὶ ἑωρακέναι τὸ αὐτὸ καὶ κατὰ ταῦτ’ ἐνδέχεται.” (*Soph. el.* 22.178a9-11)

“Is it possible to be doing and to have done the same thing at the same time?” “No”. “But it is surely possible to be seeing and to have seen the same thing at the same time and in the same respect.”

What holds true for seeing applies more generally to perceiving:

ἅπαν ἅμα ἀκούει καὶ ἀκήκοε, καὶ ὅλως αἰσθάνεται καὶ ἤσθηται, καὶ μὴ ἐστι γένησις αὐτῶν ... (*De sens.* 6.446b2-4).

Now, even if one always hears and has heard – and, in general, perceives and has perceived – at the same time, and these acts do not come into being but occur without coming into being..

In the case of *energeia*, the distinction between the mean (m) and the extremes (A and Ω) that exists in *kinesis* does not apply. While in *kinesis*, I must use the present tense when speaking from within (I am building, I am learning, etc.), and only from the perspective of the final extreme can I use the perfect tense (I have built, I have learned, etc.), when describing an *energeia*, I can use either the present or the perfect tense interchangeably. I can say that I am seeing and that I have seen, or rather, that I am in the state of

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Burnyeat (2008), I do not find the critique of Graham’s conclusions convincing at all. These conclusions are not necessarily tied to the dubious passage and can be generally applied to Aristotle’s distinction between proper movements, characterized by an external purpose, and “states” or acts or *energeiai*, characterized by an internal and ever-present purpose (see especially *Topics* VI 8.146b13-19; *Soph. el.* 22.178a9-11, *De sens.* 6.446b2-4). Rijksbaron (1989) follows a similar line of thought and has also been criticized (despite being widely utilized) in Burnyeat (2008).

<sup>31</sup> Regarding perception understood as a state that encompasses form and is thus always complete, and differs in this respect from *kinesis*, see *EN* X 4.1174b14-20.

having seen (perfect); that I am thinking and that I am in the state of having thought and so on.

This places all points of an *energeia* on an equal level and has two important consequences: first, I can no longer speak of absolute beginnings, ends, and mean; second, I can divide the action. In a movement, a point is either a beginning (when it coincides with  $A$ ), an end (when it coincides with  $\Omega$ ), or it belongs to the mean (when it belongs to  $m$ ). However, in an *energeia*, every point can be interpreted as both a beginning, an end, or belonging to the mean.

If we adopt the conventions from the previous Section and represent *kinesis* as a segment, where the order is  $A$ - $m$ - $\Omega$  linearly manifested:

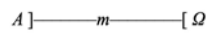


Figure 3

One effective way to represent the order in an *energeia* is in the shape of a circle:

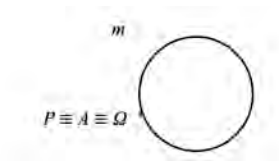


Figure 4

A point  $P$  on the circumference can be viewed as both a starting point, an endpoint, or a point belonging to  $m$ .<sup>32</sup> If we consider it as belonging to the interval  $m$ , where no divisions are made, we can describe it in the present tense. However, if we see it as an endpoint, we can express it in the perfect tense, referring to its role as the goal of  $m$  (it is worth noting that  $m$  lies between the point  $P$  when seen as the starting point  $P \equiv A$  and the same point when seen as the endpoint  $P \equiv \Omega$ ). But there is an additional aspect: this perfect tense can be understood either in a stative sense – “I am in the state of having seen” – or in a resultative sense – “I have accomplished the

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<sup>32</sup> τὸ γὰρ ἐκ τοῦ  $A$  κινούμενον ἅμα κινήσεται εἰς τὸ  $A$  κατὰ τὴν αὐτὴν πρόθεσιν (*Phys.* VIII 8.264b10-11).

action of seeing”<sup>33</sup> – depending on what we observe from the perspective of the endpoint  $P$ .

If I consider  $P$  as both the endpoint and the starting point ( $P \equiv \Omega \equiv A$ ), viewing  $m$  as what precedes  $P$  ( $P \equiv \Omega$ ) and simultaneously as what follows  $P$  ( $P \equiv A$ ), then I use the perfect tense in a stative sense. However, if I focus on  $P$  solely as the endpoint ( $P \equiv \Omega$ ) and perceive  $m$  only as what comes before, then I employ it in a resultative sense.

This holds true for every single point: if I can claim that I have completed the act of seeing at each point, I can also envision fragmenting my *energeia* without destroying it because it is already fully realized everywhere. Unlike a *kinesis*, an *energeia* can be dissected and contemplated as composed of these fragments. Unlike a *kinesis*, it is meaningful to speak of an “internal state” within an *energeia*.<sup>34</sup>

## 2. Movement and Successiveness

But what sets apart a *kinesis* from an *energeia* at its core? What prevents us from breaking down a movement, in its true sense, if not its inherent teleological purpose, encompassing two physically distinct states? Let us try to

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<sup>33</sup> At this stage, it is worth noting how Aristotle’s analysis aligns with the period which Chantraine (1926) refers to as the perfect resultative, pertaining to the outcome of a process. In his influential work, Chantraine identifies three phases in the development of the perfect tense: (a) perfect with a purely aspectual value (being in a state), (b) perfect resultative, and (c) perfect temporal. In the first two phases, aspect takes precedence over time – if we were to place them in a temporal context, both would be situated in the present, although (b) refers to an event in the past. In phase (c), however, time becomes dominant, and the perfect tense effectively becomes a past tense. According to Chantraine, in both (a) and (b), the perfect tense refers to an extension that, in (b), is “absorbed” into the past, allowing the present state, achieved through the process, to be seen as unextended, or as the culmination of that process. I will not delve into the matter here of the relationship between resultativity and transitivity, which is related but not essential to our interpretation, and for which Chantraine’s analysis has faced criticism (see, for example, Rijksbaron 1984 and Duhoux 2000, §§371-2). See Bentein (2012) §2 for an articulate discussion on the semantics of the perfect.

<sup>34</sup> Regarding the fact that it is the absence of an “external” purpose that makes the difference, see *Topics* VI 8.146b13-19 and *EN* X 5.1175a29-35: the pleasure of the geometer lies in the act of doing geometry, not in its completion, precisely because he is actively engaged in the process (see *EN* VII 12.1153a7-17; X 4.1173a17-21 e 1174b7-10).

imagine a natural movement devoid of these physical distinctions and see what, if anything, remains.

### *2.1 Objects and Movements*

Because the purpose of this operation might seem unclear or not immediately obvious, I will try to clarify it using a similar operation that may be more familiar to readers of Aristotle. Let us consider what happens when we take a natural object, instead of a movement, and examine it apart from its physical qualities.

What occurs is that we transform the physical object into a mathematical object. In other words, we no longer perceive the object in its physical form, but rather from a mathematical perspective. This aligns with Aristotle's view that mathematical objects are simply physical objects seen through a different lens, devoid of any teleological considerations.<sup>35</sup>

For instance, we can analyze a material body like a bronze cube, setting aside its intended purpose. Through this process, we arrive at its geometrical structure and at the concept of a cube. Aristotle refers to this operation as "subtraction" (*αφαίρεσις*), whereby we strip away the physical qualities to isolate an underlying mathematical structure.<sup>36</sup>

Through the process of subtraction, we arrive at Aristotle's equivalent of what we commonly refer to as space.<sup>37</sup> I use this terminology because Aristotle does not recognize the existence of a separate and independent space,

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<sup>35</sup> See *Metaph.* M 3.1077b22-1078a9; N 2.1090a13-15; *Phys.* II 2.193b23-194a12; *De An.* I 1.403a15-16.

<sup>36</sup> *Metaph.* E 1.1026a14-15. The term used by Aristotle for this operation, *αφαίρεσις*, in Greek mathematics specifically denotes subtraction. This is one of the reasons why I do not translate *αφαίρεσις* as "abstraction," as is customary. According to Aristotle, it is not the mathematical object that is "abstracted" from the physical one; rather, it is the physical properties that are "subtracted." What remains is the mathematical object. For further discussion on this matter, see Ugaglia (2017). On the term *αφαίρεσις* and its usage in mathematics, see Mueller (1990) and the bibliography cited there.

<sup>37</sup> The idea of space as a separate entity, studied in its own right, is a relatively modern invention. According to Euclid, there are objects with their properties and relationships, and it is geometry that deals with these things, eventually evolving into the study of space in much more recent times. For further insight on this topic, see De Risi's works from 2015 (introductory essay) and 2021.

as understood in Newtonian physics.<sup>38</sup> According to Aristotle, space is not a distinct entity detached from bodies; rather, it is a property inherent in objects, manifested as extension.

If Aristotle does not require a self-existent space to accommodate objects, it is reasonable to assume that he also does not require a self-existent time to accommodate movements. It is plausible to conceive of time existing in a similar manner to space, as a property. However, unlike space, time is not a property of objects but of movements. Aristotle himself emphasizes this distinction, forming the basis for his analysis of time in *Physics* IV.<sup>39</sup>

Consequently, we can now address the question that initiated this discussion: what happens when we consider a natural movement apart from its physical attributes? What we obtain is something that transcends both movement and time, yet bears a connection to both. I refer to this phenomenon as the *successiveness* of movement.<sup>40</sup>

Similar to how space manifests itself as the extension of a physical body, time consistently manifests itself as the *successiveness* of a physical movement.<sup>41</sup>

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<sup>38</sup> Space does not exist in the form of either a place or a void, according to Aristotle. In relation to the first point, Aristotle dismisses the definition of place as a three-dimensional extension occupied by a body, as discussed in *Physics* IV 1-5. Instead, he presents a concept of place as the immovable boundary or surface that separates bodies (place is the first, immovable limit of the container: τὸ τοῦ περιέχοντος πέρας ἀκίνητον πρῶτον, τοῦτ' ἔστιν ὁ τόπος in *Phys.* IV 4.211b20-21). It is crucial not to succumb to the temptation of situating the surface within space, as this would undermine Aristotle's argument and render the new definition entirely futile and redundant. Regarding the second point, Aristotle rejects the definition of void as a three-dimensional extension devoid of matter, as discussed in *Physics* IV 6-9. No alternative definition is proposed because the concept of an empty extension is demonstrated to be incompatible with the very definition of motion. For further exploration of this matter, see Ugaglia (2004).

<sup>39</sup> *Phys.* IV 11.219a1-10.

<sup>40</sup> Here, it is important to note that I am not talking about a specific extent, but rather the property of extension itself. While a cube may accidentally have a volume of 3 cubic meters, the property of being extended goes beyond that. Similarly, the cube may be red, but the property of having color is separate. I will revisit this point in Section 3.4 below, where I will delve into the distinction between successiveness and duration.

<sup>41</sup> In simpler terms, and using non-Aristotelian language, we can say that while motion has a direction and cannot be reversed, successiveness can occur in reverse. To put it in more everyday terms, Aristotle does not envision an arrow of time, but rather an arrow of motion. Unlike the arrow of time, which can be reversed at the level of kinematics and gains its directionality through thermodynamic considerations, Aristotle's cosmos has an inherent

## 2.2 Successiveness

I have chosen to label as “successiveness” what Aristotle refers to as “the before and after in movement.” It represents something that is not movement itself, yet is intrinsic to it:<sup>42</sup>

ἔστι δὲ τὸ πρότερον καὶ ὕστερον ἐν τῇ κινήσει ὃ μὲν ποτε ὄν κινήσις [ἔστιν]- τὸ μὲντοι εἶναι αὐτῶ ἕτερον καὶ οὐ κινήσις (*Phys.* IV 11.219a19-21).

The before and after in motion identical in substratum with motion yet differs from it in being, and is not identical with motion.

I have opted to use the term “successiveness” for two specific reasons. Firstly, I want to avoid explicitly referring to “before” and “after” in a temporal sense, as it would create a circular argument. Secondly, I sought a term that explicitly captures the logical operation of transitioning to the next, akin to constructing the concept of  $n+1$  based on  $n$ . This transition is closely tied to what remains of a natural movement when all qualitative determinations are subtracted from it.<sup>43</sup>

Movement entails a progression from one state to a different state, occurring continuously and forming a cohesive whole that is entirely defined by its purpose and its relationship to the initial point – the mover-movable

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orientation that dictates the direction of motion. It is precisely because the cosmos is oriented that motion is oriented (see n. 18 above).

<sup>42</sup> When identifying what Aristotle refers to as the “before and after” in motion (τὸ πρότερον καὶ ὕστερον ἐν τῇ κινήσει) as a structured orientation determined by the “now,” I am not proposing anything groundbreaking. This concept, extensively explored in White (1992), has been more recently revisited by several authors. I would like to highlight the work of Roark (2013), who associates the “now” with a “kinetic cut” and derives the orientation of the structure from the motion itself, viewed as a trajectory towards a specific goal. Similarly, Sentesy (2018) identifies the “now” as an ongoing division (mark off) of the motion and derives the orientation of what he terms the “prenumeric oriented continuity of motion” from the inherent characteristics of the moving object. What I contribute is the conceptual leap between a motion, which is a physical object, and its successiveness, which is a mathematical object.

<sup>43</sup> Although it is beyond the scope of this article, it would be interesting to compare Aristotle’s perspective, which situates this structure within motion, with that of Brouwer, who places it within the mind. Brouwer argues that our idea of transitioning to the next exists in our mind, which exists in time. In contrast, Aristotle suggests that we exist in time because we possess the idea of transitioning to the next, which resides within motion. For a comparative analysis of Aristotle’s and Brouwer’s views on time and infinity, see Bernini & Ugaglia (forthcoming).

connection, so to speak. Without this relationship, movement ceases to exist, according to its very definition. However, for a relationship to exist, there must be properties or characteristics that are brought into correlation. Now, let us envision setting aside or subtracting all these qualitative determinations. What remains is something that still retains a trace of the fact that movement entails progress from one state to a different one, yet no longer possesses the physical attributes associated with movement.

In particular, it allows for divisibility without obstacles. Let us consider a natural movement, for example, the ripening of a fruit. While it is evident that this movement involves a transition from non-red to red, when we examine the movement itself as a physical object, it becomes difficult to further analyze its nature. As discussed in Section 1.2.1, we can observe that the endpoints – the initial state  $A$  of non-red and the final state  $\Omega$  of red – are in a before/after relationship, with the process of becoming red, denoted as  $m$ , occurring in between. In this transitional phase, we can generally say that the fruit is in the process of ripening. Only at the end can we declare that the fruit is fully ripe.

However, if we set aside the physical characteristics of the movement – in this case, disregarding the color aspect – and shift our perspective from viewing it as a physical movement to considering it as mere successiveness, we can imagine dividing it without disrupting its essence. This allows us to introduce the notion of an internal point. At such a point, where we imagine interrupting the successiveness of a movement, we cannot say that the object is in a certain state of the movement because successiveness is foreign to such characterizations. However, we can say that the object is “in the now” ( $\acute{\epsilon}\nu\ \tau\acute{\omega}\ \nu\acute{\upsilon}\nu$ )<sup>44</sup> indicating that it is in between a before and an after of the successiveness of that movement. This can be applied to any point, with each “now” of the object defining a distinct division of before and after within the sequence.

Thus, the “now” ( $\nu\acute{\upsilon}\nu$ ) is not an independent entity, but should be understood as a property of the moving object. We can consider it as the property which remains when we disregard all the qualitative aspects of the movement.

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<sup>44</sup> In *Phys.* VI 3, Aristotle discusses the property of being in the now ( $\acute{\epsilon}\nu\ \tau\acute{\omega}\ \nu\acute{\upsilon}\nu$ , 234a24, 31, 34), see also n. 65 below.

When representing successiveness, a segment becomes a more suitable depiction. Similar to a segment, and unlike a movement, successiveness can be divided at any point, generating different divisions of before and after. By focusing on a specific “now,” let’s say B, we can discuss a before B and an after B, and by changing the point of focus, we introduce a different before/after division – for example, the before of  $\Gamma$  and the after of  $\Gamma$ .

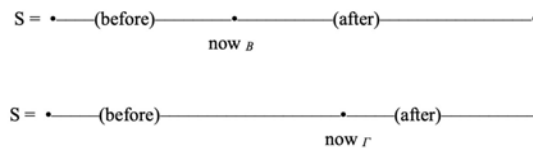


Figure 5

At this level, we notice that what separates the before from the after is no longer an extended state of movement, as we saw in the case of movement itself, but rather the “now” of the object, which is an unextended point.

Furthermore, the order of before and after in successiveness although made possible by operating within the framework of a specific movement driven by a specific purpose, no longer carries any trace of that purpose. By disregarding all the qualitative aspects of movement, successiveness becomes a mathematical structure that remains the same everywhere. At this point, there is nothing left to distinguish different movements and say, for example, “this is a translation, this is an alteration, this is a generation.”

While this may not immediately strike us as significant, it holds great importance in Aristotle’s system, where objects of different natures cannot be compared, and attempting to do so would be nonsensical. Generation and growth, chromatic variation and translation, even rectilinear and circular motion cannot be compared.<sup>45</sup>

However, once we recognize a common underlying structure in movement – any movement – a meaningful comparison becomes possible: the movements themselves may be incomparable, but their successiveness can be

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<sup>45</sup> The various types of motion are described in *Physics* III 1-3, especially at 201a11-19. Rectilinear and circular motion are discussed in *Phys.* VIII 8-9. On the impossibility of comparing non-homogeneous magnitudes, see B. Vitrac’s introduction to Euclid’s *Elements*, *Book V* (Vitrac 1994), and Mueller (1981) pp. 118-51.



put on equal footing. Moreover, successiveness allows us to consider *kinesis* and *energeia* in a similar way.

### 2.3 Successiveness and Structure of the Perfect

In the previous Sections, I compared Aristotle's language for *kinesis*, or proper movement, and for *energeia*. He speaks of *kinesis* as a whole, using present (or imperfect) tense verbs when referring to being within the movement, and perfect (or pluperfect) tense verbs when referring to the endpoint. To speak in the perfect tense, one needs to identify a point, a division within the action, from which to observe the movement. It is for this reason that in Greek one can speak of *energeia* in either the present or the perfect tense, since *energeia*, unlike *kinesis*, is divisible everywhere.

But what about movement when it is not considered in itself as movement, but rather from the perspective of its successiveness, stripped of all physical characteristics? As a mathematical structure, successiveness is divisible everywhere: we can imagine identifying a point – a division – that represents the “now” of the movable and defines a partition of before/after, or an order of before-now-after.

In contrast to the nature of movement itself, which I associated with the structure of the present, I propose associating movement as successiveness with the structure of the perfect. The movable that is “in the now” finds itself in a state that can be seen as the culmination of the preceding successiveness (or the beginning of the subsequent one), and, as such, it can be described in the perfect tense, though with some caution.

The perfect tense takes on a different meaning when applied to these internal points than when referring to the actual culmination or goal of a movement. While using the perfect tense to describe an internal point in the sequence of a movement might imply its role as the endpoint of a process – the segment of movement that precedes it in the before/after order of its successiveness – this endpoint is merely fictional. Within the successiveness, the perfect tense signifies the internal completion of a certain action, but it cannot convey the actual fulfillment or how the action manifests externally. It is a perfect tense used exclusively in a resultative sense.

Aristotle adopts this perspective, examining movement as succession and the “now” as expressed in the perfect tense, when discussing movement not as a physical entity but as a mathematical trajectory. For instance, in *Physics* VI 6, while comparing the velocities of two objects, he observes that:

δεδειγμένου δὲ τούτου φανερόν ὅτι πᾶν τὸ κινούμενον ἀνάγκη κεκινήσθαι πρότερον. εἰ γὰρ ἐν τῷ ΧΡ πρώτῳ χρόνῳ τὸ ΚΛ κενήνεται μέγεθος, ἐν τῷ ἡμίσει τὸ ὁμοταχῶς κινούμενον καὶ ἅμα ἀρξάμενον τὸ ἡμισυ ἔσται κεκινήμενον. εἰ δὲ τὸ ὁμοταχὲς ἐν τῷ αὐτῷ χρόνῳ κενήνεται τι, καὶ θάτερον ἀνάγκη ταῦτὸ κεκινήσθαι μέγεθος, ὥστε κεκινήμενον ἔσται τὸ κινούμενον (236b32-237a2).

And now that this has been proved, it is evident that everything that is in motion must have been in motion before. For if that which is in motion has traversed the distance KL in the primary time TR, in half the time a thing that is in motion with equal velocity and began its motion at the same time will have traversed half the distance. But if the thing whose velocity is equal has traversed a certain distance in the same time, the original thing that is in motion must have traversed the same distance. Hence that which is in motion must have been moved before (with minor changes to Barnes’ translation).

When applied to the final point  $\Omega$ , the perfect tense not only denotes the culmination of the movement, but also denotes the initiation of a state where the completion of the movement extends beyond its immediate confines. In this sense, we can say that the perfect tense carries a dual significance: it captures the stative aspect of the action, indicating that its fulfillment reaches beyond itself and produces external consequences.

Without this external dimension, when considering the successiveness of individual movements, each action would remain temporally confined, encapsulated within its own boundaries. However, in order to discuss the “external” aspect of the movement, it becomes necessary to introduce the notion of time, which I will further explore in Section 3.

### *3. Time*

In the first part of this article, I analyzed motion in its aspectual nature. Drawing on Aristotle’s language, I identified two distinct perspectives and corresponding expressions: motion itself, which I correlated with the structure of present, and motion as successiveness, which I associated with the

structure of perfect. I emphasized that the successiveness of motion does not yet constitute time.

In this second part, I will move from the notion of successiveness to that of time, thus shifting the focus from the aspectual qualities of the verbal system to the temporal aspects.

### 3.1 Structure of Time

According to Aristotle, the before and after – which I have referred to as the successiveness – belongs to motion. I have interpreted this viewpoint as an invitation to perceive the inherent successiveness of a natural motion in a similar way to how we perceive the geometric structure of a physical object. In this sense, it can be said that successiveness represents what remains of motion once its physical characteristics are subtracted.

However, time encompasses more than that. Time is not simply the before and after of motion, it is the before and after of motion as something countable:

τὸ δὲ πρότερον καὶ ὕστερον ἐν κινήσει ἐστίν· χρόνος δὲ ταῦτ' ἐστὶν ἢ ἀριθμητὰ ἐστίν (*Phys.* IV 14.223a28-29).

The before and after are attributes of movement, and time is these qua countable.

Or, in other words, it is the number of motion in respect of before and after.

ὅταν δὲ τὸ πρότερον καὶ ὕστερον, τότε λέγομεν χρόνον· τοῦτο γὰρ ἐστὶν ὁ χρόνος ἀριθμὸς κινήσεως κατὰ τὸ πρότερον καὶ ὕστερον (*Phys.* IV 11.219a30-b2).

On the other hand, when we do perceive a 'before' and an 'after', then we say that there is time. For time is just this – number of motion in respect of 'before' and 'after'.

In what way is time a number? And what is the relationship of this number to successiveness?

My proposition is to understand the term “number,” when applied to the successiveness of a motion, in analogy with the concept of number as it relates to the continuity of a body. The connection between number and continuity is expounded by Aristotle in Book III of the *Physics*, where he argues for the potential infinity of number. According to Aristotle, number

is potentially infinite because the potential divisions of the continuous are infinite.<sup>46</sup>

The idea is simple yet impactful. Take a segment, divide it in half, and designate this division as “one”; then continue dividing each subsequent half and assigning them numbers like “two,” “three,” and so forth. Since the segment is continuous, this process can be deemed infinite, thus allowing the number to be considered infinite without necessitating the existence of an actual infinity.<sup>47</sup>

ἐπὶ δὲ τὸ λείον αἰεὶ ἔστι νοῆσαι· ἀπειροὶ γὰρ αἱ διχοτομίαι τοῦ μεγέθους· ὥστε δυνάμει μὲν ἔστιν, ἐνεργείᾳ δ' οὐ, ἀλλ' αἰεὶ ὑπερβάλλει τὸ λαμβανόμενον παντὸς ὀρισμένου πλήθους· ἀλλ' οὐ χωριστὸς ὁ ἀριθμὸς οὗτος τῆς διχοτομίας. (*Phys.* III 7.207b11-14)

But in the direction of largeness it is always possible to think of a large number; for the number of times a magnitude can be bisected is infinite. Hence this infinite is potential, never actual: the number of parts that can be taken always surpasses any definite amount. But this number is not separable by the process of bisection.

Although the immediate purpose of this argument is to present a form of infinity that aligns with the constraint of a finite universe, it also sheds light on the broader relationship between number and continuity or, more specifically, between number and extension. Let us consider a physically extended object in one dimension. By stripping away its physical characteristics, we arrive at a continuum. As we divide this continuum, we encounter the concept of number.

In this sense, we can say that number is the number of extension. It is important to note that here, number does not refer to the measurement of the object, but rather to the possibility to divide the continuum and establish the series of numbers.

Now, if we shift our focus to a movement instead of an object, and strip away its physical characteristics, we are left with what I have termed “successiveness.” By drawing an analogy, we can state that the time of a movement is the number of its successiveness. However, unlike a static number, time, as the

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<sup>46</sup> The number that appears in the definition of time is usually related to the characterizations of number that Aristotle employs in the *Metaphysics*, which apply only to finite sets (see, for example, Senteny 2018, pp. 284-6).

<sup>47</sup> For Aristotle, the division of the continuum is the paradigmatic example of an infinite process, from which all other forms of infinity allowed in his cosmos can be derived. For more on this topic, see Ugaglia (2018).

number of movement, somehow retains the notion of transitioning to the next. I therefore introduced the term “successiveness” to capture this idea.

Counting the successiveness of a movement involves discerning the distinction between two instances of “now” in the movable, understanding how the phrase “the movable is in the now” differs when applied to different divisions of the successiveness. As we have subtracted all the physical attributes of the movable in transitioning from movement to successiveness, the difference cannot be a physical one. It is purely a mathematical difference that separates the steps in the process of transitioning to the successive. It is important to note that this does not imply the passage of time; rather, it is the movement itself that progresses from  $n$  to  $n+1$ , while time simply registers its manner.<sup>48</sup>

Postponing to Section 3.4 for further considerations on the relationship between number (of motion) and infinity, I will now analyze how Aristotle describes the operation by which the concept of time emerges through counting the before and after of movement. As previously mentioned, a key aspect is recognizing the difference – no longer physical but purely mathematical – between two instances of “now” in the movable. It is not only necessary to identify a “now,” but also to grasp how it remains the same in a certain sense – always the one to which we refer as “I am in the now” – while also being different.

This is a non-trivial operation that engages perception, memory and imagination.<sup>49</sup>

*ἀλλὰ μὴν καὶ τὸν χρόνον γε γνωρίζομεν ὅταν ὀρίσωμεν τὴν κίνησιν, τῷ πρότερον καὶ ὕστερον ὀρίζοντες· καὶ τότε φαιμέν γεγονέναι χρόνον, ὅταν τοῦ προτέρου καὶ ὕστερου ἐν τῇ κινήσει αἴσθησιν λάβωμεν. ὀρίζομεν δὲ τῷ ἄλλο καὶ ἄλλο ὑπολαβεῖν αὐτά, καὶ μεταξύ τι αὐτῶν ἕτερον.*

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<sup>48</sup> No order relation is implied in the process of dividing the continuum: once the first division is fixed, you can carry out the second one anywhere, before or after, and so on for all subsequent divisions. However, in the case of motion, you are constrained to proceed with the division following the inherent order of before and after within the motion. After all, time is not just the number of motion but the number of motion according to before and after.

<sup>49</sup> For a detailed description of this operation, see White (1992) pp. 76-90 and the similar formulation in Senteny (2018) pp. 300-2. Based on these, both authors arrive at an interpretation of time as measurement, with which I disagree (see Section 3.4 below). However, regarding the role of imagination, I recommend consulting Roark (2012).

ὅταν γὰρ ἕτερα τὰ ἄκρα τοῦ μέσου νοήσωμεν, καὶ δύο εἴπη ἢ ψυχῇ τὰ νῦν, τὸ μὲν πρότερον τὸ δ' ὕστερον, τότε καὶ τοῦτό φαμεν εἶναι χρόνον (*Phys.* IV 11.219a22-30).

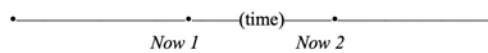
But we apprehend time only when we have marked motion, marking it by before and after; and it is only when we have perceived before and after in motion that we say that time has elapsed. Now we mark them by judging that one thing is different from another, and that some third thing is intermediate to them. When we think of the extremes as different from the middle and the mind pronounces that the ‘nows’ are two, one before and one after, it is then that we say that there is time, and this that we say is time.

Aristotle delves deeper by clarifying how the two instances of “now” should be grasped – not as the “now” that separates the before and after, but as two separate occurrences of the term “now” in the statement “the movable is in the now.” It is through this distinction that we arrive at the notion of time as the number of movement:

τὸ γὰρ ὀριζόμενον τῷ νῦν χρόνος εἶναι δοκεῖ· καὶ ὑποκείσθω. ὅταν μὲν οὖν ὡς ἓν τὸ νῦν αἰσθανώμεθα, καὶ μὴ ἦτοι ὡς πρότερον καὶ ὕστερον ἐν τῇ κινήσει ἢ ὡς τὸ αὐτὸ μὲν προτέρου δὲ καὶ ὕστερου τινός, οὐ δοκεῖ χρόνος γεγονέναι οὐδεὶς, ὅτι οὐδὲ κίνησις. ὅταν δὲ τὸ πρότερον καὶ ὕστερον, τότε λέγομεν χρόνον· τοῦτο γὰρ ἐστὶν ὁ χρόνος ἀριθμὸς κινήσεως κατὰ τὸ πρότερον καὶ ὕστερον (*Phys.* IV 11.219a30-b2).

For what is bounded by the ‘now’ is thought to be time – we may assume this. When, therefore, we perceive the ‘now’ as one, and neither as before and after in a motion nor as the same element but in relation to a ‘before’ and an ‘after’, no time is thought to have elapsed, because there has been no motion either. On the other hand, when we do perceive a ‘before’ and an ‘after’, then we say that there is time. For time is just this – number of motion in respect of ‘before’ and ‘after’.

If we want to use the familiar framework, keeping in mind the necessary precautions, we find ourselves in the following situation:



*Figure 6*

The successiveness – that is, the before/after of movement – once counted or capable of being counted is referred to by Aristotle as time.

### 3.2 Time and Successiveness

Based on what has been stated so far, since successiveness is a characteristic of individual movements, it follows that time is also inherent to each individual movement. Are there, then, as many instances of time as there are movements? Or does the relationship that connects the “nows” of a single movement, allowing them to be counted, have a broader scope that extends to different movements and different objects?

In *Physics* IV 14, towards the end of his analysis, Aristotle states that time that is “together” (ἅμα) is one and the same, and so there must be times that are not together.<sup>50</sup> This undeniably suggests an affirmative answer, as further supported by the following passage from *Physics* VIII. This argument not only corroborates the hypothesis that time can extend beyond the confines of an individual movement but also explains the mechanisms and reasons behind this expansion:

εἰ οὖν ἀδύνατόν ἐστιν καὶ εἶναι καὶ νοῆσαι χρόνον ἄνευ τοῦ νῦν, τὸ δὲ νῦν ἐστὶ μεσότης τις, καὶ ἀρχὴν καὶ τελευτὴν ἔχον ἅμα, ἀρχὴν μὲν τοῦ ἐσομένου χρόνου, τελευτὴν δὲ τοῦ παρελθόντος, ἀνάγκη αἰεὶ εἶναι χρόνον. τὸ γὰρ ἔσχατον τοῦ τελευταίου ληφθέντος χρόνου ἐν τινὶ τῶν νῦν ἔσται (οὐδὲν γὰρ ἔστι λαβεῖν ἐν τῷ χρόνῳ παρὰ τὸ νῦν), ὥστ' ἐπεὶ ἐστὶν ἀρχὴ τε καὶ τελευτὴ τὸ νῦν, ἀνάγκη αὐτοῦ ἐπ' ἀμφοτέρα εἶναι αἰεὶ χρόνον. ἀλλὰ μὴν εἴ γε χρόνον, φανερόν ἐστι ἀνάγκη εἶναι καὶ κίνησιν, εἴπερ ὁ χρόνος πάθος τι κινήσεως (*Phys.* VIII 1.251b19-27).

Now since time cannot exist and is unthinkable apart from the now, and the now is a kind of middle-point, uniting as it does in itself both a beginning and an end, a beginning of future time and an end of past time, it follows that there must always be time; for the extremity of the last period of time that we take must be found in some now, since in time we can take nothing but nows. Therefore, since the now is both a beginning and an end, there must always be time on both sides of it. But if this is true of time, it is evident that it must also be true of motion, time being a kind of affection of motion.

The concept is that while a movement has a beginning and an end, determined by its physical characteristics, the notion of a final step in a successiveness is inconceivable. To put it in more Aristotelian terms, it is impossible to have a now that marks an end but not a beginning. However, since time is a property of movement and not an independent entity, the only way to avoid the end of time is by avoiding the end of movement. There must exist an infinite movement, in which time is inherent.

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<sup>50</sup> ὁ αὐτὸς γὰρ χρόνος καὶ εἰς ὁ ἴσος καὶ ἅμα· εἶδει δὲ καὶ οἱ μὴ ἅμα (*Phys.* IV 14.223b3-4).

In Aristotle's cosmos, such a natural movement exists, encompassing all the movements within the sublunary world. Aristotle sees these movements as integral parts of a unified and ordered cosmic cycle, governed by the rotation of the celestial sphere.<sup>51</sup> From the perspective of movement itself, which is inherently physical and teleological, the individual components of the cycle form a naturally heterogeneous sequence. To perceive them as "pieces" of a singular movement we must reason in terms of successiveness, where the order is purely mathematical, enabling comparison and connection.

Thus, not only do individual movements possess their own before/after structure and, when counted, a time, but the fact that these individual movements contribute to an infinite cyclical motion allows their distinct structures to be seen as interconnected pieces of a unified before/after structure. Once identified and numbered, the "nows" of one movement can be related to the "nows" of others.

In particular, Aristotle states that movements which overlap, that is, occur together (*ἄμα*), share the same time.<sup>52</sup> In this case, there are multiple distinct objects that are "in the now", where "being in the now" is the exact same predicate for all, regardless of their differences in subject. From this perspective, the before/after of the entire set of movements in the cosmos is something universal – as Aristotle says, time is the same everywhere<sup>53</sup> – even though it results from the before/after of the individual movements.

Let us refer to this before/after, when applied to a "now" of this set of movements, as past/future. And let us say that the "now" of time is the limit separating them. What we obtain is an image of time as commonly perceived and expressed in everyday language.

Now, let us take any movement, defined by its own successiveness, that is, by its own order of before/after, and apply to its endpoints the considerations presented in *Physics* VIII 1. This operation allows us to read that movement in time – that is, within the successiveness of the entire set of sublunary

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<sup>51</sup> *GC* II 10, *passim*; *Phys.* II 1.193a27-28. The process and its relation to the movement of the celestial sphere are discussed in Ugaglia (2022). Regarding the choice to interpret time as a property of this movement rather than the rotation of the heavens, see also Sentesy (2018).

<sup>52</sup> οὕτω δὲ καὶ τῶν κινήσεων τῶν ἄμα περαινομένων ὁ αὐτὸς χρόνος (*Phys.* IV 14.223b6-7).

<sup>53</sup> *Phys.* IV 14.223b10-12.



movements – without implying the existence of a separate and self-subsistent “container”. From an Aristotelian perspective, a movement is in time because its local structure of before/after is part of a global structure, that of the cycle of sublunary changes. Furthermore, since time is composed of countable “nows,” placing a successiveness in time provides its measure, that is, the duration of the movement.

Therefore, not only does a movement have a time, meaning it possesses a structure of countable successiveness, but it exists within time, meaning it has a duration:<sup>54</sup>

ἐπεὶ δ' ἔστιν ὁ χρόνος μέτρον κινήσεως καὶ τοῦ κινεῖσθαι, μετρεῖ δ' οὗτος τὴν κίνησιν τῷ ὀρίσαι τινὰ κίνησιν ἢ καταμετρήσει τὴν ὅλην (ὥσπερ καὶ τὸ μῆκος ὁ πήχυς τῷ ὀρίσαι τι μέγεθος ὁ ἀναμετρήσει τὸ ὅλον), καὶ ἔστιν τῇ κινήσει τὸ ἐν χρόνῳ εἶναι τὸ μετρεῖσθαι τῷ χρόνῳ καὶ αὐτὴν καὶ τὸ εἶναι αὐτῆς, ἅμα γὰρ τὴν κίνησιν καὶ τὸ εἶναι τῆς κινήσεως μετρεῖ, καὶ τοῦτ' ἔστιν αὐτῇ τὸ ἐν χρόνῳ εἶναι. καὶ τοῦτ' ἔστιν αὐτῇ τὸ ἐν χρόνῳ εἶναι, τὸ μετρεῖσθαι αὐτῆς τὸ εἶναι, δῆλον ὅτι καὶ τοῖς ἄλλοις τοῦτ' ἔστι τὸ ἐν χρόνῳ εἶναι, τὸ μετρεῖσθαι αὐτῶν τὸ εἶναι ὑπὸ τοῦ χρόνου (*Phys.* IV 12.220b32-221a9).

Time is a measure of motion and of being moved, and it measures the motion by determining a motion which will measure the whole motion, as the cubit does the length by determining an amount which will measure out the whole. Further to be in time means, for movement, that both it and its essence are measured by time (for simultaneously it measures both the movement and its essence, and this is what being in time means for it, that its essence should be measured).<sup>55</sup>

I will address the difference between time and duration, and the related distinction between number and measure, in Section 3.4.

### 3.3 Time and Grammar

In Section 2.2, I linked the successiveness of a movement to the structure of the perfect tense, asserting that identifying a moment in the successiveness – a “now” of the object that separates a before and an after – enables us to construe that point as the aim of the preceding “segment” of the

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<sup>54</sup> *Phys.* IV 12.220b32-222a9.

<sup>55</sup> Here, Aristotle states that the being of motion is measured by time: τοῦτ' ἔστι τὸ ἐν χρόνῳ εἶναι, τὸ μετρεῖσθαι αὐτῶν τὸ εἶναι ὑπὸ τοῦ χρόνου. Elsewhere, when discussing the “placement” of an intrinsic successiveness in time, that is, indicating the duration of a motion, Aristotle speaks of the “when first” of that motion. In *Physics* VI 5, he discusses the “when first” (ὅτε πρῶτον) of a motion in analogy to the “where first” of an object, that is, the place that contains it.

(successiveness of) movement. This is why it can be expressed in the perfect tense. I also noted that the perfect tense primarily carries a resultative connotation.

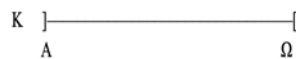
In Section 3.1, I discussed the transition from successiveness to time, expanding the before/after relationship to encompass any number of points or “nows.” Even when considering these points individually, we can employ the perfect tense, which assumes (also) a temporal significance: I state that something “has been” because it comes before something that is presently occurring, irrespective of whether there is a definite outcome achieved.<sup>56</sup>

Here, the points are not merely perceived as endpoints but as “nows” positioned within a reference framework constituted by the movement’s beginning and end.

This perspective applies within any individual successiveness, where we may establish connections between “segments” of the same movement by assigning numbers to their endpoints. However, what occurs when we attempt to extend this line of reasoning to encompass the entirety of movements, that is, time as a whole?

### *3.3.1 Topological Considerations*

Let us now revisit the concept of movement itself, which I depicted as an open segment, arguing that its endpoints are limits but do not belong to it. Graphically speaking:



*Figure 7*

I then associated open segments with verbs in the present tense, and the limits of these open segments with verbs in the perfect tense, highlighting how they are simply two different perspectives on the same subject. As for these limits, I briefly mentioned without delving into it that the left limit A belongs to the

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<sup>56</sup> Regarding the relationship between the three uses of the perfect tense see Chantraine (1926) and above n. 33.

state preceding the movement, while the right limit  $\Omega$  belongs to the state following it.<sup>57</sup> But what exactly does Aristotle say about this limit?

The issue of  $\Omega$ 's status is raised by Aristotle in *Physics* VI 3. Here, he states that if the “now” is the common boundary between the past and the future, and if a thing can move throughout the entire past and remain at rest throughout the entire future, then we encounter a paradox. It arises from the fact that in this common boundary, which belongs to both the past and the future, that thing must simultaneously move (as it is the extreme of the first time) and remain at rest (as it is also the extreme of the second time). In other words, we face the absurdity that  $\Omega$  must belong to the movement and yet also to the state that follows the movement.

ἔτι δ' εἰ τὸ αὐτὸ μὲν ἐστὶ τὸ νῦν ἐν ἀμφοῖν τοῖν χρόνοι, ἐνδέχεται δὲ τὸν μὲν κινεῖσθαι τὸν δ' ἡρεμεῖν ὅλον, τὸ δ' ὅλον κινούμενον τὸν χρόνον ἐν ὁπωῦν κινήσεται τῶν τούτου καθ' ὃ πέφυκε κινεῖσθαι, καὶ τὸ ἡρεμοῦν ὡσαύτως ἡρεμήσει, συμβήσεται τὸ αὐτὸ ἅμα ἡρεμεῖν καὶ κινεῖσθαι· τὸ γὰρ αὐτὸ ἔσχατον τῶν χρόνων ἀμφοτέρων, τὸ νῦν (*Phys.* VI 3.234a34-b5).

Moreover, inasmuch as it is the same now that belongs to both the times, and it is possible for a thing to be in motion throughout one time and to be at rest throughout the other, and that which is in motion or at rest for the whole of a time will be in motion or at rest in any part of it in which it is of such a nature as to be in motion or at rest: it will follow that the same thing can at the same time be at rest and in motion; for both the times have the same extremity, viz. the now.

Regardless of the fact that Aristotle refers to it as the “whole,” which can be understood as complete with its boundary, what I have previously labeled as “closed” in order to align with the terminology used in topology, the essence of the matter is that if we were to confine ourselves to considering only closed intervals, the issue of limit points would become unsolvable.

However, this argument is revisited and elegantly resolved in *Physics* VIII 8, where Aristotle asserts that even though the same limit exists, it should be understood as belonging to “the succeeding state” of the movable:

δῆλον δὲ καὶ ὅτι ἐὰν μὴ τις ποιῇ τοῦ χρόνου τὸ διαιροῦν σημεῖον τὸ πρότερον καὶ ὕστερον ἀεὶ τοῦ ὕστερου τῷ πράγματι, ἔσται ἅμα τὸ αὐτὸ ὄν καὶ οὐκ ὄν, καὶ ὅτε γέγονεν οὐκ ὄν. τὸ σημεῖον μὲν οὖν

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<sup>57</sup> In our language,  $\Omega$  is the extremal point of motion and the minimum of completed motion. In more Aristotelian terms, there is no ultimate instant of motion (= the present), but there is a first instant of having finished moving (= the perfect). *Phys.* VI 5.235b6-236a7, cf. *Phys.* VIII 8.263b9-15 mentioned below.



Monica Ugaglia, Discussing Natural Motion

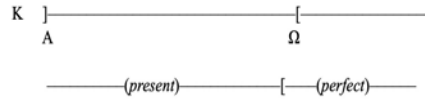


Figure 9

Based on this, we can depict movements and states on a line divided into open and closed intervals:

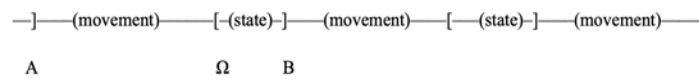


Figure 10

These intervals are associated with different verb forms. For instance, when discussing the open interval  $A\Omega$ , I use the present tense. However, when referring to the point  $\Omega$ , I have the option to use either the perfect or the present tense. I employ the perfect tense if I perceive it as the boundary of the preceding movement; but I can choose between the present and the perfect tense if I consider it as a point within the subsequent state. In a broader sense, I can interchangeably use the present or the perfect tense, depending on the context, to denote the closed interval  $\Omega B$ . Similarly, for the point  $B$ , I utilize the perfect tense when referring to it as the limit of the following movement; but I can opt for either the present or the perfect tense if I regard it as a point within the preceding state. This pattern continues throughout.

### 3.4 Time vs Duration

In Section 3.1, I proposed interpreting Aristotle's reference to number in his definition of time in light of the concept of number as the number of divisions of the continuum (*Phys.* III 7.207b11-14). I briefly mentioned that in both cases, the term "number" should not be taken in the improper sense of measurement. Now, to support my thesis, I will add some observations related to Aristotle's conception of the infinite.

Of course, the time of a movement also implies a duration. Once you have identified two distinct "nows," you can consider what lies between them, which Aristotle still refers to as time, as a measure of the movement,

just as you can consider what lies between two divisions of the continuum as a measure of extension. In this sense, time is continuous.

However, time is not solely duration, and Aristotle is careful to distinguish between the two. Although he does not employ separate terms, the intended meaning becomes evident from the semantic context:<sup>58</sup> time is always associated with number, while duration pertains to measurement.<sup>59</sup> But why is it crucial to keep time and duration distinct?

To address this question, let us revisit Aristotle's position concerning the infinite, starting from the previously mentioned passage from *Physics* III 7, and focusing on the final sentence:

ἐπὶ δὲ τὸ λεῖον αἰεὶ ἔστι νοῆσαι· ἄπειροι γὰρ αἱ διχοτομῖαι τοῦ μεγέθους· ὥστε δυνάμει μὲν ἔστιν, ἐνεργείᾳ δ' οὐ, ἀλλ' αἰεὶ ὑπερβάλλει τὸ λαμβανόμενον παντὸς ὀρισμένου πλήθους· ἀλλ' οὐ χωριστὸς ὁ ἀριθμὸς οὗτος τῆς διχοτομίας (*Phys.* III 7.207b11-14).

But in the direction of largeness it is always possible to think of a large number; for the number of times a magnitude can be bisected is infinite. Hence this infinite is potential, never actual: the number of parts that can be taken always surpasses any definite amount. But this number is not separable by the procedure of bisection.

The final clarification regarding the inseparability of the infinite number from the process of division is crucial for understanding Aristotle's notion of potential infinite, which is always related to some procedure. We can certainly stop the procedure at a certain point and obtain a number – say, seven – that can also be attributed to other things like a group of horses or stars. However, no matter how large we make this number, it will always be finite. In contrast, when we talk about the infinite number, we are specifically referring to the number of divisions of the continuum, or of the steps of another permissible infinite process within Aristotle's cosmos.

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<sup>58</sup> In *De caelo*, a similar situation arises concerning the distinction between weight as a quality (what we would call specific weight) and weight as a quantity (what we refer to as absolute weight). Although Aristotle uses the same term, the difference becomes clear from the semantic context: absolute weight is always accompanied by a term related to measurement. I have addressed this issue in Ugaglia (2015).

<sup>59</sup> The necessity to distinguish between number and measurement is discussed in detail in Cavagnaro (2002) and Coope (2005). While providing a compelling analysis in many respects, Sentesy (2018), on the other hand, reintroduces the overlap between number and measurement, time and duration (“time is the number of motion, an extent measured out by two nows that limit and define it – an extent taken as though it were indivisible,” p. 303).

In Aristotle's cosmos, actual infinity does not exist, neither in terms of size (there are no infinitely extended objects) nor in terms of quantity (there are no infinitely large sets of objects). Therefore, we cannot "obtain" an infinite number by counting an infinite number of objects that simply do not exist. The only way to "obtain" it is by counting the steps of an infinite process connected to a finite object (like a segment in the case of division).

Now, let us consider a different scenario. Instead of a segment, imagine we have a circle with a finite radius. Let us visualize a uniform circular motion occurring on the circle and try to count the revolutions. Since the motion is periodic, it is inherently infinite, and the act of counting becomes infinite as well. However, because the circumference on which the motion takes place is finite, this type of motion aligns perfectly with Aristotle's conception of the cosmos.

Like the process of dividing the continuum, the counting number is potentially infinite. However, in this case, since it counts a movement, this infinite number is nothing but the time of that infinite movement.

Just as the infinite number is inseparable from the process itself, the infinite time is inseparable from the periodic motion it counts. In my interpretation, this motion refers to the cycle of sublunary movements, but the same applies to the rotation of the celestial sphere. The important thing is the existence of a natural periodic infinite motion that can be counted.

Although the motion is circular – returning to itself after a period – the number that counts its "nows" never repeats itself. In this sense, we can say that time is infinite and it is linear.

It is now clear that this reasoning applies to the number, and it is evident why Aristotle's concept of time can be infinite and linear when defined as a number. If instead time were merely a measure, namely an extension, some problem would arise concerning how this extension can be said to be infinite. Indeed, while Aristotle acknowledges that numbers can be infinite towards the large, he explicitly denies that extension can be.<sup>60</sup>

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<sup>60</sup> I note that while we can affirm that the rotation of the celestial spheres has a time, we cannot affirm, except in an improper sense, that it is within a time, meaning that it has a duration. For something to be within a time, there must be a time that contains it, which is not the case in this instance. Similarly, we can only affirm, again in an improper sense, that the cosmos is within a place (*Phys.* IV 5.212b7-22).

For this reason, I lean towards the view that when he says “number”, he means it in the literal sense and not as a figure of speech for “measure”.

### 3.4.1 *Number vs Measure*

But what does this reasoning amount to if we consider a different system from Aristotle’s? The rationale I just presented in support of understanding time as a number is closely tied to the finite nature of Aristotle’s cosmos and his unique conception of the infinite. Once we move beyond finitude or loosen the constraints on the infinite, the necessity of understanding time as a number diminishes, and a more “natural” notion of time as a measure can be reintroduced.

However, once we remove the reference to number, which, as we have seen, is intimately linked to the concept of division in Aristotle’s framework, the significance of the unextended “now” – a division, in essence – becomes less prominent. It can ultimately be replaced with the idea of an extended present, which aligns better with the verbal system.

This is in a sense what happens in Stoic philosophy. The Stoics rejected both Aristotle’s definition of time as a number and the notion of the  $\nu\upsilon\nu$  as a limit. By redefining time as an interval,<sup>61</sup> they introduced the concept of an extended present (*ἐνεστῶς παρατατικός*) to replace the unextended “now” that Aristotle sought to address. Consequently, they developed a framework that Hoffmann describes as “a present of physical time isomorphic to the value of the extended verbal present.”<sup>62</sup>

The convergence of time and extension, along with its connection to the verbal system, reached its culmination in Neoplatonic philosophy when Damascius defined time as the “measure of the duration of being” (*μέτρον τῆς τοῦ εἶναι παρατάσεως*). Here, the term *παρατάσις* is directly borrowed

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<sup>61</sup> *διάστημα τῆς τοῦ κόσμου κινήσεως* *SVF* II 510.

<sup>62</sup> Hoffmann (1983) p. 6. See, in particular, the discussion of the passage in Priscian where the dilation of the present moment is justified by invoking Aristotle himself, who understood the present moment not only as a limit (*πέρας*) that separates the past and the future but also as a conjunction (*συνέχεια*, *Phys.* IV 13.222a10-12) that holds them together. Unlike the limit, which is necessarily punctual, the conjunction (*iuncturam*) can be seen as something extended that holds the past and the future together (*ibid.*, p. 7).



from grammar and serves as the technical term for describing the durative aspect of the verb.

For a more detailed exploration of the path leading from the Stoic definition to the Neoplatonic interpretation, specifically through the lens of grammar, I recommend consulting Hoffmann's article, which provided the foundation for the present article. It is worth noting that Damascius firmly believed that his interpretation aligned with Aristotle's true intentions.<sup>63</sup>

Interestingly, this brings us full circle. We began with Aristotle's definition of time in relation to motion, suggesting that it draws heavily on the analysis of how the Greek language, particularly its verbal system, describes motion. And now, we find ourselves back at that very definition, reinterpreted within a Neoplatonic framework and illuminated by the same linguistic factors, which have been partially formalized through the study of grammar. The main difference lies in the fusion and complementarity of philosophy and grammar in Neoplatonic discourse, whereas they remained distinct in Aristotle's analysis.

As I have attempted to demonstrate in this article, Aristotle was careful to distinguish between the realm of motion itself, which is discussed in terms of pure aspect and characterized by the notion of an extended present, and the realm of motion as successiveness, where the speaker's concern extends beyond aspectual matters to include temporal relations of before and after. While both perspectives involve the examination of the same object, that is, motion, Aristotle takes great care to keep them separate. Importantly, he never conflates the two meanings of "now" when referring to these respective domains, a distinction that is usually evident from the context.

For instance, when Aristotle says, "Now I am walking," it is clear that he is employing the term "now" in reference to the extended present, pertaining to the motion itself rather than its temporal aspect. Conversely, when he asserts that "now" signifies the demarcation between the before and after of a motion (or, more broadly, the past and future), he is addressing the successiveness of motion or, in a broader sense, the concept of time. In this

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<sup>63</sup> Damascius read Aristotle in light of Pseudo-Archytas, whom he considered a primary source. It was indeed Pseudo-Archytas who interpreted number and interval as synonymous, both referring to measure understood as order. See Hoffmann (1983) p. 19.

context, “now” should be understood as the unextended<sup>64</sup> boundary where nothing is in motion.<sup>65</sup>

Aristotle seems to have been the first to realize that in order to understand the relationship between motion and time, it was necessary to separate the two realms. By doing so, he manages to keep a part the definition of time from the perception of time. The perception of time has to do with duration and with the extended present. The definition of time focuses on successive-ness and on the unextended “now”. The inclusion of the semantic domain of numbers and counting, which belongs to the realm of time but is foreign to that of motion, is crucial to this separation.

However, the difficulty of the subject matter, the dialectical nature of the argument as presented in *Physics* IV, and the apparent constraints that this mode of reasoning imposes on language gradually leads to a decrease in references to numbers among developments of Aristotle’s conception. Reference to numbers will be replaced by an emphasis on measurement. Because of this seemingly innocent semantic shift, which appears to be supported by putative Aristotelian origins, the two levels of discourse will once again converge. Simultaneously, the distinction between aspect and verb, recognized by Aristotle in linguistic observations but not yet codified, will be formalized by grammarians and used by Neoplatonic philosophers, not to keep the levels apart, but to unite them.

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<sup>64</sup> Aristotle introduces a different terminology for the “now” of time understood in a proper sense, which is called “by itself” (*καθ’αυτό*), and for the present of common language, which is called “according to another” (*καθ’ ἕτερον*): “And it is also necessary that the now, not the one called according to another but by itself and primarily, be indivisible” (*Ἀνάγκη δὲ καὶ τὸ νῦν τὸ μὴ καθ’ ἕτερον ἀλλὰ καθ’αὐτὸ καὶ πρῶτον λεγόμενον ἀδιαίρετον εἶναι*, *Phys.* VI 3.233b33-34).

<sup>65</sup> Consider the opposition between being in motion and being “with respect to something” (*κατὰ τι*) introduced in *Physics* VI and used to resolve Zeno’s paradox of the arrow. In time, it can be said that something is in motion but not that it is *κατὰ τι*, whereas in the now, it can be said that it is *κατὰ τι* but it makes no sense to say that it is in motion (see especially *Phys.* VI 3.234a25-b9 and VI 8.239a36-b3).

#### 4. Conclusion

In this paper, I have delved into Aristotle's concept of motion, exploring it at three distinct levels:

1) Motion in itself: natural motion considered in its entirety, characterized by its teleological orientation and qualitative aspects.

2) Successiveness: what remains of that motion outside of a physical perspective.

3) Time: the counted successiveness, interlinked with one another.

Alongside these levels of analysis, I have identified three verbal structures associated with them:

1) Structure of present: actions are considered as actions, with a discernible ontological order of before and after. The beginning of motion is designated as before, while its end is labeled as after. Before and after are separated by an extended present.

2) Structure of perfect: by reducing actions to mathematical objects, an internal division emerges, establishing a sequential order of before and after. This temporal distinction is now represented by a punctual "now," which is the "now" of a specific movable.

3) Structure of time: in the action, reduced to a mathematical object, two or more divisions are identified, and the focus is on the relationship between these divisions, which are counted. The relationship is extended to divisions belonging to different successiveness, that is, different motions. Consequently, the local order of before and after expands into a universal sense of past and future. The past and the future are demarcated by a punctual "now," representing the unextended present for all objects moving together.

If we consider the logical-ontological plane and ask what comes first, then level (1) is the most foundational because it underlies the others: (1) serves as the base from which we derive (2), and from (2) we derive (3). However, if we shift our focus to the epistemological plane and ask which level better explains the structural order of change, then (3) takes precedence, and the sequence is reversed: in (3), the order is expressed in general terms, in (2) in specific terms, and in (1) it is not yet articulated.

Furthermore, as we move from (1) to (3), from the level of motion as motion to the level of motion as time, there is an increasing amount of

analysis and reevaluation applied to observation, resulting in the emergence of a greater clarity in the structure of order. The more we mediate the original data regarding motion, the clearer the order becomes.

Does all of this imply that time is subjective? Or perhaps less objective than motion? To put it in more Aristotelian terms: if time is number and the soul is what counts, can there be time without a soul?

As mentioned earlier, I do not claim to have an answer to this question. What I argue is that the type of response one chooses to give to this question is closely tied to the response one would give to the question: can there be mathematical objects in the absence of a soul?

Certainly, it can be affirmed that even in the absence of a soul, there are physical objects, including mathematical ones. However, they are not distinct entities, but rather inseparable except in the realm of thought. Likewise, it can be asserted that even without a soul, there is motion, and thus, the logical structure of motion exists, which I have referred to as successiveness. It is an inherent aspect of motion, not separate from it, and, like mathematical objects, inseparable except in the realm of thought, that is, in the soul.

This seems to be what Aristotle himself implies when addressing the question regarding the relationship between time and the soul:

πότερον δὲ μὴ οὐσίας ψυχῆς εἶη ἂν ὁ χρόνος ἢ οὐ, ἀπορήσειεν ἂν τις. ἀδύνατον γὰρ ὄντος εἶναι τοῦ ἀριθμήσοντος ἀδύνατον καὶ ἀριθμητόν τι εἶναι, ὥστε δῆλον ὅτι οὐδ' ἀριθμός. ἀριθμός γὰρ ἢ τὸ ἠριθμημένον ἢ τὸ ἀριθμητόν. εἰ δὲ μὴδὲν ἄλλο πέφυκεν ἀριθμεῖν ἢ ψυχὴ καὶ ψυχῆς νοῦς, ἀδύνατον εἶναι χρόνον ψυχῆς μὴ οὐσίας, ἀλλ' ἢ τοῦτο ὅ ποτε ὄν ἐστὶν ὁ χρόνος, οἷον εἰ ἐνδέχεται κίνησιν εἶναι ἄνευ ψυχῆς. τὸ δὲ πρότερον καὶ ὕστερον ἐν κινήσει ἐστίν. χρόνος δὲ ταῦτ' ἐστὶν ἢ ἀριθμητὰ ἐστίν (*Phys.* IV 14.223a21-29).

Whether if soul did not exist time would exist or not, is a question that may fairly be asked; for if there cannot be someone to count there cannot be anything that can be counted either, so that evidently there cannot be number; for number is either what has been, or what can be, counted. But if nothing but soul, or in soul reason, is qualified to count, it is impossible for there to be time unless there is soul, except that there could be that, whatever it is, by being which time is, i.e. if movement can exist without soul. The before and after are attributes of movement, and time is these qua countable (with minor changes to Barnes' translation).

So, if mathematical objects exist without a soul to bring them forth, then the successiveness of motion also exists without soul. Otherwise, if mathematical objects are created by a soul, and do not exist without a soul, also the successiveness is created by a soul, and does not exist without the soul.

Therefore, accepting the idea that mathematical objects do not depend by a soul, I am inclined to assert that at least up to level (2), we are dealing with something objective. The question that remains is regarding level (3), specifically time in its proper sense. It might indeed require an intellect capable of numbering, much like the concept of number itself when understood as the potentially infinite divisions of the continuum.

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GIUSEPPE FEOLA

ARISTOTELE SULL'ANALOGIA TRA LE FACOLTÀ  
COGNITIVE DEGLI ESSERI UMANI  
E DEGLI ALTRI ANIMALI

**Aristotle on the Analogy between the Cognitive Faculties  
of Human Beings and Other Animals**

**Abstract**

In *Historia animalium* VIII 1.588a18 ff., Aristotle describes the cognitive powers of non-human animals as sketches of human cognitive powers. According to the wording he chooses here, the cognitive powers of non-human animals are “traces” or “footprints” (ἵχνη, 588a19) of human ones. In this paper I explore the conceptual framework that lays behind this image, in order to show that it is much more than a rhetorical figure, and that Aristotle’s wording encompasses a whole articulated theory, whose details are set out in *De anima* and the *Parva naturalia*. Moreover, I try to clarify some technicalities of the scientific model he devises in order to explain certain features of the sensory-perceptual part of the soul (with particular attention to the perception of the so-called “common” and “incidental” sensory items) that bear a real analogy to the functions of reason and intellect, and that can consequently be considered their precursors.

**Keywords**

Non-human Animals, Sense-perception, *phantasia*,  
Reason and Intellect, Analogy

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1. *Historia animalium VIII 1.588a25-b2: temi e problemi*

Gli studi sulla psico-biologia animale di Aristotele, ossia sulle sue teorie circa la cognizione e sul comportamento animale, sono molto cresciuti negli ultimi vent'anni,<sup>1</sup> e affrontano varie sfaccettature delle sue ipotesi circa la relazione tra facoltà cognitive e comportamento.<sup>2</sup> Manca però ancora, a nostro avviso, un tentativo complessivo di ricostruzione che consideri sia lo schema unitario di tutte le sue ipotesi a riguardo, sia la varietà di applicazioni in cui tale schema è utilizzato.<sup>3</sup> Senza la pretesa di esaurire qui l'argomento, si cercherà di fornire una chiave di lettura tramite la nozione di *phantasia*.

Secondo Aristotele, tra tutte le specie animali, solo quella umana possiede il *logos* (λόγος)<sup>4</sup> o “ragione”.<sup>5</sup>

Alle altre specie animali sono attribuite differenti forme di intenzionalità. La domanda che qui si pone è la seguente: che tipo di intenzionalità Aristotele attribuisce agli animali non umani (alla lettera, “fiere”, θηρία<sup>6</sup>)? In via preliminare, sulla base di un esame molto superficiale dei testi, riconosciamo due tipi di intenzionalità attribuita ad essi: ovviamente la sensazione semplice, che è la differenza essenziale del genere *animale* nell'ambito del più

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<sup>1</sup> Cfr. p. es. Carbone (2011), Charles (2013), Cooper (2012), Gourinat (2015), Henry (2013), (2015), Johnson (2005), Küllmann (2001), Leunissen (2010), Quarantotto (2005), Rashed (2002), Sedley (2010), oltre a tutti gli studi contenuti in Connell (2021b).

<sup>2</sup> Cfr., tra gli altri, Connell (2021a), Corcilius (2008), (2013), Charles (2011), Labarrière (2005), Schmitt (1996), e ovviamente tutti gli studi inclusi nel volume edito da Primavesi e Rapp (2020), oltre all'accuratissimo commento al *De motu animalium* in Primavesi & Corcilius (2018).

<sup>3</sup> Fra i contributi di carattere più sintetico cfr. Beare (1906), Connell (2021), Corcilius (2008), Labarrière (2005), Morel (2007) e (2016).

<sup>4</sup> Cfr. *Pol.* I 2.1253a10. Si noti che l'intelletto (νοῦς) è anche proprio della natura del dio, che Aristotele chiama ζῶον (cfr. p.es. *Metaph.* Λ 7.1072b29) senza attribuirgli il *logos*: quindi è propriamente il *logos* a costituire la differenza specifica della specie umana rispetto a tutti gli altri enti e, più specificamente, rispetto agli altri animali.

<sup>5</sup> Una tradizione secolare ha portato il latino *ratio* a fungere da calco del greco λόγος, sia nel lessico psicologico che in quello matematico (dove vale “rapporto”): riteniamo dunque “ragione” la più adeguata traduzione del termine.

<sup>6</sup> θηρίον non ha in greco il valore spregiativo che ha in italiano “bestia”. La traduzione più appropriata sarà “fiera” o, se si vorrà evitare un arcaismo, si dovrà ricorrere alla perifrasi “animale non umano”.



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ampio significato di *vivente*,<sup>7</sup> e poi altre forme, su alcune delle quali avremo modo di soffermarci. Il primo tipo è assai studiato dallo Stagirita nelle sue trattazioni sulla sensazione elementare e sulle sue tipologie;<sup>8</sup> non sarà dunque questo l'argomento in esame. Per quanto riguarda il secondo, Aristotele attribuisce ad alcuni animali forme di intenzionalità non limitate ai cinque sensi: la *phantasia* (φαντασία),<sup>9</sup> la memoria (μνήμη),<sup>10</sup> ed anche altre, a quanto sembra di poter evincere da *Historia animalium* VIII 1.588a25-b2. Ivi Aristotele enumera caratteri anatomici e funzionali in qualche modo comuni, seppur con differenze, all'uomo e agli altri animali. Alcuni di questi caratteri sono comuni solo "per l'analogia"; per altri, le differenze sono "secondo-il-più-e-il-meno", sono cioè questione di misura:<sup>11</sup>

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<sup>7</sup> Cfr. *PA* III 4.666a34: la sensazione è ciò che definisce l'animale. Più specificamente, il tatto, il più basilare tra i cinque sensi, costituisce la base di tutte le eventuali altre forme di sensazione; è dunque il tatto a essere coesteso al genere *animale*, definendolo essenzialmente (*De an.* III 13.435b4-17).

<sup>8</sup> *De an.* II 7-11, *Sens.* 1-6.

<sup>9</sup> La *phantasia* è attribuita agli animali in *De an.* III 3.429a5-9 con il compito di motivare all'azione; tale ruolo è tematizzato più ampiamente in *MA* 6-8, dove più volte è proposto il parallelo tra il ruolo che la *phantasia* non controllata dal pensiero (νοῦς) svolge negli animali non umani e il ruolo del pensiero nell'uomo quale facoltà motivatrice e orientatrice dell'azione. Cfr. *De an.* III 10.433a12 e 27, e *MA* 6.700b18-21. Per la traduzione di νοῦς in questi luoghi, con "pensiero", cfr. Nussbaum (1985) p. 333; Primavesi & Corcilius (2018) p. 103.

<sup>10</sup> Cfr. *Mem.* 2.453a6-10 per l'attribuzione ad alcuni animali della memoria, τὸ μνημονεύειν (non però dello ἀναμνησθεσθαι, che è una sorta di συλλογισμὸς τις, e non appartiene, dice Aristotele, ad alcun animale conosciuto, tranne che all'uomo). Cfr. anche *An. post.* II 19.99b34-100a6, *Metaph.* A 1.980b26, dove però non è chiaro se il concetto di 'memoria' in gioco sia quello tecnico sviluppato nel *De memoria*, il possesso di una rappresentazione in quanto immagine di un evento passato (*Mem.* 1.451a15-17). Cfr. Lanza in Lanza & Vegetti (1971) n. 30.

<sup>11</sup> Coles (1997) p. 293, nota che la *scala naturæ* cognitiva abbozzata da Aristotele è talvolta formulata in termini di 'più-e-meno', talaltra in termini di analogia. Pur descrivendo e interpretando in modo spesso brillante i passi dove Aristotele parla di una forma di intelligenza non umana, Coles sembra però sottovalutare le difficoltà insite nell'attribuire ad Aristotele la tesi per cui gli animali avrebbero νοῦς (1997, p. 296). Una posizione che equilibra queste difficoltà si trova in Schmitt (1997). Sulle differenze riconosciute da Aristotele tra cognizione umana e non umana cfr. Van der Eijk (1997) p. 255. Sulla genesi del concetto di *scala naturæ* si mostra ancora utile il classicissimo Solmsen (1955); sulla struttura dello stesso si veda invece Granger (1985).

Infatti per alcuni dei caratteri menzionati è <solo> nel più e nel meno che alcuni animali differiscono dall'uomo, e che l'uomo differisce da molti degli animali; rispetto ad altri [caratteri] c'è analogia: come infatti nell'uomo [vi sono] tecnica e sapienza e comprensione, così alcuni degli animali hanno un'altra siffatta capacità naturale. Quanto detto è chiarissimo per chi osserva la condizione dei bambini: in quella fase di tempo, è possibile vedere come tracce (ἵχνη) e semi (σπέρματα) delle disposizioni che poi vi saranno, e l'anima non differisce in nulla, per così dire, da quella degli animali non umani in questo periodo di tempo. Così, non è irragionevole se alcune caratteristiche [della loro anima] sono identiche, altre simili, altre ancora analoghe a quelle degli altri animali.<sup>12</sup>

Le parole chiave “traccia” o “impronta” (ἵχνος), e “seme” (σπέρμα) caratterizzano il rapporto tra le prestazioni cognitive proprie dell'infante e quelle dell'uomo adulto. Le capacità cognitive infantili, pre-verbali, sono esplicitamente assimilate a quelle cognitive di alcune specie non umane: Aristotele può affermare che le une e le altre non differiscono in nulla – almeno “per così dire” (ὡς εἰπεῖν, 588b1).<sup>13</sup>

Nello sviluppo delle facoltà sono quindi riconosciute due fasi: nella prima vi è un'identità per genere delle prestazioni cognitive del bambino con

<sup>12</sup> *Hist. anim.* VIII 1.588a25-b2: Τὰ μὲν γὰρ τῷ μᾶλλον καὶ ἥττον διαφέρει πρὸς τὸν ἄνθρωπον, καὶ ὁ ἄνθρωπος πρὸς πολλὰ τῶν ζώων (ἔνια γὰρ τῶν τοιούτων ὑπάρχει μᾶλλον ἐν ἀνθρώπῳ, ἔνια δ' ἐν τοῖς ἄλλοις ζώοις μᾶλλον), τὰ δὲ τῷ ἀνάλογον διαφέρει· ὡς γὰρ ἐν ἀνθρώπῳ τέχνη καὶ σοφία καὶ σύνεσις, οὕτως ἐνίοις τῶν ζώων ἐστὶ τις ἕτερα τοιαύτη φυσικὴ δύναμις. Φανερώτατον δ' ἐστὶ τὸ τοιοῦτον ἐπὶ τῆν τῶν παιδῶν ἡλικίαν βλέψασιν· ἐν τούτοις γὰρ τῶν μὲν ὑπερῶν ἕξω ἐσομένων ἔστιν ἰδεῖν οἷον ἵχνη καὶ σπέρματα, διαφέρει δ' οὐδὲν ὡς εἰπεῖν ἡ ψυχὴ τῆς τῶν θηρίων ψυχῆς κατὰ τὸν χρόνον τοῦτον, ὥστ' οὐδὲν ἄλογον εἶ τὰ μὲν ταῦτ' ἀπὸ τῶν δὲ παραπλήσια τὰ δ' ἀνάλογον ὑπάρχει τοῖς ἄλλοις ζώοις. (Sull'inciso ὡς εἰπεῖν, 588b1, omissio in A<sup>a</sup> e C<sup>a</sup>, cfr. *infra*, n. 13.) Ove non altrimenti indicato, tutte le traduzioni da testi antichi o stranieri sono mie. Si noti tra l'altro che, se ha ragione Fazzo (2004), secondo cui il *De motu animalium* non è un trattato sui principi del movimento animale, bensì “un texte composite sur le principe universel de tout mouvement possible” (p. 229), aumenta l'importanza di *Hist. anim.* VIII e IX, perché è a questi libri che sarebbe delegata l'unica presentazione delle teorie di Aristotele sui comportamenti animali.

<sup>13</sup> Per ora seguiamo il testo di Louis, ma dobbiamo tener conto che molto probabilmente questo inciso è un'inserzione tardiva. Come Silvia Fazzo mi fa notare, in 588b1 l'inciso “ὡς εἰπεῖν” (qui tradotto “per così dire”) non compare nei codici A<sup>a</sup>, *Marcianus* 208, e C<sup>a</sup>, *Laurentianus* 87.4 (Louis 1969, p. 2). Questi secondo Louis i due manoscritti più antichi tra quelli integri superstiti, la cui autorità è corroborata dai frammenti del *vetustissimus Parisinus* Suppl. gr. 1156 (Louis 1964, pp. xlvii-xlviii). L'argomento dello studio presente risulta peraltro per più aspetti rinforzato se si opta per il testo di A<sup>a</sup> e C<sup>a</sup>. D'altronde, sempre come nota Fazzo (*per verba*), per Aristotele *le facoltà dell'anima progressivamente si includono le une nelle altre*: questo schema teorico, nella sua estrema generalità, implica una forma di significativa identità fra alcune facoltà dell'anima umana e quelle degli animali inferiori.

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quelle di alcuni animali; da tali facoltà si svilupperanno le facoltà umane adulte. La parola “seme”, a proposito delle facoltà infantili, sembra riferirsi solo alla condizione infantile, mentre “traccia, impronta” appare più atta a caratterizzare la condizione non umana, al centro dell'attenzione di Aristotele in questo capitolo. Passiamo dunque ad esaminare quale sia l'uso di quest'ultima parola, e cerchiamo di capire quali teorie implichi: il modello che andremo a ricostruire dovrà giustificare l'estensione delle facoltà in esame a una parte del regno animale.

## 2. L'articolazione e la natura dell'ipotesi di Aristotele

L'ipotesi principale di Aristotele muove da questa osservazione: un animale umano sviluppa progressivamente le proprie capacità linguistiche e razionali a partire da un grado in cui non ha ancora *logos*, ma è capace di prestazioni cognitive identiche o affini<sup>14</sup> a quelle di alcune specie animali. Tale osservazione si fonda sull'esperienza di innumerevoli generazioni, ed è perciò per Aristotele inconfutabile. L'ipotesi deve spiegare come sia possibile *in rerum natura* che un vivente passi da uno stadio in cui possiede determinate funzioni non

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<sup>14</sup> A 588a28 Aristotele mette in rapporto di analogia gli infanti e gli animali con gli uomini adulti; tra infanti ed animali pone invece una sorta di identità, molto più forte di un'analogia. Se il *caveat* “per così dire” (ὡς εἰπεῖν, 588b1) non è una glossa posteriore (cfr. n. prec.), esso si riferisce alle facoltà cognitive infantili, il “seme” da cui poi si svilupperanno le facoltà cognitive umane adulte, fenomeno impossibile nelle facoltà animali. Eccetto questa differenza le facoltà cognitive degli infanti si mostrano identiche a quelle animali, almeno nella prospettiva in esame. Certo, ogni specie animale avrà le sue facoltà e le sue modalità cognitive proprie – come diffusamente illustrato dagli interi libri VIII e IX della *Historia animalium* –, e analogamente saranno differenti gli infanti umani dagli altri animali, in modo che le differenze cesseranno di apparire un “nulla”. Tuttavia, a un determinato livello di generalità, Aristotele afferma chiaramente che è possibile considerare le facoltà cognitive dell'infante identiche a quelle di alcune specie animali. Ciò implica che l'anima sia soggetta a successivi momenti di sviluppo, in contrasto con la ben nota dottrina che ritiene l'anima non soggetta al cambiamento: cfr. *Phys.* I 9.192a27-29. Cfr. anche *De an.* I 4.408b1-18. Probabilmente, coloro che hanno operato l'inserzione della clausola “ὡς εἰπεῖν” lo hanno fatto proprio perché convinti che il testo, così come era stato loro tramandato, porrebbe una ‘sfida’ al ben noto passo *De an.* I 4.408b1-18. E la stessa *ratio* ha guidato le scelte editoriali di Louis. Si tornerà sulla questione *infra*, §5.

logiche e non verbali, comuni ad alcuni animali e agli infanti, ad uno in cui possiede le facoltà logiche e verbali, distintive dell'umano adulto.<sup>15</sup>

Per esempio, sia il cane sia l'infante sanno distinguere un estraneo di cui diffidare da un amico o parente fidato: possiedono le categorie di *alleato* ed *estraneo* e tendono a collocare (a volte con successo, altre no) persone o animali con cui devono rapportarsi nell'una o nell'altra categoria. Ciò presuppone che l'infante e l'animale ricorrano alle medesime risorse: le loro anime quasi non differiscono (588b1), ma attraversano le stesse tappe cognitive.<sup>16</sup> Così, ricorrendo alla teoria delle capacità del vivente, ossia dei tipi di anima, è possibile individuare queste risorse in quelle dell'anima sensitiva o percettiva. In questo modo tanto l'infante quanto l'animale rappresentano istanze di quel tipo di organizzazione propria del vivente che è l'anima percettiva,<sup>17</sup> l'animale perché ha l'anima percettiva per essenza; l'infante perché non possiede ancora le funzioni dell'anima intellettiva-razionale che nello sviluppo si sovrappongono all'anima percettiva, mutandone le funzioni.

Aristotele sembra ritenere possibile un modello di cognizione non verbale, non elementare (cioè non limitata ai cinque sensi), sufficientemente astratto da valere come modello del funzionamento dell'anima percettiva in generale, tanto nei casi in cui sia la funzione dell'anima essenzialmente propria di alcuni animali, quanto nei casi in cui appartenga agli infanti, e quindi non sia ancora subordinata al governo dell'anima razionale.

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<sup>15</sup> Trattare questo aspetto, estremamente sfumato, visto che non mancano affermazioni aristoteliche in apparente contrasto con l'esegesi standard, secondo cui l'anima non è soggetta a mutamento e movimento (cfr. p.es. *Somn. vig.* 1.454a9-10, *Phys.* VII 2.244b11-12), richiederebbe un contributo a sé.

<sup>16</sup> Per quanto poi riguarda l'anima vegetativa e riproduttiva, la biologia aristotelica prevede che quella di ciascuna specie sia distinta da ogni altra, visto che essa gestisce le funzioni di crescita, mantenimento e riproduzione di corpi da specie a specie diversi, che richiedono operazioni diverse: cfr. Menn (2002), in particolare pp. 121-2.

<sup>17</sup> Che Whiting (2002) chiama "anima motrice" (*locomotive soul*). Spetta a questa studiosa il merito di aver chiarito due differenti tipi di relazione tra le funzioni del vivente: la prima tra funzioni diverse che investono la stessa parte dell'anima, la seconda tra funzioni che pertengono a parti diverse dell'anima. La posizione di Whiting rivede quella di Menn (2002) e in qualche modo la integra.

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In questione, quindi, non sono né l'infante né l'animale (le cui facoltà cognitive sono oggi oggetto di indagini scientifiche notevolmente ardue<sup>18</sup>), ma il modello generale di un'anima non linguistica e non razionale, non limitata ai cinque sensi. La sua possibilità è garantita dalla presenza di prestazioni cognitive complesse in enti non ancora razionali, come gli infanti. Aristotele costruisce il suo modello unendo le osservazioni condotte sugli infanti e sugli animali alla teoria dell'anima percettiva sviluppata nel *De anima* e nei *Parva naturalia*.<sup>19</sup> Inoltre, in *An. post.* II 19 Aristotele spiega i vari stadi di sviluppo dell'anima umana, descrivendo lo sviluppo dell'esperienza dal grado più semplice, quello della sensazione elementare, fino a quello del possesso dei concetti scientifici.

Abbiamo visto che Aristotele è propenso a trattare come realtà tra loro confrontabili l'anima umana in fase di sviluppo e le anime di certi animali. Il modello di *An. post.* II 19 fornisce elementi preziosi da integrare alle teorie del *De anima* e dei *Parva naturalia*. Cercheremo ora di interpretare quanto Aristotele afferma sui gradi di sviluppo delle facoltà umane per comprendere la sua teoria sulle facoltà degli animali.

Ciò permette, osservando le fasi della crescita umana, di 'mappare' il territorio intermedio tra facoltà cognitive sensorio-fantastico-percettive, che nell'infante non interagiscono col *logos*, e le facoltà adulte, nelle quali l'interazione tra *logos*, *phantasia* e percezione è invece pervasiva.

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<sup>18</sup> Un'introduzione, comprensiva di discussioni metodiche, allo studio delle modalità cognitive degli animali è costituita da Vallortigara (2000).

<sup>19</sup> Riassumendo: l'*identità*, presunta da Aristotele, tra le prestazioni cognitive di cui l'infante è *attualmente* capace prima di acquisire il linguaggio e quelle di alcuni animali non umani permette di usare la condizione infantile umana come caso parallelo dei tipi di cognizione di cui quegli animali sarebbero capaci: la gradualità stessa del passaggio dalla condizione infantile a quella adulta che si esprime attraverso il linguaggio dà ragione di ritenere che tra l'una condizione e l'altra lo iato non sia invalicabile. Si ottengono così due conclusioni generalissime, distinte: (1) l'anima di alcuni animali non umani obbedisce allo stesso tipo di funzionalità dell'anima degli infanti umani; (2) l'anima dell'uomo adulto è frutto di uno sviluppo che, partendo da un livello identico a quello di alcuni animali non umani, porta a un altro livello.

3. Un'ipotesi di lavoro sulla teoria aristotelica circa la sensazione e percezione

Secondo Aristotele, la sensazione elementare è già cognizione di proprietà di enti nel mondo o di caratteri dell'ambiente, ed è dotata di intenzionalità, ossia di riferimento cognitivo al mondo esterno. Il sostantivo αἴσθησις e il verbo αἰσθάνομαι possono riferirsi infatti correntemente sia all'atto dei cinque sensi, sia ad azioni molto più complesse: in ogni caso, si tratta di atti cognitivi rivolti all'esterno.<sup>20</sup>

Per giustificare l'attribuzione dell'intenzionalità ad animali che egli presume non dotati di *logos*, Aristotele sviluppa il concetto di 'discriminazione'. In *De an.* II 6.418a14, 11.424a5-10, e III 2.426b10, egli definisce la sensazione un κρίνειν, anche se non è diretta dalla ragione in ogni sua istanza.<sup>21</sup> Essa comunque comporta il distinguere e il discernere una cosa da un'altra.<sup>22</sup>

Ora, come ci può essere intenzionalità senza proposizionalità? Si può pensare a una corrispondenza biunivoca tra gli stati del mondo esterno, che l'animale percepisce in quanto sensibili, e gli stati fisiologici del sistema sensorio centrale. L'azione sulla pupilla di un'istanza nell'ambiente di un determinato colore C<sub>1</sub>, produce su di essa e poi sull'organo di senso centrale un discostarsi da un 'blind spot' intermedio (chiamato in *De an.* III 13.435a21-22 "medietà": μεσότης), che si concretizza (e viene registrato) come stato sensorio (αἴσθημα) C<sub>2</sub>; quest'ultimo risulta automaticamente riferito a C<sub>1</sub> in virtù della corrispondenza tra le varietà dei sensibili esterni e i modi in cui lo

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<sup>20</sup> Per questo valore del verbo greco, sono particolarmente significativi esempi come A. *Pr.* 957, S. Aj. 1318-9, *Pb.* 75, E. *Hipp.* 603, *Tr.* 638.

<sup>21</sup> Esame dei valori del verbo quando è usato da Aristotele in Kal (1988) p. 149 n. 6 e Polansky (2010) pp. 255, 334, 394.

<sup>22</sup> Infatti, se la sensazione elementare fosse già proposizionale e fosse già una forma di giudizio, Aristotele non potrebbe appellarsi a essa nella spiegazione della genesi della proposizionalità e delle facoltà di giudizio, come invece fa in *An. post.* II 19.99b32-100a3, dove, in coerenza col *De anima*, la sensazione è caratterizzata come una facoltà o capacità o potenza (δύναμιν) "discriminativa" (κριτικήν, 99b35). Su questo punto cfr. Barnes (2002) p. 263: "it seems more probable that he had discrimination rather than judgement in mind [...]: if a capacity to judge presupposes some conceptual mastery, then Stage (A) [quello della sensazione] will already involve the possession of concepts, and the [...] account cannot coherently function as an account of concept-acquisition", e Detel (1993) p. 831: "Die Wahrnehmung [...] ist also nicht notwendigerweise propositional".

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stato del sensorio si discosta dalla 'medietà'. Per Aristotele è così che distinguiamo e discerniamo i colori.<sup>23</sup>

Come tra poco vedremo, a molte specie animali Aristotele attribuisce tipi di intenzionalità ben più complessi della sensazione elementare. Questi, in assenza di *logos*, devono necessariamente spiegarsi sulla base di ipotetiche 'estensioni' delle facoltà sensorio-percettive, ossia come prestazioni dell'anima sensitiva. Inoltre, negli animali in cui si manifestano questi tipi di intenzionalità, l'anima sensitiva che ne è responsabile è anche la forma sostanziale dell'animale stesso. Ora, il grado molto elevato di unità ontologica che Aristotele pone come irrinunciabile per ogni forma sostanziale esige che anche le facoltà percettive complesse si colleghino organicamente alla sensazione semplice, affinché l'anima sensitiva si caratterizzi in modo unitario. Dovremo indagare in che modo e con quali limiti tale unitarietà sia garantita.

#### 4. La percezione complessa

In *De an.* III 3 Aristotele postula negli animali la presenza della *phantasia*. L'introduzione della *phantasia* serve a risolvere il problema della natura dei tipi di cognizione intermedi tra sensazione semplice, ragione e intelletto.<sup>24</sup> La permanenza dello stato sensorio è il punto di partenza di una teoria su un livello di cognizione non concettuale e non proposizionale, il livello *da cui* sorgono intelletto e *logos*. Secondo infatti *An. post.* II 19.99b36-37:

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<sup>23</sup> Abbiamo argomentato *in pro* della nostra interpretazione della teoria di Aristotele sulla sensazione elementare in Feola (2014). Qui prendiamo le mosse da questa ipotesi di lavoro, fondamento necessario del contributo. L'ipotesi proposta è compatibile d'altronde con una corrente di interpretazione bene attestata, nella quale si collocano, tra gli altri, Ward (1988), Silverman (1989), Sisko (1996), Rapp (2001), Polansky (2010), che attribuisce alla sensazione elementare in Aristotele natura di intenzionalità, in virtù del suo carattere trasduttivo: gli stati interni all'animale corrispondono agli stati ambientali esterni in base ad un legame di corrispondenza funzionale.

<sup>24</sup> Su questa lettura dell'argomento del capitolo cfr. Temistio 87.19 Heinze e si veda Watson (1982) p. 101 e Feola (2012): *De anima* III 3 è una digressione – relativamente autonoma nell'ambito del *De anima* – sui criteri per distinguere, nell'ambito delle facoltà cognitive, quelle pertinenti a sensazione e percezione da quelle pertinenti a ragione e intelletto. La *phantasia* non è dunque il tema principale, ma è introdotta in maniera strumentale come connettivo tra i due ambiti.

Quanto si presenta la sensazione,<sup>25</sup> in alcuni animali si produce una permanenza dello stato sensorio, in altri invece non si produce. Gli animali nei quali non si produce, o non hanno affatto cognizione al di fuori della sensazione, o almeno non ne hanno di ciò circa cui non si produce in essi una permanenza dello stato sensorio. Altri invece possono conservare nell'anima lo stato sensorio anche dopo che hanno percepito.<sup>26</sup>

Cruciale, qui, è il concetto di “permanenza dello stato sensorio” (μονή τοῦ αἰσθηματος, 99b36 ss.). Negli *Analitici posteriori* Aristotele si esprime così, mentre in *De anima* III 3<sup>27</sup> introduce la funzione di φαντασία. Aristotele definisce la *phantasia* come “moto generato dalla sensazione in atto” (κίνησις ὑπὸ τῆς αἰσθήσεως τῆς κατ' ἐνέργειαν γιγνομένη, *De an.* III 3.429a1-2). È un impulso fisiologico, dotato di valenza cognitiva, che perpetua l'impulso sensorio, e persiste nel corpo senziente come omogeneo all'impulso stesso.<sup>28</sup> Per “omogeneo” s'intende che i suoi oggetti intenzionali sono dello stesso tipo di quelli della sensazione. La *phantasia* più semplice è quella relativa agli oggetti dei cinque sensi. Essa riattiva e prosegue uno stato cognitivo il cui oggetto intenzionale è il medesimo (o quanto meno della stessa specie<sup>29</sup>) di quello già colto.<sup>30</sup>

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<sup>25</sup> Il greco antico non distingue tra “sensazione” e “percezione”. Il sostantivo αἰσθησις e il verbo αἰσθάνομαι si riferiscono genericamente all'azione di “notare/accorgersi di x”. Cfr. *supra*, n. 21.

<sup>26</sup> *An. post.* II 19.99b36-100a1: ἐνούσης δ' αἰσθήσεως τοῖς μὲν τῶν ζώων ἐγγίγνεται μονὴ τοῦ αἰσθηματος, τοῖς δ' οὐκ ἐγγίγνεται. ὅσοις μὲν οὖν μὴ ἐγγίγνεται, ἢ ὅλως ἢ περὶ ἃ μὴ ἐγγίγνεται, οὐκ ἔστι τούτοις γνώσις ἔξω τοῦ αἰσθάνεσθαι· ἐν οἷς δ' ἐνεστὶν αἰσθομένοις ἔχειν ἔτι ἐν τῇ ψυχῇ.

<sup>27</sup> Su *De an.* III 3 la bibliografia è molto estesa. Le interpretazioni che riteniamo più affini alla nostra sono quelle di Frede (1992), Caston (1996) e Rapp (2001); sulla stessa linea anche l'interpretazione del *De motu animalium* proposta da Corcilius (2008) pp. 211-5.

<sup>28</sup> Ciò sembra implicito nell'uso del verbo “generare” (γίγνομαι) per indicare il rapporto tra sensazione e *phantasia*, visto che tale verbo è normalmente usato per descrivere la generazione di un essere vivente da parte di parenti della stessa specie: sembra dunque appropriato a caratterizzare il venire all'essere di qualcosa a opera di qualcos'altro di omogeneo.

<sup>29</sup> Il *caveat* è reso necessario dal riconoscimento, da parte di Aristotele, del fenomeno dell'alterazione dell'apparenza dell'oggetto intenzionale a causa del progressivo ‘decadere’ della traccia fisiologica lasciata nel corpo senziente dall'esperienza originaria: cfr. *Insomn.* 2.459b13-18. Ciò che qui importa è che i due oggetti intenzionali ricadono entrambi nell'ambito della modalità visiva dell'esperienza, o entrambi nella modalità uditiva, ecc. Per il concetto di ‘modalità sensorio-percettiva’, ossia di tipo di esperienza ascrivibile al paradigma di un senso o di un altro, cfr. Humphrey (1998).

<sup>30</sup> Il caso più semplice è quello delle *after-images*, descritto in *Insomn.* 2.459b13-18: dopo aver lanciato uno sguardo a una fonte di luce, se chiudiamo gli occhi possiamo notare che continuiamo ad avere un'esperienza visiva che è frutto del ‘decadere’ della stimolazione, e che muta di fenomenologia conseguentemente al progredire del decadimento.



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La nostra normale e assai complessa esperienza sensorio-percettiva si rivolge però ad oggetti intenzionali più complessi. La *phantasia* può riproporre *in toto* una trascorsa esperienza dei sensi o può costruire oggetti intenzionali alternativi alle passate esperienze del soggetto.<sup>31</sup> Se l'episodio cognitivo si svolge in condizioni non favorevoli al corretto esercizio della sensazione, p.es. nel sonno, o in stato di malattia, o dove non sono soddisfatti i requisiti ambientali ottimali, il soggetto può non essere in grado di distinguere tra l'oggetto intenzionale proposto dalla *phantasia*, privo di riscontro nell'ambiente, e la realtà ora presente.<sup>32</sup> In tal caso, esso si rapporta all'oggetto rappresentato dalla parvenza fantastica come se fosse un ente reale o una circostanza occorrente.

Ciò di cui le condizioni sfavorevoli (endogene o esogene) sono considerate responsabili è l'incapacità del soggetto di rifunzionalizzare i plessi di *phantasiai*<sup>33</sup> come tasselli di una nuova ricostruzione efficace dell'ambiente: esse sono cioè chiamate in causa per spiegare l'occasionale incapacità del soggetto di usare le *phantasiai* come completamento della sensazione attuale in vista di una percezione complessa efficace fondata sull'esperienza.

In situazioni favorevoli, la ricostruzione è supervisionata da una funzione cognitiva diversa, sovraordinata alla *phantasia*, che Aristotele chiama "principio controllore e dirimente" (τὸ κύριον καὶ τὸ ἐπικρῖνον, *Insomn.* 3.461b25), il cui compito non è produrre edifici complessi usando le *phantasiai* come materiale costruttivo,<sup>34</sup> bensì scartare le costruzioni fallaci a

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<sup>31</sup> Come tipicamente accade nel sogno: cfr. *Insomn.*, *passim*.

<sup>32</sup> Per la tipologia di errore dovuta a sfavorevole condizione fisiologica, cfr. *Insomn.* 2.460b11-16: a un febbricitante appaiono figure di animali su un muro a partire da una somiglianza delle screpolature che vi s'incrociano. Come errore dovuto a condizioni ambientali sfavorevoli (p.es. assenza di adeguati punti di riferimento), cfr. l'incapacità di apprezzare 'a occhio' che il Sole sia più grande della Terra: *De an.* III 3.428b2-3.

<sup>33</sup> Tali plessi si creano in virtù della loro aggregazione endogena, in modo spontaneo, a causa di effetti collaterali dell'esercizio dei sensi, oppure a causa dell'abitudine, ossia del ripetersi di stimoli percettivi simili tra loro, la cui regolarità dirige in direzioni determinate la loro produzione interna. L'attribuzione agli animali di abitudini percettive create dalle passate esperienze è studiata da Labarrière (1984), (1990), (2005).

<sup>34</sup> Ciò, come detto, dovrebbe avvenire per aggregazione spontanea di tracce di esperienze passate. Nel caso degli animali capaci di *logos* (secondo *Mem.* 2.453a7-14), la costruzione può avvenire anche mediante esercizi consapevoli del ragionamento (p.es. quando le persone addestrate nella mnemotecnica costruiscono e usano i loro teatri interiori: cfr. *Mem.* 2, *per totum*, e Sorabji 1972, pp. 22-46). Nel caso degli animali non razionali capaci di costruzioni

vantaggio di quelle affidabili: esso controlla, confronta e sovrintende (dando una ratifica, o negandola ove non si riscontri coerenza tra diversi plessi di rappresentazioni), non costruisce.<sup>35</sup>

La dimensione diacronica che scaturisce dal parlare di “permanenza dello stato sensorio” richiede dei criteri d’identità attraverso il tempo; essi devono essere tali da permettere di ‘scavalcare’ il fatto che lo stato sensorio corrisponda o meno a un’interazione attiva tra l’animale e l’ambiente. Dallo stato sensorio dobbiamo passare a considerare il *moto* o *impulso* sensorio,<sup>36</sup> inteso come processo che può continuare ad avere effetti nella fisiologia dell’animale dopo che l’episodio originario è cessato, e che può tornare a riattivare il medesimo stato cognitivo. Avendo già automaticamente riferito lo stato sensorio a un carattere dell’ambiente in virtù della ‘medietà’ (cfr. *supra*, §3), definiamo il moto sensorio-percettivo al modo seguente: un processo fisiologico conta come moto sensibile *k* se (e solo se) *k* induce uno stato sensorio (αἴσθημα) nel sensorio centrale.<sup>37</sup>

Introduciamo ora un concetto non consueto nella bibliografia sulla teoria aristotelica del vivente, ma che si può legittimamente estrapolare dai testi. Aristotele ipotizza che l’impulso sensibile abbia quantità, sia nel senso di intensità maggiore o minore (cfr. *Sens.* 7, *passim*<sup>38</sup>), sia nel senso di maggiore o

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consapevoli che si avvicinano alle prestazioni del *logos* (cfr. *infra*, §5), tali prestazioni andranno attribuite alla facoltà pre-razionale analoga al ragionamento.

<sup>35</sup> Sul fenomeno descritto in *Insomn.* 2.460b11-16, cfr. *supra*, n. 32. Sembra che ciò che impedisce al febbricitante di smentire una *phantasia* errata sia lo stato di scarsa operatività di questa funzione. Sulla teoria aristotelica circa il “principio controllore e dirimente”, cfr. Kahn (1966), Modrak (1989). Sia su Aristotele sia sulla ricezione tardoantica e medievale della teoria cfr. Bydén & Radović (2018).

<sup>36</sup> Sul concetto di ‘moto sensibile’ cfr. *Somn. vig.* 1.454a2-4: τὸν δὲ αἰσθανόμενον ἐγρηγορέναι νομίζομεν, καὶ τὸν ἐγρηγορότα πάντα ἢ τῶν ἐξωθέν τινος αἰσθάνεσθαι ἢ τῶν ἐν αὐτῷ κινήσεων; “riteniamo che chi percepisca vegli, e che ogni individuo sveglio percepisca o qualcuno dei moti [provenienti] dall’esterno o [qualcuno dei moti] in lui stesso [insiti]”.

<sup>37</sup> Vegliare è identico a esercitare la sensazione (*Somn. vig.* 1.454a2-4); ed esercitare la sensazione consiste nel ‘subire’ l’azione di moti sensibili *k* indotti da qualità sensibili di oggetti esterni, o da stati interni (parimenti sensibili) del nostro corpo.

<sup>38</sup> Tutta la discussione in *Sens.* 7 è volta a risolvere l’aporia su come possiamo avvertire due diversi sensibili al contempo se “l’impulso sensibile maggiore ottunde il minore” (ἡ μείζων κίνησις τὴν ἐλάττω ἐκκρούει, 447a14-15), sicché il primo dovrebbe rendere inavvertibile il secondo, e quest’ultimo dovrebbe diminuire la discernibilità del primo. Tale discussione dà per presupposto che i sensibili esterni, e gli impulsi sensibili che ne derivano, differiscano

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minore durata del condizionamento esercitato sul sensorio, che si abitua al sensibile in quantità proporzionale al durare (cfr. *Insomn.* 2.459b11-13, *πολὺν χρόνον*) della sensazione. A quest'ultimo proposito, è come se Aristotele concepisse il genere *sensibile<sub>2</sub>* (distinguiamo d'ora in poi lo stato indotto nel sensorio e il sensibile esterno, chiamando il primo "sensibile<sub>2</sub>" e il secondo "sensibile<sub>1</sub>") come un genere le cui istanze possono fissarsi nel sensorio (che ne è il sostrato) con maggiore o minore tenacia a seconda della durata della stimolazione. Potremmo esprimere questo concetto dicendo che la percezione di qualcosa<sub>1</sub> (un carattere dell'ambiente) *carica* l'organo di senso del corrispondente stato sensorio, qualità<sub>2</sub>, con tenacia proporzionale alla durata della stimolazione.

Se questa interpretazione è corretta, allora implica che, ad esempio, se un punto della mia pelle passasse attraverso 10 cm di aria secca, poi attraverso 5 cm di aria umida, si accumulerebbe nel mio sensorio centrale una quantità di secco<sub>2</sub> doppia della quantità di umido<sub>2</sub>.<sup>39</sup> È possibile che tale 'quantità' fosse intesa dallo Stagirita in senso letterale, ossia come quantità di sangue che, durante l'episodio di sensazione, dal sensorio periferico giunge al cuore qualificata secondo quel dato stato sensorio.

Il permanere dei sensibili<sub>2</sub> sotto forma di *phantasmata* fa sì che, pur senza che si abbia percezione del tempo (una capacità ulteriore e più complessa), l'effetto del primo stato sensibile, dopo essersi accumulato in quantità proporzionale alla lunghezza percorsa, permarrà anche mentre quella parte della pelle percorre il secondo sensibile: andrà così a comporsi con lo stato sensorio relativo al secondo sensibile, in rapporto di 2:1. Avremo così uno stato sensorio complesso, composto dalla successione dei due stati sensori, di diverse durate, relativi ai due diversi sensibili elementari. Lo stato sensorio composto è così dato dal susseguirsi dell'uno all'altro sensibile, ognuno con la sua propria durata e consente la percezione del mutamento ambientale, della successione e della quantità.

Sulla base dell'ipotesi della permanenza dello stato sensorio abbiamo così costruito un modello percettivo del moto e del mutamento ambientale,

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per quantità puntuale, ossia per essere "maggiore" o "minore" in un dato lasso di tempo in cui intervengono insieme: ossia per quella che possiamo parafrasare come "intensità".

<sup>39</sup> Si ricordi che freddo<sub>2</sub> ≠ freddo: il freddo è una qualità dell'ambiente; il freddo<sub>2</sub> è lo stato del cuore che corrisponde al freddo.

ovvero del sensibile comune a partire dal quale lo Stagirita ritiene di poter costruire tutte le altre percezioni di sensibili comuni (cfr. *De an.* III 1.425a16-20).<sup>40</sup> La nostra ipotesi prevede che – conformemente al programma esplicativo schematizzato in *De. an.* III 1.425a16-20 – è possibile costruire una teoria relativa a tutti i tipi di percezione dei sensibili comuni e *per accidens*, partendo dalla percezione del moto e ipotizzando che Aristotele avesse in mente un meccanismo di accumulazione e ricombinazione della *phantasiai*.<sup>41</sup>

In *Insomn.* 2.460b11-16, Aristotele porta l'esempio di un febbricitante cui appaiono animali su un muro a partire da una somiglianza delle screpolature che vi s'incrociano:

Perciò, anche, ai febbricitanti talora appaiono animali sui muri, a partire da una piccola somiglianza delle linee che vi s'incrociano. E questi fenomeni a volte si intensificano insieme agli stati di malattia a tal punto, che, se i soggetti non sono molto ammalati, non sfugge loro che si tratta di apparenze false; ma se la malattia è più grave, se ne lasciano suggestionare.<sup>42</sup>

Il passo è ricco di indizi su come Aristotele concepiva la sua teoria sulla sensazione complessa. In primo luogo, sembra presupposto un meccanismo in base a cui il sistema sensorio registra l'eventuale somiglianza tra l'esperienza di qui e ora (l'incrocio delle crepe sul muro) con esperienze trascorse, e reagisce riportando in atto plessi di stati sensori accumulati contemporaneamente a tali sensazioni originarie.

In secondo luogo, si nota che gli *aisthēmata* prodotti dall'episodio in corso si uniscono ai *phantasmata* dei pregressi episodi, formando un'unità coesa in cui l'identità dei singoli mattoni non è più riconoscibile, perché si impone l'unità composta del nuovo *aisthēma*, formato dagli uni e dagli altri.

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<sup>40</sup> Cfr. Feola (2012) pp. 87-91. Questa ricostruzione si fonda *in toto* sull'ipotesi che Aristotele ponga a fondamento della percezione complessa la sua teoria sulla *phantasia*. Diversa è la lettura di Gregorič (2007) pp. 59-60, il quale ritiene che sia possibile ricostruire la teoria della percezione complessa dal cosiddetto "senso comune" (*common sense*), senza chiamare in causa la *phantasia*.

<sup>41</sup> Gregorič (2007) pp. 205-6, ammette tuttavia che la *phantasia* giochi un ruolo nella percezione dei sensibili *per accidens*.

<sup>42</sup> *Insomn.* 2.460b11-16: διὸ καὶ τοῖς πυρέττουσιν ἐνίοτε φαίνεται ζῶα ἐν τοῖς τοίχοις ἀπὸ μικρᾶς ὁμοιότητος τῶν γραμμῶν συντιθεμένων. καὶ ταῦτ' ἐνίοτε συνεπιτείνει τοῖς πάθεσιν οὕτως, ὥστε, ἂν μὲν μὴ σφόδρα κάμνωσι, μὴ λανθάνειν ὅτι ψεῦδος, ἐὰν δὲ μείζον ἢ τὸ πάθος, καὶ κινεῖσθαι πρὸς αὐτά.

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Il nuovo stato sensorio, attivandosi, produce una nuova esperienza, diversa da quella che sarebbe prodotta separatamente dai suoi componenti.

In terzo luogo, notiamo che l'esempio addotto è un esempio di percezione falsa di un sensibile *per accidens* (l'animale) e di percezione di sensibili comuni (figura, moto, quiete) in parte vera e in parte falsa. Tale *performance* è esplicitamente attribuita al livello sensorio dell'anima: anche se l'esempio parla di un essere umano, la descrizione sembra poter valere anche per gli altri animali.

Già il fatto che qui sia descritto un episodio di sensazioni di sensibili comuni in cui verità e falsità si mescolano inestricabilmente, così come normalmente accade nell'esperienza, mostra che<sup>43</sup> per Aristotele la medesima teoria deve spiegare tanto la percezione vera di sensibili *per accidens* e comuni quanto quella falsa. Se quindi questo passo del *De insomniis* spiega la percezione falsa di sensibili *per accidens*,<sup>44</sup> si può ipotizzare che anche quella vera fosse da Aristotele spiegata allo stesso modo. L'ipotesi è rinforzata da *De an.* III 3, dove Aristotele afferma che la teoria sulla percezione complessa, ancora da costruire, dovrebbe spiegare in modo unitario tanto la percezione complessa vera quanto quella falsa.<sup>45</sup>

Riassumendo. Aristotele costruisce, dapprima solo a grandi linee nel *De anima*, e poi con maggiore dettaglio in alcuni dei *Parva naturalia*, una teoria sulla parte sensorio-percettiva dell'anima che permette di attribuire anche ad esseri privi di *logos* forme raffinate di discriminazione delle caratteristiche e degli oggetti dell'ambiente. In tal modo, pensa di poterne spiegare la capacità

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<sup>43</sup> *De an.* III 3.427a29-b6: ciò che qui Aristotele contesta alle teorie presocratiche sulla cognizione è proprio l'incapacità di spiegare, in base ai medesimi principi, tanto la verità quanto l'errore. Nel corso del capitolo, Aristotele si focalizza sull'errore percettivo. Il caso più rivelativo, che Aristotele mobilita contro Platone, è quello dell'impossibilità di percepire correttamente la dimensione del Sole (428b2-9): esso infatti avviene anche quando l'opinione è corretta. Su *De an.* III 3 come contestazione delle teorie presocratiche e platoniche dell'errore, cfr. Caston (1996) e Feola (2012).

<sup>44</sup> Vedi in *Insomn.* questi esempi di percezione erronea di sensibili *per accidens* che chiamano esplicitamente in causa la *phantasia*: 2.460b3-7, erronea identificazione di persone umane; 460b11-13: l'errore percettivo dell'animale sul muro, che comporta anche un'errata percezione di moto.

<sup>45</sup> Frede (1992) p. 283: la *phantasia* è all'opera in tutte le percezioni di sensibili comuni e *per accidens*, per provvedere al completamento e continuità del campo percettivo, dal momento che la sensazione dei sensibili propri, per lo Stagirita, è puntuativa. Cfr. anche Beare (1906) p. 289.

di attuare comportamenti appropriati alla sopravvivenza e al raggiungimento dei fini che la natura di ciascuna specie pone agli individui. Queste forme di discriminazione sono attribuite all'*aisthētikon*, mediante l'ipotesi della capacità di incamerare *phantasmata* e costruire spontaneamente – per aggregazione diretta dall'abitudine – stati cognitivi complessi costituiti di *aisthēmata* e *phantasmata*, che automaticamente 'proiettano lì fuori' oggetti intenzionali complessi, tali da poter corrispondere in maggiore o minor misura all'ambiente con cui al momento l'animale deve interagire. Nel caso estremo, quello del sogno, la corrispondenza è nulla.

##### 5. *L'habitus fantastico percettivo e lo status ontologico del senziente*

Secondo Aristotele, gli animali hanno caratteri<sup>46</sup> che derivano dalle loro abitudini.<sup>47</sup> Leggiamo in *De divinatione* 1: “i melancolici [...] a causa della (loro) mutevolezza, velocemente ciò che è successivo (nella serie delle *phantasiai*) si presenta a essi”;<sup>48</sup> “inoltre, a causa della (sua) veemenza, in essi il moto [fantastico] non è respinto da un altro moto”.<sup>49</sup>

Se l'interpretazione qui proposta è corretta, i *phantasmata* tornano a riattivarsi seguendo una serie ordinata di 'precedente' e 'successivo'. Tale serie tenderà a riprodurre la successione delle qualità e degli oggetti previamente percepiti nell'ambiente, man mano che l'esperienza dell'individuo si accresce, con sempre maggiore articolazione e fedeltà.<sup>50</sup>

L'*habitus* fantastico-percettivo è una predisposizione acquisita (condizionata dalla fisiologia dell'animale e sedimentata tramite l'abitudine<sup>51</sup>) a

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<sup>46</sup> Cfr. *HA IX* 1.608a11, per l'ascrizione di caratteri (ἤθη) agli animali.

<sup>47</sup> Cfr. *EN II* 1.1103a17-18, anche per il legame etimologico presunto da Aristotele tra “carattere” e “abitudine” (ἔθος).

<sup>48</sup> *Div.* 1.464a32-b1: οἱ δὲ μελαγχολικοὶ [...] διὰ τὸ μεταβλητικὸν ταχὺ τὸ ἐχόμενον φαντάζεται αὐτοῖς.

<sup>49</sup> *Div.* 1.464b4-5: ἔτι δὲ διὰ τὴν σφοδρότητα οὐκ ἐκκρούεται αὐτῶν ἡ κίνησις ὑφ' ἐτέρας κινήσεως.

<sup>50</sup> Cfr. anche *Sens.* 5.444a1-3; *Mem.* 2.451b10-14, 452a26-27; *Div.* 464a33-b5.

<sup>51</sup> Cfr. Beare (1906) p. 315: la successione di moti fantastici imita, sotto forma di regolarità statistica, la relativa regolarità della successione dei moti percettivi. Questo meccanismo rappresenta la chiave di volta di tutta la teoria aristotelica sulla cognizione sensorio-percettiva complessa; a Beare spetta il merito di averlo portato all'attenzione degli interpreti.

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costruire *aisthēmata* complessi in un modo piuttosto che in un altro, e dunque a distinguere tra due cose piuttosto che tra due altre.<sup>52</sup>

Aristotele costruisce una teoria in base alla quale può spiegare cosa sia percepire un uomo o percepire Antonio senza dover attribuire al soggetto che percepisce né la capacità di coniare nomi propri (per nominare Antonio) né la capacità di formare concetti (p.es. di uomo). Questo è possibile perché i *phantasmata* incamerati nel corso della vita dell'animale tendono a ripresentarsi nello stesso ordine dell'episodio di sensazione originaria. Ad esempio, sentiti il giallo e l'amaro, la sequenza di riattivazione dei *phantasmata* giallo<sub>2</sub> e amaro<sub>2</sub> riproporrà tendenzialmente quella serie; così alle diverse cose ed eventi che l'animale ha incontrato nell'ambiente corrisponderanno diversi plessi o sequenze di *phantasmata*; le loro varie possibili combinazioni daranno luogo ad altrettante 'proiezioni' di cose ed eventi. Nel sogno, se non ci accorgiamo di sognare, la *phantasia* del blu è indistinguibile da una vera sensazione di colore; la *phantasia* di un odore salino è indistinguibile da una vera sensazione di odore salino; avere *phantasia* di blu e di odore salino insieme, è fenomenologicamente indistinguibile dall'aver sensazione di blu e di odore salino insieme. Se, tra tutte le cose (reali) di cui abbiamo fatto esperienza, solo il mare (quello che noi, animali linguistici, chiamiamo "mare") è blu e ha odore di sale (p.es. se non abbiamo mai visto un lago salato, o una laguna prossima al mare), allora avere insieme *phantasia* del blu e dell'odore salino è aver *phantasia* del mare (anche se non lo si identifica come "mare", non si sa che è fatto di acqua, non si alcuna idea del fatto che ci si può bagnare ma non si può bere). Nelle condizioni appena descritte, se, invece del *phantasma* di blu, ho un vero *aisthēma* di blu (uno stato sensorio dovuto all'azione di un'istanza di blu nel mondo esterno), e se il mio *habitus* fantastico-percettivo è tale che al *phantasma* o *aisthēma* del blu consegua il *phantasma* dell'odore salino, allora la visione di quel blu causerà la *phantasia* di un odore salino; e,

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<sup>52</sup> Un'ipotesi possibile è che Aristotele identificasse i minori o maggiori gradi di adattamento dell'*habitus* all'ambiente al modo seguente: se l'animale ha un bagaglio di *phantasmata* tale da identificare senza equivoci ogni situazione rilevante per i fini vitali postigli dalla sua natura nel suo *habitat*, ha raggiunto l'*habitus* ottimale. Resta verosimile che per Aristotele l'*optimum* non sia mai raggiunto; ma il fatto che egli parli di *gradi* di errore (cfr. *De an.* III 1.425b7: μάλλον e 3.428b25: μάλιστα) sembra implicare che egli supponesse la possibilità di un *optimum*, rispetto al quale la condizione di un animale *x* in un dato momento *y* può considerarsi più o meno distante.

posto che il plesso  $\text{blu}_2 + \text{salino}_2$  identifica un determinato tipo di oggetto (che noi, animali linguistici, chiamiamo “mare”), avremo uno stato cognitivo relativo al mare innescato dalla sensazione del blu. Se quel blu che causa ora questo processo è davvero il blu del mare, che sta ora agendo sul mio occhio, ho percezione vera del mare, in presenza del quale effettivamente mi trovo: in tal caso la proiezione di un carattere *salato* alla porzione d’ambiente che vedo blu è una corretta anticipazione, e lo stato cognitivo complesso è una percezione vera del mare. Se invece quel blu è solo un effetto luminoso dovuto ad una rifrazione del colore del cielo sulla superficie di una pozzanghera (e dunque è, sì, blu, ma non il blu del mare), allora la mia percezione *per accidens* dell’oggetto come liquido e salato, ossia come mare, è erronea. Se questa ricostruzione è corretta, si può concludere quanto segue:

(I) il *phantasma* relativo a un sensibile *per accidens*  $x$  si presenta (= ho *phantasia* di un dato sensibile *per accidens*  $x$ ) se un *aisthēma* porta il mio *habitus* fantastico ad attivarsi come quando il mio sistema sensorio è stimolato da un plesso di caratteri sensibili propri o comuni che inerisce a quel dato oggetto del mondo,  $x$ . Tale plesso, nel mio bagaglio esperienziale, distingue infatti  $x$  dalle altre entità di cui ho fatto esperienza;

(II) l’*aisthēma*, ovvero lo stato sensorio relativo a un sensibile *per accidens*  $x$ , si presenta se l’*aisthēma* che ha suscitato quella serie di associazioni nell’*habitus* fantastico-percettivo si riferisce a un plesso di caratteri sensibili realmente appartenenti all’oggetto reale  $x$ . L’oggetto  $x$  infatti, agendo sui miei sensori, ha prodotto l’*aisthēma* di partenza, e inoltre ha altri caratteri, oltre a quelli colti dall’*aisthēma*, che corrispondono alla catena suscitata nel mio *habitus* fantastico-percettivo. Vedo del blu; quel blu è il blu del mare. Se, a seguito dell’occorrenza dell’*aisthēma* del blu, si suscita in me la catena che, nel mio *habitus* fantastico-percettivo, identifica il mare, allora percepisco il mare; se invece si suscita quella che identifica il cielo, sono in errore.

Leggiamo in *Insomn.* 2: “appaiono alcune cose non solo se il sensibile muove, ma anche se il senso si muove da sé, qualora si muova come se fosse mosso dal sensibile”.<sup>53</sup> Ciò che *si* muove, va però notato, non è la capacità

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<sup>53</sup> *Insomn.* 2.460b23-25: οὐ μόνον τοῦ αἰσθητοῦ κινουῦντος φαίνεται ἀδήποτε, ἀλλὰ καὶ τῆς αἰσθήσεως κινουμένης αὐτῆς, ἐὰν ὡσαύτως κινῆται ὡσπερ καὶ ὑπὸ τοῦ αἰσθητοῦ.



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sensitiva con cui si nasce: questo per Aristotele è impossibile.<sup>54</sup> Il senso si muove da sé in quanto l'*habitus* fantastico-percettivo, ossia la disposizione in cui si trova il soggetto dopo che ha già iniziato a esplorare l'ambiente, è capace di riattivarsi in modo più o meno appropriato nel riconoscere le situazioni che incontra.

Così, Aristotele è già prossimo ad attribuire alla parte sensorio-percettiva dell'anima un'autonomia analoga a quella propria dell'anima intellettiva e razionale: è tale somiglianza a permettergli di attribuire a taluni animali quelle "tracce" delle disposizioni cognitive umane adulte che *Hist. anim.* VIII 1.588a25-b2 assegna anche agli infanti della specie umana (cfr. *supra*, §1).

Certo, l'*habitus* fantastico-percettivo è ben lungi dal permetterci di cogliere la reale natura delle cose: consiste infatti nella mera registrazione delle tendenze dell'ambiente a esibire certi tratti in connessione regolare tra loro. Visto però che i tratti ambientali che l'*habitus* registra come regolari<sup>55</sup> sono accidenti di sostanze e dipendono, secondo Aristotele, dalla realtà delle cose, reagire a essi è automaticamente reagire alla realtà ambientale.<sup>56</sup>

L'*habitus* fantastico guida il comportamento e permette di legare la classificazione anatomica a quella etologica,<sup>57</sup> entrando così nella costituzione ontologica degli individui, non come parte della forma sostanziale, ma come 'plessò' di proprietà (attinenti alla categoria del *quale*) che determinate specie – in virtù della forma sostanziale immutabile – possono acquisire, in modi che variano dall'una all'altra. È chiaro dunque che per Aristotele gli animali non agiscono solo in base alla loro natura innata: oltre a questa si

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<sup>54</sup> Categorico, su questo punto, il capitolo *De an.* II 5, in particolare 416b33-417a9.

<sup>55</sup> Automaticamente eliminando le irregolarità con la mera forza del numero.

<sup>56</sup> Kanisza (1980) pp. 333-6 descrive questo esperimento: a un gruppo di persone viene mostrato un quadrato di legno scomposto in parallelepipedi e triangoli irregolari; e viene loro chiesto di ricostruirlo. Il tempo medio di riuscita è 8'43"; a un altro gruppo è sottoposto lo stesso quadrato, scomposto nello stesso modo, salvo che al centro, prima di scomporlo, era stato dipinto un cerchio rosso. Il tempo medio di riuscita è ora di 3'26"; le parti rosse dei pezzi del quadrato segnalano infatti la parte di ciascun pezzo da rivolgere verso il centro della figura: ricostruito il cerchio, automaticamente è ricostruito il quadrato. Credo sia questo il tipo d'efficacia che Aristotele assegna alla percezione *per accidens*.

<sup>57</sup> Nei viventi la composizione dei *phantasmata* dipende dalla costituzione fisica individuale, dalle esperienze passate e dall'apparato sensoriale di cui sono dotati per specie. Le differenze tra *habitus* di diversi individui rispecchiano le nature degli individui stessi: due gatti avranno *habitus* uguali per specie, un gatto e una lince uguali per genere.

attiva in loro qualcosa di non predeterminato. La natura innata fornisce un telaio di possibilità che, nell'incontro con un dato sensibile od un altro, si sviluppano in una direzione o in un'altra, dando luogo ad *habitus* diversi, non solo da specie a specie, ma anche da individuo a individuo, a causa delle diverse esperienze cui si trovano esposti.<sup>58</sup>

Questo modello cognitivo consente anche di salvare la forma sostanziale dal mutamento: le prestazioni di cui l'animale è capace col cumularsi delle esperienze divengono sempre più raffinate. Ora, tali mutamenti sono propri dell'animale, e si istanziano in cambiamenti del suo sistema percettivo, mentre l'anima soggiace al progressivo passaggio dallo *status* di potenza seconda o atto primo a gradi successivi di attualizzazione: tutti atti secondi rispetto all'atto primo con cui si identifica. Tali atti secondi, passaggi dell'anima-*ousia* dallo *status* di atto primo a quello di atto secondo, si sedimentano come ulteriori specificazioni del corpo animale e ricadono nella categoria della qualità,<sup>59</sup> e non in quella di sostanza; non mutano dunque in alcun modo la forma sostanziale.<sup>60</sup> La stessa forma, passando dallo *status* di atto primo a quello di atto secondo nei modi possibili, ossia fungendo da telaio dei comportamenti dell'animale, plasma il corpo senziente imprimendo in esso i risultati fisiologici degli atti secondi. In tal modo, fa sì che esso diventi di volta in volta capace di prestazioni sempre più raffinate.

#### 6. *Attraversare il confine tra non umano e umano*

A questo punto è possibile occuparci del concetto di *ichnos*, usato da Aristotele per descrivere il rapporto tra le facoltà cognitive comuni agli infanti ed a certi animali e quelle degli umani adulti (cfr. §1). Rileggiamo il passo:

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<sup>58</sup> Animali che apprendono dall'esperienza: *HA* IX 6. Comportamenti frutto d'intelligenza: *HA* IX 6.612b4-5, 10; 37.621b28ss.; 40.627b22. Comportamenti efficaci non si sa se appresi o innati: *HA* IX 6.611b32ss.; 612a3, 12, 24, 35; 8.613b18; 11; 32.619a20, 32, b4; 55.611b23 ss. Riconoscimento del luogo di una passata esperienza: *HA* VIII 28.606a2-5.

<sup>59</sup> Sono disposizioni ( $\epsilon\tilde{\xi}\epsilon\iota\varsigma$ ) e le disposizioni sono qualità: cfr. *Cat.* 8.8b27; due righe dopo, in b29, si menzionano, come esempi di disposizioni, le scienze, che sono un caso chiarissimo di disposizioni cognitive acquisite, cui sembra dunque legittimo affiancare le capacità fantastiche acquisite.

<sup>60</sup> Mi sembra questa la posizione di Morel (2007) e (2016) p. 11.

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Infatti riguardo alcuni (dei caratteri menzionati) differiscono (gli altri animali) rispetto all'uomo, e l'uomo rispetto a molti degli animali, per il più-e-meno, [...] rispetto ad altri [caratteri] per analogia: come infatti nell'uomo (vi sono) tecnica e sapienza e comprensione, così alcuni degli animali hanno un'altra siffatta capacità naturale. Chiarissimo è quanto detto, per chi osserva la condizione dei bambini: in essi infatti è possibile vedere come tracce (o "impronte") e semi delle disposizioni che poi vi saranno, e non differisce in nulla, per così dire, la (loro anima da quella delle bestie, in quella fase di tempo, sì che non è irragionevole se alcune caratteristiche (della loro anima) sono identiche, altre simili, altre analoghe a (quelle de)gli altri animali.

Qui *ichnos*, in ragione dell'endiadi con 'seme',<sup>61</sup> non indica il residuo di un percorso, ma la traccia che anticipa ciò che si sviluppa più avanti. Ci si può chiedere allora se e in che modo anche le facoltà cognitive animali, p.es. di un cane, possono nel loro rapporto con le umane lasciarsi descrivere da questa metafora. Prendendo sul serio l'equiparazione tra infanti e animali, lo Stagirita potrebbe invitarci a usare *An. post.* II 19 per la spiegazione di questi tipi di cognizione.<sup>62</sup> Percorriamo dunque ora queste 'tracce' e conduciamo un esperimento ermeneutico: ciò che negli *Analitici* è detto sullo sviluppo delle facoltà umane, lo leggeremo come indizio circa la sua teoria sulla mente umana, come Aristotele stesso, in *Hist. anim.* VIII 1, invita a fare. La relazione tra questi due capitoli del *corpus* non è stata a nostro avviso sufficientemente tematizzata: qui leggeremo 'a ritroso' *An. post.* II 19 alla luce di *Hist. anim.* VIII 1, chiedendoci come, e in che misura, quanto riportato sullo sviluppo della cognizione umana possa applicarsi all'argomento dell'opera biologica, ossia il grado di approssimazione della mente animale a quella linguistica dell'essere umano adulto. Eravamo rimasti a *An. post.* II 19.99b36-37 e 99b39-100a1: "essendovi sensazione, in alcuni tra gli animali s'ingenera permanenza dello stato sensorio, in altri invece non s'ingenera. [...] A quelli nei quali è presente dopo aver sentito, (è possibile) aver(la [i.e. la sensazione o meglio il suo risultato]) ancora nell'anima". Continuiamo.

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<sup>61</sup> Cfr. la metafora del seme che si articola in essere vivente compiuto: *H.* VIII 1.588a33 (*loc. cit.*, cfr. §1)

<sup>62</sup> Per la ricostruzione della teoria aristotelica sullo sviluppo diacronico della facoltà cognitive umane cfr. Feola (2009).

Avvenendo in gran copia cose siffatte, ecco si genera una *diaphora*: onde ad alcuni [animali] si genera *logos* dalla permanenza di cose siffatte, ad altri no.<sup>63</sup>

Il parallelo con ciò che Labarrière (1990, p. 420) chiama “proto-remini-scenza”, l'*habitus* fantastico-percettivo (cfr. §5), ci permette di fornire al passo un senso collegato ai temi delle opere biologiche: alcuni animali hanno un *habitus* fantastico-percettivo tendenzialmente isomorfo al loro *habitat*, *habitus la cui articolazione interna di rapporti* è un λόγος, in senso più esteso e più debole di quando il termine denota la ragione umana. Proseguiamo:

dalla sensazione nasce dunque memoria [...]; da memoria che si genera spesso circa la stessa cosa, [nasce] esperienza: le memorie, molte di numero, sono un'esperienza sola.<sup>64</sup>

Il lessico del “nascere da”, unito all'uso della polarità ‘uno-molteplice’, accenna a un rapporto di composizione:<sup>65</sup> l'esperienza ‘nasce dalle’ memorie<sup>66</sup> (qui probabilmente Aristotele non si riferisce alla memoria ‘esplicita’ o ‘tematica’ di *Mem.* 1, ma alla memoria nell'accezione platonica, mero deposito dei risultati di un trascorso esercizio cognitivo<sup>67</sup>).

Dall'esperienza, o da tutto l'universale quietatosi nell'anima, dall'uno al di là dei molti, che in tutti è insito come uno, lo stesso per essi, nasce principio d'arte e di scienza.<sup>68</sup>

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<sup>63</sup> *An. post.* II 19.100a1-: πολλῶν δὲ τοιούτων γινομένων ἤδη διαφορὰ τις γίνεται, ὥστε τοῖς μὲν γίνεσθαι λόγον ἐκ τῆς τῶν τοιούτων μονῆς, τοῖς δὲ μή.

<sup>64</sup> *An. post.* II 19.100a3 e 4-5: Ἐκ μὲν οὖν αἰσθήσεως γίνεται μνήμη [...], ἐκ δὲ μνήμης πολλακίς τοῦ αὐτοῦ γινομένης ἐμπειρία· αἱ γὰρ πολλαὶ μνήμαι τῷ ἀριθμῷ ἐμπειρία μία ἐστίν.

<sup>65</sup> Che la preposizione ἐκ possa essere usata da Aristotele per indicare composizione anche nel caso dell'assemblamento di stati cognitivi, lo mostra, p.es., *Sens.* 7.448b27-28, dove l'uso della preposizione a proposito della composizionalità degli stati cognitivi rispecchia gli innumerevoli usi nello stesso capitolo (e linguisticamente più ovvi, perché tipici della prosa non filosofica) della stessa a proposito della composizione dei caratteri del mondo esterno che sono oggetti di sensazione.

<sup>66</sup> Cfr. *Metaph.* A 1.980b29-981a1: αἱ γὰρ πολλαὶ μνήμαι τοῦ αὐτοῦ πράγματος μιᾶς ἐμπειρίας δύναμιν ἀποτελοῦσιν, “infatti le molte memorie della stessa cosa portano a compimento il potere [causale] di un'unica esperienza”.

<sup>67</sup> Cfr. Plat. *Phil.* 34a10.

<sup>68</sup> *An. post.* II 19.100a3-9: ἐκ δ' ἐμπειρίας ἢ ἐκ παντὸς ἡρεμήσαντος τοῦ καθόλου ἐν τῇ ψυχῇ, τοῦ ἐνὸς παρὰ τὰ πολλὰ, ὃ ἂν ἐν ἅπασιν ἐν ἐνῇ ἐκείνοις τὸ αὐτό, τέχνης ἀρχὴ καὶ ἐπιστήμης.

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L'esperienza su un qualcosa  $Q$  è una condizione che precorre ciò che nell'essere umano dotato di scienza è l'universale scientifico relativo a  $Q$ . L'esperienza è qualcosa che in tutte quelle memorie sta insito come uno e identico, perché ogni singola occorrenza di una memoria circa  $Q$  richiama in funzione – secondo lo schema dell'*habitus* fantastico-percettivo (cfr. §5) – tale esperienza complessiva, divenuta parte integrante dell'economia cognitiva dell'individuo.<sup>69</sup> Ed è qui, allo stadio in cui l'esperienza si serve dei meccanismi dell'*habitus* fantastico ma è già qualcosa di ulteriore, è cioè già un proto-universale 'da cui' nascerà poi il vero universale, principio del sapere scientifico, che abbiamo certamente valicato (secondo Aristotele di molto) il confine tra animale e umano.

Ma allora dov'era il confine?

Consideriamo più in dettaglio lo stadio del cosiddetto 'proto-universale', ossia dell'esperienza: se il proto-universale produce aspettative cognitive non più falsificabili circa  $Q$ , non solo vedo ormai un mammifero in ogni elemento dell'ambiente che sia qualcosa di semovente, quadrupede e dotato di peli, ma tale modalità cognitiva è anche corretta. Questo stadio, costituito dall'esperienza umana adulta e informata da una familiarità specialistica con

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<sup>69</sup> In *Mem.* 2 sono catalogate le varie tipologie di rapporto tra impulsi fantastico-percettivi: tipologie sulla cui base Aristotele imposta una spiegazione e giustificazione teorica dell'arte della mnemotecnica. Qui Aristotele scrive che gli impulsi in questione possono collegarsi, a volte, per una relazione (tra le altre possibili tipologie pertinenti di relazione) di parte-tutto o tutto-parte (*Mem.* 2.451b12, 452a26-27: "infatti i moti [i moti fantastici che sono portatori di stati cognitivi relativi agli oggetti che si desidera ricordare], rispetto ad alcuni di essi [rispetto ad alcuni dei moti fantastici che abbiamo già a disposizione senza doverli richiamare] sono proprio gli stessi [e quindi non c'è bisogno di esercitare la mnemotecnica], rispetto ad altri sono in relazione di immediata contemporaneità [gli oggetti e situazioni cui si riferiscono si presentarono in contemporanea], e di altri ancora sono in relazione di parte-tutto", αἱ γὰρ κινήσεις τούτων τῶν μὲν αἱ αὐταί, τῶν δ' ἅμα, τῶν δὲ μέρος ἔχουσιν). Questa descrizione copre più casi: quello in cui un dettaglio è richiamato alla memoria come parte di una situazione o scenario più vasto; ma anche quello in cui lo scenario o situazione più vasta è richiamata come contesto del dettaglio, in modo che la ripresentazione del contesto è parte dello stato mnemonico relativo al dettaglio; copre poi il caso in cui un aspetto della cosa richiama la totalità della cosa, o viceversa; e anche quello in cui un caso singolo richiama la previamente assimilata esperienza circa la categoria generale, o viceversa. La relazione parte-tutto è tra le relazioni cardinali intrattenute dagli oggetti di esperienza sensorio-percettiva (che poi diventano oggetti di memoria) che Aristotele riconosce.

l'oggetto, consente già l'uso linguistico ad un grado di padronanza e proprietà tipico dell'esperto.

In quale punto, allora, abbiamo valicato il confine tra animali non linguistici e linguistici? È chiaro infatti che non tutti coloro che adoperano il linguaggio a proposito di qualcosa possano essere anche esperti e dire cose plausibili allo stesso proposito.

In 100a15-b13 Aristotele si occupa dello stadio, successivo all'esperienza, dell'*habitus* della scienza; anche qui però ci imbattiamo nella sua concezione degli stati cognitivi comuni a uomo e animali: "si percepisce il particolare, ma la percezione è dell'universale: p.es. di *uomo*, e non di *Callia uomo*".<sup>70</sup>

Com'è chiaro, stiamo parlando dei sensibili *per accidens*. L'oggetto intenzionale della percezione di un sensibile *per accidens* può comprendere solo un sottoinsieme dei caratteri dell'oggetto reale, ed è dunque un'astrazione rispetto ad esso: è cioè un universale<sup>71</sup> (100a17-b1). Ora, questo carattere astratto va attribuito anche alla percezione degli animali capaci di sviluppare l'*habitus* fantastico-percettivo.

Come ha notato M. Wedin,<sup>72</sup> è proprio questa astrazione dell'*habitus* fantastico-percettivo a candidare la sensazione-percezione-*phantasia* a germe del pensiero. Ciò che invece la cognizione sensori-percettiva, fondata sulla cumolazione delle *phantasiai*, non può ottenere, in assenza di linguaggio, è la capacità di confrontare la nozione catturata dall'*habitus* fantastico-percettivo, non ancora "al di là" (*An. post.* II 19.100a3-9, *cit.*) delle molte memorie perché può essere falsificata da nuove esperienze, con il tipo, astratto in modo diverso e più radicale, rappresentato dal segno vocale linguistico.<sup>73</sup> Il segno vocale linguistico rappresenta un tipo, appreso tramite

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<sup>70</sup> *An. post.* II 19.100a16-b1: καὶ γὰρ αἰσθάνεται μὲν τὸ καθ' ἕκαστον, ἢ δ' αἴσθησις τοῦ καθόλου ἐστίν, οἷον ἀνθρώπου, ἀλλ' οὐ Καλλίου ἀνθρώπου.

<sup>71</sup> Cfr. Wedin (1988) pp. 157, 252: la sensazione è sempre e solo sensazione di tipi; per quanto riguarda la sensazione dei sensibili *per accidens*, concordo con lui.

<sup>72</sup> *Ibid.*

<sup>73</sup> In Falcon (2021) si offre un'interpretazione analoga del pensiero di Aristotele sulla mente infantile: ciò che manca agli infanti, quando stanno iniziando a parlare senza avere piena cognizione dell'uso corretto delle parole (cfr. *Phys.* I 1.184a16-23), è la capacità di delimitare i termini linguistici in accordo col significato che essi hanno nella lingua degli adulti. Essi non avrebbero la capacità di demarcare tra loro i diversi universali denotati dai diversi termini: "I argue that Aristotle's diagnosis of the problem is that there is not enough conceptual articulation in the infant mind that calls all men 'papa' and all women 'mama'" (p. 369), "they do not

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l'educazione linguistica, tale da non poter essere falsificato dalla mia singola esperienza sensorio-percettiva (è 'al di là' di essa). Quest'ultima può dirmi se quanto sto sperimentando coincide o meno con la mia pregressa esperienza, e, quando è congiunta al linguaggio, se la cosa ricade sotto un dato universale, ma non può dirmi se i tipi sono stati demarcati in modo appropriato.

A distinguere l'essere umano adulto, l'animale linguistico e ragionevole, dall'animale non-linguistico, per Aristotele non è dunque la mera capacità di sviluppare sistemi di rappresentazioni,<sup>74</sup> bensì il possesso di un sistema di rappresentazioni la cui struttura si fonda su una topografia di tipi astratti convenzionali, sedimentati nel linguaggio. Questa topografia deve obbedire ai seguenti requisiti: (*a*) deve poter essere confrontata con l'*habitus* fantastico-percettivo per verificare la sua congruenza con i sensi, la *phantasia* e la memoria; (*b*) deve essere più o meno aderente ad un'adeguata rappresentazione del mondo, dunque problematizzabile nella sua portata veritativa rispetto a esso.<sup>75</sup>

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yet have the ability to draw conceptual distinctions, which requires the acquisition and correct use of the relevant concepts" (p. 380); perciò, pur essendo percettualmente capaci di distinguere quei particolari individui che sono la madre e il padre dagli altri esseri umani (p. 373), non applicano i nomi "padre" e "madre" con la dovuta proprietà.

<sup>74</sup> Infatti Aristotele attribuisce la voce (φωνή), cioè il suono significativo (σημαντικός τις ψόφος; *De an.* II 8.420b33; cfr. anche II 8.420b5, 29; *GA V* 7.786b24), anche ad animali non umani: gran copia di luoghi pertinenti in Bonitz (1960), s.v. "φωνή".

<sup>75</sup> Scrive De Haan (2018) p. 8 (enfasi mia): "intellectual understanding and conceptualization about the world can be knowledge only if understood conceptualizations have been rationally verified in a judgment that truly grasps such-and-such is the case. And this requires intellectual *reflection* on the phantasms as well as vigilant observations and continuous active exploration of the world". Secondo lo studioso, cioè, per Aristotele il livello intellettuale-razionale e quello sensorio-fantastico oltre ad essere in una relazione di costituzione materiale (il livello sensorio-percettivo fornisce la materia di quello razionale-intellettuale) si problematizzano a vicenda nella loro portata veritativa: solo così, infatti, la cognizione umana può essere spiegata nella sua complessità, ovvero come rapporto tra i due diversi livelli di astrazione propri di percezione-immaginazione e ragione-intelletto. De Haan (2018) p. 10, condivide l'idea aristotelica che le operazioni immaginative ed estimative necessarie ad un appropriato orientamento nell'ambiente naturale appartengano al livello sensorio dell'organizzazione del vivente: "Humans (and other animals) deploy a range of personal level (or animal level) psychosomatic abilities, call these psychological level attributes. These psychosomatic abilities can be distinguished into lower-level psychosomatic operations like seeing, hearing, and touching, and higher-level psychosomatic operations like enactive perceptual and estimative registration, memory, motivation, emotion, and a range of executive functions. These higher-level and lower-level psychosomatic operations are all animal level

Per concludere, il mondo è composto, per lo Stagirita, di *ousiai*; carattere principe dell'*ousia* (tanto prima quanto seconda) è quello di non inerire ad alcunché (cfr. *Cat.* 5, *per totum*), mentre le fantasmagorie proiettate dai *phantasmata* e dall'*habitus* fantastico-percettivo dipendono dal soggetto, poiché dipendono *in toto* dalle alterazioni dei suoi organi di senso. L'animale non linguistico, reagisce agli oggetti<sub>2</sub> proiettati dalle sue proprie rappresentazioni, senza potersi chiedere, grazie ad un sistema astratto di rappresentazioni fondato su tipi, se l'apparenza sensoria sia corretta o meno. Invece, il ricorso al concetto di '*ousia*', con le sue implicazioni di indipendenza ontologica, distinzione tra soggetto e predicati e catalogazione del reale, permette di tematizzare la cosa esperita come qualcosa di più o meno reale od illusorio. Permette cioè di considerarla come qualcosa di indipendente da noi, ponendo il problema della discrepanza tra apparenza sensibile e realtà esterna.

È quando all'*habitus* fantastico-percettivo si sovrappone, integrandolo, tale sistema di rappresentazioni (il *logos*, appunto) riferite a tipi di oggetti intenzionali, che il confine tra animali pre-razionali e razionali è valicato.<sup>76</sup>

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attributes, which admit of a surfeit of sub-animal level attributes, such as the complex hierarchy of multilevel mechanisms [...]. Lower-level and higher-level psychosomatic operations interact with each other in a variety of complex ways. Sometimes the lower-level psychosomatic operations are actualized by environmental stimuli which thereby drive the coordinated manifestations of higher-level psychosomatic operations. In other cases, the animal's powers for enactive perception, motivation, and executive registrations enable the animal to exert effective control over the coordinated manifestation of its higher-level and lower-level psychosomatic powers, such as the animal's capacities for enactive sensory perception and motivation that guide locomotion".

<sup>76</sup> I miei più sentiti ringraziamenti a Silvia Fazzo per i preziosi suggerimenti, a Marco Ghione e Clelia Attanasio per i consigli redazionali.



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PETER SWALLOW

**NATURAL SELECTION SHADOWED FORTH:  
ARISTOTLE'S *DE PARTIBUS ANIMALIUM*  
AFTER DARWIN**

**Abstract**

Until the last years of his life, Charles Darwin had actually never read Aristotle. The sole reference he makes to his naturalist forebear in *On the Origin of Species* came in an addition to the fourth edition, published in 1866, in which he mistakenly refers to Aristotle's summation of Empedocles' position at *Physica* II 8, as Aristotle's own, and notes that 'we see here the principle of natural selection shadowed forth' (while disputing the specific scientific point Aristotle – though actually Empedocles – was supposedly making). So when his friend William Ogle, a minor scientist and physician, and an evangelist Christian, published a translation of Aristotle's *De partibus animalium* in 1882 and sent a copy to Darwin, he was able to declare that he felt "some self-importance in thus being a kind of formal introducer of the father of Naturalists [Aristotle] to his great modern successor [Darwin]." Ogle, who despite his religious inclinations was nevertheless a strong proponent of Darwin's theories, did not agree with Aristotle's scientific theories – not least because Aristotle's teleological model of animal development, which had been adopted as a model by many post-classical Christian scientists and theologians for centuries, was dealt a serious blow by Darwin's theory of natural selection. So it is perhaps surprising to see Ogle produce a translation of one of Aristotle's major biological treatises. By looking at key passages of Aristotle and Ogle's translation, this paper will examine the reasons for Ogle's curious choice to publish his work, setting it into the wider scientific, and Darwinian, context of late-nineteenth century Britain, and explaining how Aristotle the teleologist was used by Ogle to re-enforce Darwin's position as a modern natural historian.

**Keywords**

Darwin, Aristotle, Natural History, History of Science, Biology

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The sole reference Darwin makes to Aristotle in *On the Origin of Species* is in a note added to the fourth edition, published in 1866 (seven years after the book's initial release), in which he mistakenly refers to Aristotle's summation of Empedocles' position at *Physica* II 8.198b, as Aristotle's own:

Aristotle, in his 'Physics Auscultationes' (lib. 2, cap. 8, s. 2), after remarking that rain does not fall in order to make the corn grow, any more than it falls to spoil the farmer's corn when threshed out of doors, applies the same argument to organisation; and adds (as translated by Mr. Clair Grace, who first pointed out the passage to me), "So what hinders the different parts [of the body] from having this merely accidental relation in nature? as the teeth, for example, grow by necessity, the front ones sharp, adapted for dividing, and the grinders flat, and serviceable for masticating the food; since they were not made for the sake of this, but it was the result of accident. And in like manner as to the other parts in which there appears to exist an adaptation to an end. Wheresoever, therefore, all things together (that is all the parts of one whole) happened like as if they were made for the sake of something, these were preserved, having been appropriately constituted by an internal spontaneity; and whatsoever things were not thus constituted, perished, and still perish." We here see the principle of natural selection shadowed forth, but how little Aristotle fully comprehended the principle is shown by his remarks on the formation of the teeth.<sup>1</sup>

But the very next sentence in the Greek demonstrates that Aristotle is *refuting* this position, not adopting it – he says that "it is impossible that this should really be the way of it. For all these phenomena and all natural things are either constant or normal, and this is contrary to the very meaning of luck or chance." The argument he cites here comes from Empedocles, who, like Darwin, rejected a teleological model of species development underpinned by intelligent design, though his model was driven by random chance rather than natural and sexual selection, as Darwin would have it.

Darwin's attention was drawn to this passage, as he notes, by a letter from Clair James Grece, not himself a scientist but a philologist whose interest must have been piqued by Darwin's *Origin of Species*. According to Darwin, "he was so kind as to send me translations of several passages in Greek authors bearing on Natural Selection",<sup>2</sup> which, Grece said, showed "that 'Natural Selection' was known to the ancients".<sup>3</sup> Sadly, we have lost this

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<sup>1</sup> Darwin (1866) p. xiii.

<sup>2</sup> Darwin to John Murray, 31 December 1867. Darwin Correspondence Project (DCP) letter no. 5743.

<sup>3</sup> Grece to Darwin, 12 November 1866. DCP letter no. 5267.

original letter and the other passages Grece included in it. While it is clear that Darwin had not read the original text, in Greek or in English translation, Grece had – and felt compelled to share it with Darwin. Whether Grece also misread the passage in question, or Darwin just misunderstood his summation, we cannot say.

Regardless of the misidentification, Darwin would be right to see both Aristotle and Empedocles as his predecessors – for both were interested in the development of species, and Empedocles even attempted to put forward a theory of evolution. Even so, the footnote's mistake, whether Darwin's or not, was driven by Darwin's complete ignorance of ancient Greek natural history.<sup>4</sup> In a letter to schoolteacher and amateur naturalist J.A. Crawley in 1879, he declared: "I have forgotten the very little Greek which I once knew. Nor have I ever read, to my shame be it spoken, the works of Aristotle."<sup>5</sup> In the 'Historical Sketch' as it was first added to his *Origin of Species* at its third printing in 1861, his only reference to classical authors is to declare that he will be "passing over" them.<sup>6</sup> In 1838, when he was just back from his famous voyage on the *Beagle* and had already begun to formulate what would become his theory of natural selection, Darwin had written in a notebook "Read Aristotle to see whether any my views very ancient?"<sup>7</sup> – using the imperative and ending on a question-mark. But even so, it took him 44 years to get round to it, by which time Darwin was in the last months of his life.

The catalyst for finally reading Aristotle was his friend William Ogle, a minor scientist and physician, as well as committed evangelist, who nevertheless was a strong proponent of Darwin's theories. Ogle had been educated at Rugby under Thomas Arnold, and was a lifelong proponent of hospital and nursing reform, about which he corresponded with Florence Nightingale.<sup>8</sup> He wrote to Darwin in 1871 to thank him for sending him a copy of *Descent of Man*:

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<sup>4</sup> In *Descent of Man*, his work on sexual selection, Darwin wrote two of his footnotes in Latin to shield his readers from indelicacy. Not trusting in his unpractised Latin, however, he had to ask his son to check the translation (Dawson 2007, pp. 36-8).

<sup>5</sup> Darwin to J.A. Crawley, 12 February 1879. DCP letter no. 11875.

<sup>6</sup> Darwin (1861) p. xiii.

<sup>7</sup> Barrett et al. (1987) p. 325 c267.

<sup>8</sup> Wildman (2023).

which you have been so kind as to send to me, and many congratulations to you on having so successfully reached the end of another stage in your work. I need hardly say that I am greedily reading the book, not only with pleasure and admiration, like all the rest of the world, but with compelled assent, which I fear cannot be said equally of all your readers.<sup>9</sup>

The *Descent of Man*, which explicitly argued that humans had a common ancestor with apes, was by far the most controversial of Darwin's works,<sup>10</sup> so for Ogle to offer it "compelled assent" was no empty gesture.<sup>11</sup>

In 1882, Ogle published a translation of Aristotle's *De partibus animalium*, and it is in this edition that Charles Darwin first came to read Aristotle. Ogle sent Darwin a copy of the book upon publication, alongside a note which declared:

I feel some self-importance in thus being a kind of formal introducer of the father of Naturalists to his great modern successor. Could the meeting occur in the actual flesh, what a curious one it would be! I can fancy the old teleologist looking sideways and with no little suspicion at his successor, and much astounded to find that, while there was actually no copy of his own works in the house and while his views were looked on as mere matters of antiquarian curiosity, Democritus whom he thought to have effectually and everlastingly squashed, had come to life again in the man he saw before him! I have, however, such faith in Aristotle as a real honest hunter after truth, that I verily believe, that, when he had heard all you have to say on your side, he would have given in like a true man, and have burnt all his writings...<sup>12</sup>

This final sentiment is quite striking – Ogle, who had just gone to the effort of translating one of Aristotle's biological treatises, declaring that Aristotle himself would want to burn it upon meeting Darwin! But it can be explained through the distinction Ogle here makes between Democritus and Aristotle.

Ogle's dichotomy is intended to map onto contemporary battle-lines between materialists, with Darwin at their head, and on the other hand teleologists insisting on the active intervention of a creator. The very first line of Ogle's introduction states, "how came these adaptations about, is a question coeval, we may be sure, with the first recognition of the adaptations

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<sup>9</sup> Ogle to Darwin, 25 February 1871. DCP letter no. 7514.

<sup>10</sup> Dawson (2007) pp. 26-81.

<sup>11</sup> On the difference between humans and non-human animals in Aristotle, see Labarrière (1984).

<sup>12</sup> Ogle to Darwin, 17 January 1882. DCP letter no. 13621.



themselves.”<sup>13</sup> The demonstrative pronoun ‘these’ here, coming as it does without clear antecedent because this is the first line in the book, can only refer to the ‘adaptations’ currently being discussed at length in both academic and popular discourse – that is, debates about evolution, and whether Darwin’s materialist explanation of it was accurate. Ogle follows by saying:

The answers to it fell of old, as ever since, into two main divisions. One group of philosophers there was, who fancied that they found an adequate cause for the phenomena in the necessary operations of the inherent properties of matter; while another sought a solution in the intelligent action of a benevolent and foreseeing agent, whom they called God, or Nature, as the case might be.<sup>14</sup>

Aristotle, according to Ogle, falls into this latter camp, as his explanation of adaptation has nature as the operating force in a teleological model of change. Later Christian thinkers certainly did appropriate his views on gradualism into a theological model of evolution, by replacing ‘Nature’ with ‘God’.<sup>15</sup> Meanwhile Democritus and Empedocles are Ogle’s prime examples of the former division, though it is Darwin, says Ogle, who has perfected their ancient model. As we have seen, there is some truth in this, though Darwin was certainly not across all the details. In a footnote, Ogle sums up Empedocles’ position then observes that “the relation in which the hypothesis stands to that of Darwin may thus be expressed; the old philosopher insists on the survival of the fit, Darwin on the survival of the fittest. What a vast difference underlies the apparent similarity in the introduction of a single short syllable scarcely needs to be pointed out.”<sup>16</sup>

It is not a stretch of the imagination to think that Ogle, who was an expert on Aristotelian natural history and had pointed out relevant passages to Darwin himself in the past,<sup>17</sup> had spotted Darwin’s mistake in falsely attributing Empedocles’ explanation of the development of teeth to Aristotle, and meant, with this footnote, to provide a polite and oblique correction of his friend.

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<sup>13</sup> Ogle (1882) p. i.

<sup>14</sup> *Ibid.*

<sup>15</sup> For the definitive account of the history of this idea, see Lovejoy (1936).

<sup>16</sup> Ogle (1882) p. ii, 2n.

<sup>17</sup> Darwin to Ogle, 25 September 1875. DCP letter no. 10171.

So Ogle is interested in Aristotle's biology at least in part because of the way in which it can contextualise contemporary debates about evolution and Darwinism, and provide it with a classical lineage – if not necessarily back to Aristotle himself then to Empedocles. But why, if Ogle is a supporter of Darwin, translate a treatise he believes argues the opposing side? Ogle makes clear that Aristotle was wrong<sup>18</sup> – yet values Aristotle not so much for his argument, but for the scientific method which he developed:

By the skilful use of scientific method to discover new truths is a noble achievement; but far nobler is it to discover the method itself, by which alone such achievements are made possible; and to have done this is Aristotle's glory. That the method as left by him was not perfect, that there were flaws which the fuller experience of after-ages detected, and gradually remedied, may be allowed... To detect and strengthen these is to confer a benefit on mankind; but is a service which can never be put on a par with that rendered by the original conception.<sup>19</sup>

This empiricism – improved on by Darwin, but founded by Aristotle – was what had made Darwin's theory of evolution so convincing, supported as it was by years of carefully collected observations of the natural world.<sup>20</sup> And it is something Ogle strives to emphasise in Aristotle's scientific method too, which is why he endlessly reasserts that Aristotle carried out dissections, including probably of human foetuses.<sup>21</sup> We are reminded of Ogle's claim in his letter to

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<sup>18</sup> Ogle's presentation of a dichotomy between Aristotelian teleology and Darwinian materialism was shaped by contemporary debates about Darwinism; more recent scientific thought has highlighted how evolution is at least partially an Aristotelian teleological process, driven by natural biological systems. "The major importance of natural genetic engineering is that this capability removes the process of genome restructuring from the stochastic realm of physical-chemical insults to DNA and replication accidents. Instead, cellular systems for DNA change place the genetic basis for long-term evolutionary adaptation in the context of cell biology where it is subject to cellular control regimes and their computational capabilities" (Shapiro 2002, p. 747). Teleology isn't necessarily at odds with materialism. See also, Jablonka and Ginsburg (2013); Ginsburg and Jablonka (2015); for the historical view, McDonough (2020).

<sup>19</sup> Ogle (1882) p. xix.

<sup>20</sup> On Aristotle's scientific method and how it is represented in *De partibus animalium* 1, see Leunissen (2010) pp. 76-81; Lang (2019) pp. 57-64.

<sup>21</sup> E.g. Ogle (1882) pp. 149, 165, 210, 212f. Aristotle describes observing miscarried embryos at *Hist. anim.* 583b. Bubb notes with some scepticism that "the small size of human fetuses and neonates – and all the more so those aborted or miscarried early in gestation [...] – suggests that any fetal dissection that Aristotle might have engaged in would have remained mostly at the level of gross anatomy, allowing him simply to confirm or modify in a

Darwin – that upon presentation of Darwinian evidence, Aristotle, the great empiricist, would have no choice but to acquiesce and burn all his writings.

Moreover, Ogle sees in Aristotle a fellow natural historian, and one whose passion for the subject bridges the more than two thousand years separating them. Aristotle's defence of his interest in natural history – offering an answer to Plato's emphasis on the human soul above all else – is given early on in the treatise:

Every realm of nature is marvellous: and as Heraclitus, when the strangers who came to visit him found him warming himself at the furnace in the kitchen, is reported to have bidden them not to be afraid to enter, as even in that kitchen divinities were present, so we should venture on the study of every kind of animal without distaste; for each and all will reveal to us something natural and something beautiful. Absence of hap-hazard and conduciveness of everything to an end are to be found in Nature's works in the highest degree, and the resultant end of her generations and combinations is a form of the beautiful.<sup>22</sup>

Reading that, it is clear why a nineteenth-century natural historian would feel a connection to Aristotle, despite differing views on the primacy of form or function.

That Ogle chose to put forward his argument for the longevity of the scientific method, and Darwin's exemplary position at its head, through the translation of an ancient Greek treatise may be a little idiosyncratic. But "Victorians located science in many places, not just in the laboratory [...] large and small public lectures and scientific demonstrations, textbooks, atlases, dozens of popular magazines and pamphlets, and even the literature of science fiction provided hosts of learners with insights into the discoveries of science."<sup>23</sup> Why not in classical literature too? Late Victorian society still held up "antiquity as an exemplary standard, something of permanent and general value able to resist the corrosions of change and relativity"<sup>24</sup> – so that

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general way the parallels that he had drawn from animal subjects" (Bubb 2022, p. 30). Le Blond, meanwhile, argues that Aristotle's "study of the development of the [human] embryo is truly extraordinary and could only have been completed with the help of a microscope" (Le Blond 1945, p. 25)! See also Lennox (2018); Crivellato and Ribatti (2007).

<sup>22</sup> *De part. anim.* 645a = Ogle (1882) p. 17.

<sup>23</sup> Gates (1997) p. 179.

<sup>24</sup> Stray (1996) p. 77.

Aristotle could still be expected to carry intellectual and rhetorical weight in support of Ogle’s model of science.

Indeed, for all its antiquity, *De partibus animalium* must have struck Ogle as strikingly contemporary. Aristotle’s interest in categorising animals (fig. 1), although taking up only the first part of the book and by no means “systemic”,<sup>25</sup> really was the intellectual forefather of Linnaeus’ programme of taxonomy, “one of the quintessential achievements of modern science.”<sup>26</sup> “One of the striking features of Ogle’s Introduction”, remarks Gotthelf, “especially to a 19th century reader, is the fresh sense it gives of the breadth – the immensity – of Aristotle’s undertaking, and of the way he has brought an incredible mass of data under theoretical control.”<sup>27</sup> And that Aristotle does not appear to really reach a conclusion to his own satisfaction in the work, also may have appealed to Ogle’s sense of the progressiveness of science, as much as it also frustrated him. Aristotle’s enquiry sets himself out as the direct ancestor of the nineteenth-century natural philosopher, while his inability to answer the many questions he raises simultaneously legitimises his descendants.

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|---|---|
| i. SANGUINEOUS ANIMALS [ <i>Vertebrata</i> ].                       |   |
| A. Vivipara [ <i>Mammalia</i> ].                                    | 1. Man.   |
|   | 2. Quadrupeds.  |
|   | 3. Cetacea.   |
| B. Ovipara.   |   |
| a. With perfect ovum.   | 4. Birds.   |
|   | 5. Quadrupeds and Apoda [ <i>Reptiles and Amphibia</i> .]               |
| β. With imperfect ovum.   | 6. Fishes.  |
| ii. BLOODLESS ANIMALS [ <i>Invertebrata</i> ].                      |   |
| a. With imperfect ovum.   | 7. Malacia [ <i>Cephalopods</i> ].                                      |
|   | 8. Malacostraca [ <i>Crustacea</i> ].                                   |
| β. With scolex.   | 9. Insecta [ <i>Remaining Arthropoda and some Vermes</i> .]             |
| γ. With generative<br>slime; buds;<br>or spontaneous<br>generation. | 10. Ostracoderma or Testacea [ <i>Mollusca excepting Cephalopods</i> ]. |
| δ. With spontaneous<br>generation only.                             |   |
|   | 11. [ <i>Zoophytes</i> .]   |

Fig. 1: Aristotle’s “main groups of animals”, as set out by Ogle (1882) p. xxxiii.

<sup>25</sup> Ogle (1882) p. xxi.

<sup>26</sup> Ritvo (1997) p. 335. On the influence of Aristotle on debates over the categorisation of plants before Linnaeus, see Larson (1971) pp. 1-49; Aristotle’s taxonomy is discussed in an extensive footnote, 22-4. See also Pellegrin (1986) p. 58f.

<sup>27</sup> Gotthelf (1999) p. 21.

At the same time, Ogle's temptation to read too much into Aristotle skates over the many places where, as far as modern biology is concerned, Aristotle is wholly ignorant. At times, one sees how hard Ogle must fight to make Aristotle's natural history seem intellectually contiguous with nineteenth-century science. So the ground-breaking work of Linnaeus to categorise animals is given more precedence in Aristotle's own categorisation than warranted, through careful translation. In an early footnote, Ogle notes that while Aristotle's term εἶδος is "practically defined" and "scarcely differs from that of Cuvier", justifying its translation as species,<sup>28</sup> the definition of γένος in Aristotle is harder to map onto Linnaean taxonomy; Ogle says "it may mean any natural group of animals larger than a species and not larger than a class".<sup>29</sup> (An example of a 'class' would be – mammal). In fact, Aristotle "is very far from adhering strictly to this definition of genus. He uses the term in the most lax manner to express any group however large and however small."<sup>30</sup> One can detect the note of frustration in Ogle – though we should not be surprised that Aristotle's language fits improperly onto Linnaean taxonomy, given it predates it by 2,000 years. His understanding of and interest in natural history was fundamentally different, and *De partibus animalium* is only circumstantially a book about taxonomy. Ogle, nevertheless chaffed by Aristotle's lack of Linnaean foresight, endeavours to correct Aristotle's shortcomings – and translates γένος "variously – genus – order – tribe – class – natural group – kind, etc., as seemed most convenient in each separate case."<sup>31</sup> The significant effect of this can be seen at 644b. I have given the Greek, A.L. Peck's Loeb translation and Ogle's own:

σχεδὸν δὲ τοῖς σχήμασι τῶν μορίων καὶ τοῦ σώματος ὅλου, ἐὰν ὁμοιότητα ἔχωσιν, ὠρίσται τὰ γένη, οἷον τὸ τῶν ὀρνίθων γένος πρὸς αὐτὸ πέπονθε καὶ τὸ τῶν ἰχθύων καὶ τὰ μαλάκιά τε καὶ τὰ ὄστρεια.

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<sup>28</sup> *Ibid.* p. 141.

<sup>29</sup> *Ibid.*

<sup>30</sup> *Ibid.* p. 142.

<sup>31</sup> *Ibid.*

Peck

Now it is practically by resemblance of the shapes of their parts, or of their whole body, that the groups are marked off from each other: as e.g. the groups Birds, Fishes, Cephalopods, Testacea.

Ogle

It is generally similarity in the shape of particular organs, or of the whole body, that has determined the formation of the larger groups. It is in virtue of such a similarity that Birds, Fishes, Cephalopoda, and Testacea have been made to form each a separate class.<sup>32</sup>

(Testacea was the Linnaean name for what Aristotle simply labels “bivalves”, as they are indeed now classed.) Where Peck translates γένος as “group”, capturing Aristotle’s ambiguity, Ogle has translated it first as “larger groups” and then as “class”, the correct Linnaean term – presumably as a back-formation, because the examples Aristotle proceeds to give are all identifiable with Linnaean classes. He is trying to neaten up Aristotle and bring him in line with nineteenth-century taxonomic terminology.<sup>33</sup>

Throughout his translation and the copious notes that accompany them, Ogle works hard to tie Aristotle to Darwinism too, sometimes through the continuity of ideas and sometimes through the continuity of the scientific method. He is not always subtle about it. When Aristotle is explaining why he has chosen to focus on the physiology of animals rather than their development, Ogle makes a telling translation choice:

δεῖ δὲ μὴ λεληθέναι καὶ πρότερον προσήκει λέγειν, ὥσπερ οἱ πρότερον ἐποιοῦντο τὴν θεωρίαν, πῶς ἕκαστον γίνεσθαι πέφυκε μᾶλλον ἢ πῶς ἔστιν. οὐ γὰρ τι μικρὸν διαφέρει τοῦτο ἐκείνου. ἔοικε δ’ ἐντεῦθεν ἀρκτέον εἶναι (καθάπερ καὶ πρότερον εἶπομεν, ὅτι πρῶτον τὰ φαινόμενα ληπτέον περὶ ἕκαστον γένος, εἶθ’ οὕτω τὰς αἰτίας τούτων λεκτέον) καὶ περὶ γενέσεως [...] ἢ γὰρ γένεσις ἔνεκα τῆς οὐσίας ἐστίν, ἀλλ’ οὐχ ἢ οὐσία ἔνεκα τῆς γενέσεως.

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<sup>32</sup> *De part. anim.* 644b = Ogle (1882) pp. 15-6.

<sup>33</sup> Ogle is completely correct when he highlights the difficulty in pinning down a single meaning for γένος in Aristotle, certainly one which aligns to a specific theory of taxonomy. This is because in Aristotle’s biological treatises “there is no classification scheme in the background, and all attempts to construct one for Aristotle have failed” (Balme 1962, p. 85). This includes, of course, the taxonomic system Ogle draws up from *De part. anim.* (fig. 1). See also Pellegrin (1986) pp. 58-61. My interest here is not so much in what Aristotle may actually mean by γένος and εἶδος, however, but what Ogle is trying to *make* him mean.

Peck

We must also decide whether we are to discuss the processes by which each animal comes to be formed – which is what the earlier philosophers studied – or rather the animal as it actually is. Obviously there is a considerable difference between the two methods. I said earlier that we ought first to take the phenomena that are observed in each group, and then go on to state their causes. This applies just as much to the subject of the process of formation [...] the process is for the sake of the actual thing, the thing is not for the sake of the process.

Ogle

Another matter which must not be passed over without consideration is, whether the proper subject of our exposition is that which the ancient writers concerned themselves, namely, what is the process of formation of each animal; or whether it is not rather, what are the characters of a given creature when formed. For there is no small difference between these two views. The best course appears to be that we should follow the method already mentioned, and begin with the phenomena presented by each group of animals, and, when this is done, proceed afterwards to state the causes of the phenomena, *and to deal with their evolution* [...] *For the process of evolution is for the sake of the thing finally evolved*, and not this for the sake of the process.<sup>34</sup>

Aristotle says that when we have finished looking at what an animal's form is, we can ask how it came to be in that form – its γένεσις. For the process of its development (again, γένεσις) exists to furnish its form, rather than its form being predicated upon the process of development. Ogle chooses to translate γένεσις as “evolution” or “process of evolution”, and notably in the last sentence even renders ἡ οὐσία as “the thing finally evolved” – but that is clearly not what Aristotle meant. He was not talking about the development of a species over time, but at a fixed point of development – the development of a foetus into a person rather than the development of *Homo sapiens* over millennia. For Aristotle, “the question of the origins of life, animals and humans did arise, but as a problem involving a single-generation beginning rather than a continuing process [...] The question of whether species have changed was not posed.”<sup>35</sup> Ogle must have known he was stretching the definition of γένεσις to the point of mistranslation here. As it was, Darwin “was famously reluctant to use the term [evolution] (it does not appear at all in the *Origin*)”,<sup>36</sup> but it was nevertheless attached to him and fairly swiftly

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<sup>34</sup> *De part. anim.* 640a = Ogle (1882) p. 3f. Emphasis mine.

<sup>35</sup> Lang (2019) p. 36.

<sup>36</sup> Gribbin and Gribbin (2020) p. 34.

became almost synonymous with Darwinism.<sup>37</sup> I am not suggesting that Ogle was conflating Aristotelian teleology with anti-teleological Darwinism – but he *was* putting the ideas together and presenting them as competing theories of evolution, which Aristotle’s certainly is not. This ability to connect Aristotle to Darwin was aided substantially by the fluidity of what Darwinism actually meant in the popular consciousness of late-nineteenth century Britain.<sup>38</sup> Although Ogle never substantially mischaracterises Darwin’s theories or endorses Aristotle’s teleological model, other biologists and public voices *were* actively mischaracterising Darwin and arguing in favour of teleological evolution, so that Darwin could indeed be made, somehow, to support Aristotle. In this context, Ogle’s project does not look as unexpected.

Ogle’s attempts to put Darwin in conversation with Aristotle are best exemplified in his copious notes. In a discussion about teeth, Aristotle notes that:

Nature allots each weapon, offensive or defensive, to those animals alone that can use it; or, if not to them alone, to them in a more marked degree; and she allots it in its most perfect state to those that can use it best; and this whether it be a sting, or a spur, or horns, or tusks, or what it may of a like kind. Thus as males are stronger and more choleric than females, it is in males alone that such parts as those just mentioned are found, or at any rate it is in males that they are found in the highest degree of perfection.<sup>39</sup>

The footnote of this section approves of Aristotle’s observation, but replaces Aristotle’s teleological explanation – Nature has formed the teeth as offensive or defensive weapons according to the function required by each animal, and differently according to sex – with Darwin’s theory of sexual selection:

... it is more probable that both weapons and temperament are attributable to one common cause; and what that cause is Darwin has shown in his work on sexual selection. The males contend with each other for the females, and such males as chance variation has endowed

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<sup>37</sup> Thomas Huxley, ‘Darwin’s bulldog’ and populariser of Darwinism, was slow to accept all of the mechanisms behind Darwin’s theory. In his 1880 work *The Crayfish: An Introduction to the Study of Biology*, “he pushed his readers to accept evolution but never discussed the role of natural selection” (Lightman 2010, p. 10). Although later in life he did draw more of a distinction between evolution and Darwinism (Moore 1991, pp. 353-5), by then the popular conception of Darwinism as, if not the only, certainly the foremost model of evolution had well-and-truly been established.

<sup>38</sup> Moore (1991).

<sup>39</sup> *De part. anim.* 661b = Ogle (1882) p. 58.



with a slightly stronger weapon or slightly stouter heart will as a rule prevail in the struggle; and, obtaining preferential possession of the females, will leave offspring in greater numbers than their less favoured competition. Of this offspring some will inherit the physical and moral advantages of their sires. Of these again the best-armed and the most valiant will be most successful in propagating their kind; and so on, generation after generation, the comparatively weakly and cowardly being eliminated at each stage of improvement.<sup>40</sup>

This is a neat summation of Darwin's theory, evidenced by an observation taken from Aristotle but used to correct Aristotle's incorrect conclusion. (And by the way, Darwin's theory of sexual selection, as set out in *Descent of Man*, is somewhat distinct from his theory of natural selection, though the two are interconnected and often conflated.) Again, by the very fact that Ogle chose to make this point in a footnote about teeth, we might see this as another polite and oblique correction to Darwin's incorrect footnote from the *Origin of Species*.

When Aristotle states that "the large size and great branching of [deer's] horns makes these a source of detriment rather than of profit to their possessors",<sup>41</sup> Ogle comments that "it is somewhat astounding to find so determined a teleologist suddenly declaring that antlers are not merely useless but injurious to stags" before reflecting that "their great size and branching serve however as ornaments, and so give an advantage in the sexual struggle" – citing Darwin in the process.<sup>42</sup> To support Aristotle's assertion that animals are never provided with more than one means of defence, Ogle quotes Darwin's similar, albeit more equivocal, statement that "very few male quadrupeds have weapons of two distinct kinds specially adapted for fighting with rival males".<sup>43</sup>

But Ogle is not only interested in connecting Aristotle's works to Darwin. His footnotes are full of references to dozens of eighteenth- and nineteenth-century biologists from Britain and across Europe, tying Aristotle's observations into contemporary debates about natural history. When Aristotle makes a brief observation about the mouth of cephalopods,<sup>44</sup> Ogle takes the opportunity to comment that Aristotle's "account of the anatomy and

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<sup>40</sup> Ogle (1882) p. 187

<sup>41</sup> *De part. anim.* 663a = Ogle (1882) p. 61.

<sup>42</sup> Ogle (1882) p. 189.

<sup>43</sup> Darwin (1871) p. 257.

<sup>44</sup> *De part. anim.* 679a = Ogle (1882) p. 98.

habits of the Cephalopods has received a tribute of praise from many writers. ‘Respecting the living habits of the Cephalopods,’ says Owen, ‘Aristotle is more rich in detail than any other zoological author, and Cuvier has justly observed that his knowledge of this class, both zoological and anatomical, is truly astonishing’.<sup>45</sup> Ogle is therefore not only eager to praise Aristotle himself, but also acknowledge the praise of two of the greats of modern biology, the French naturalist Georges Cuvier (1769-1832), who first proved that animals can go extinct, and Sir Richard Owen (1804-1892), most famous now for his bitter opposition to Darwin’s theories but a celebrated palaeontologist and naturalist in his own right. (He also coined the word ‘dinosaur’.) Quoting Owen quoting Cuvier has the nice effect of making the praise of Aristotle seem all the more universal – for if two of the most significant and celebrated biologists saw Aristotle as their equal, so surely must the entire academy.

When faced with one of Aristotle’s errors, Ogle variously adopts three different strategies. If he resolves to simply dispute Aristotle, he does so briefly and matter-of-factly; thus, when Aristotle asserts that “vision is so placed [in the head] in all animals”,<sup>46</sup> Ogle merely comments, “not so” before citing starfish and scallops, which both have eyes elsewhere.<sup>47</sup> When Aristotle states that rennet is found in ruminants’ third stomach,<sup>48</sup> Ogle simply states: “This is erroneous. It is the fourth stomach that gives rennet”.<sup>49</sup>

More frequently, Ogle will go to pains to explain that, while Aristotle was wrong, he had good cause for thinking as he did, and is not therefore to be overly criticised. So when discussing Aristotle’s brief mention of how the body causes motion, which Aristotle ascribed to the contraction of various sinews by the heart, thereby ignoring both muscles and nerves, Ogle remarks:

Of the contractility of muscular tissue he knew nothing; though it is impossible to suppose that he did not know that what we call a muscle swelled up, becoming shorter, and broader, during action [...] That he himself felt how unsatisfactory [his explanation] was, we may infer from his saying so very little on the subject, notwithstanding its importance. We must remember, moreover, that, while nerves were still undiscovered, no explanation of voluntary

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<sup>45</sup> Ogle (1882) p. 220f.

<sup>46</sup> *De part. anim.* 656b = Ogle (1882) p. 44.

<sup>47</sup> Ogle (1882) p. 174.

<sup>48</sup> *De part. anim.* 676a = Ogle (1882) p. 91.

<sup>49</sup> Ogle (1882) p. 217.

motion was possible. A. had to find some anatomical machinery connecting the tendons, which were clearly the immediate agents that acted on the bones, with the volitional centre, which he took as we know to be the heart and not the brain. He could find no other continuous substance between these two, than some or other kind of fibrous tissue, in the form either of tendinous fibre or of arterial wall. This therefore he assumed to be the intermediate agent, no other being apparently forthcoming.<sup>50</sup>

From the evidence at his disposal, Ogle argues, Aristotle made a perfectly logical, albeit wrong, inference.

Occasionally, Ogle works hard to explain how, in actual fact, Aristotle was not wide of the mark at all. So for example, Aristotle argues that “nutrition in all cases consists of fluid and solid substances, and [...] it is by the force of heat that these are concocted and changed”.<sup>51</sup> Ogle defends this by noting that, “although we have now learnt that digestion is due to the action of gastric and other juices, yet it is no less certain that heat is not without considerable influence on the process.”<sup>52</sup> This is very generous to Aristotle, for whom heat was not only influential but the active agent in digestion.

How did Darwin respond to all this? Well, he sent an initial reply to Ogle's letter containing the translation the very same day, thanking him for the gift but sounding decidedly sceptical about Aristotle: “I suspect that your Introduction will interest me more than the text, notwithstanding that he was such a wonderful old fellow”,<sup>53</sup> he wrote. Nevertheless, a month later, Darwin had actually read the introduction as well as a good chunk of the translation besides. He now replied, unsolicited, with another note, praising Ogle in the highest:

You must let me thank you for the pleasure which the Introduction to the Aristotle book has given me. I have rarely read anything which has interested me more; though I have not read as yet more than a quarter of the book proper. From quotations which I had seen I had a high notion of Aristotle's merits, but I had not the most remote notion what a wonderful man he was. Linnæus & Cuvier have been my two Gods, though in very different ways, but they were mere school-boys to old Aristotle. – How very curious, also, his ignorance on some points as on muscles as to means of movement. – I am glad that you have explained in so probable a manner some of the grossest mistakes attributed to

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<sup>50</sup> *Ibid.* p. 197.

<sup>51</sup> *De part. anim.* 650a = Ogle (1882) p. 28.

<sup>52</sup> Ogle (1882) p. 159.

<sup>53</sup> Darwin to Ogle, 17 January 1882. DCP letter no. 13622.

him. I never realised before reading your book to what an enormous summation of labour we owe even our common knowledge.<sup>54</sup>

So Ogle's message on the importance of empiricism in biology, and its foundation with Aristotle, was quite accepted by at least one contemporary reader – by Charles Darwin, himself. Although Darwin was aware of Aristotle's mistakes, he praised Ogle's approach to "explaining" them. Ogle's mission in translating *De partibus animalium* was to establish a place for Aristotle in the pantheon of natural historians, while also creating a noble ancestry for Darwin's own scientific endeavours – with Darwin's firm approval of Ogle's translation, it would seem he was successful on both counts.

Lightman has suggested that "Darwin must have been constantly disappointed by the way in which prominent popularizers – even his friends – presented his theory. Evolution was rarely popularized in ways that reflected Darwin's major contribution to biology, his theory of natural selection."<sup>55</sup> If that be so, he may have recognised his legacy was on safer grounds with Ogle – who never quite made Aristotle or Empedocles into Darwinians, but rather presented them as interlocutors within a distinctly modern discipline defined by Darwinism. They could both be safely wrong, because they were, of course, writing right at the birth of biology as a discipline – but they provided the subject with a continuity and illustriously ancient interlocutors which reinforced both biology as a whole, and Darwin in particular. Darwin, in turn, could take pride that he was standing on the shoulder of such giants. In Ogle's work, it could be made clear – what Empedocles and Aristotle had started, Darwin perfected.

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<sup>54</sup> Darwin to Ogle, 22 February 1882. DCP letter no. 13697. For a comprehensive account of these two letters to Ogle, see Gotthelf (1999) pp. 3-30.

<sup>55</sup> Lightman (2010) p. 6.

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