

Chapter 3
Nature as a Principle of Change
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Introduction

The study of nature, says Aristotle, aims at the understanding of the principles, causes and elements that constitute or govern the natural world, and this is the fruit of an investigation that starts from things more familiar to us, yet mixed with much confusion as to their true nature, and proceeds towards things less familiar to us but more intelligible by nature, i.e. to the discovery of this true nature (*Phys.* I.1, 184a14-23). The things that are familiar to us are compounded, comprehensive, and closer to perception, and we understand them in a universal and undifferentiated manner; further investigation is needed in order to grasp our subject matter in a more detailed manner. Our first conception does not have the status of scientific understanding, but it has the advantage of being based on some sort of inductive reasoning that lends to it the status of an obvious and fundamental assumption.¹ One such assumption is that the natural world of changing things exist (*Phys.* I.2, 185a12-3). Starting from this, *Physics* I investigates the principles necessary for change, natural or otherwise, and this leads to a better understanding of change itself. This investigation meets the programmatic thesis that our study should move from what is more intelligible to us towards what is more intelligible by nature, but merely identifying the principles of change does not mean that the analysis of change is complete. Other principles and causes need to be added as well, such as most prominently the efficient cause. In other words, nothing in the *Physics* I analysis of change provides in itself sufficient material for understanding the complexity of – say – the changes involved in animal generation.

Physics II turns to the investigation of the principles of *natural* change,

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¹ See Bolton 1991: 27-9.

and first to what nature is, i.e. to a definition that demarcates the entities that possess a nature. Still, further investigation will be needed in order to determine in detail that which is characteristic of each kind of natural being. In that sense, the definition, or so it may be argued, does not give us any more an articulated picture of what nature is than the analysis of change in book I in terms of the operation of three principles (form, subject and privation) gives us a complete account of what change is. So although by the end of *Physics* II.1 Aristotle establishes more clearly what nature is, his is by no means the complete account. It is understandable, then, that the proposed definition of nature as an inner principle of change and rest, is often found wanting. Both this definition and the ideas associated with it require further elaboration before they can yield a *complete* understanding of nature.

My aim in this paper is to examine the conditions Aristotle's preliminary definition of nature in *Physics* II.1 introduces. I argue that the claim that nature is a principle of change need not be read as offering a complete and final articulation of what nature is, but rather should be interpreted as a general account or preliminary sketch that Aristotle's further qualifies in order to accommodate the nature of various natural kinds. For ultimately, it is the detailed study of natural kinds that Aristotle presents in other works that provides a much richer network of distinctions and a more precise determination of what is characteristic and distinctive of natural beings. In section I, I specify the conditions included in Aristotle's definition of nature. In sections II and III, I explain the way in which natural generation satisfy these general conditions, while artificial production does not. Section IV shows how even the locomotion of the elements counts as natural given these conditions, despite the fact that the elements are not self-movers.

I Aristotle's definition of nature in *Physics* II.1

The list of entities that exist by nature includes animals and plants, parts thereof, the four simple bodies, and, most likely, their mixtures. The reason these entities exist by nature is according to Aristotle that: 'each of them has within itself a principle of change and rest, some in respect of place, some in

respect of growth and decline, some in respect of alteration' (*Phys.* II.1, 192b13-15).²

Two things deserve comment here. First it is uncertain how we should interpret the expression 'principle [*archē*] of change'. □ natural way to understand it, and the way in which it has been traditionally read, is as denoting the 'efficient cause' of change.³ This reading however is questionable for several reasons. First, nothing in what precedes in *Physics* I indicates that 'principle' refers merely to the efficient cause.⁴ Second, this reading seems to exclude several types of *natural* changes of entities such as the elements, their mixtures and possibly some of the animate beings, because they are not produced by an internal efficient cause. Third, the arguments offered in *Phys.* II.1 supporting the identification of nature with either the matter or the form of entities that are considered to exist by nature, do not turn exclusively on the activity of matter or form as efficient causes (Kelsey 2003: 61). Rather the ways in which something can be the nature of an entity includes (in many cases) all four Aristotelian causes.

Second, it is worth asking whether the definition of nature Aristotle offers here is supposed to count as a scientific definition in the strict *Posterior Analytics*' sense. I don't believe it is; it is rather a first approximation or nominal definition that states a common, general characteristic of natural things. More precise definitions are to be provided elsewhere and they will track the different ways in which various kinds of entities possess a nature. Starting an investigation with a general definition is not unprecedented in Aristotle. In *On the Soul*, he argues that it would be absurd to try to provide a *common* definition of the soul, without also working towards the definitions of *particular* kinds of soul that correspond to the proper indivisible species of

² Animal parts and elements are excluded in other works, because they lack the kind of unity necessary for being substances, let alone natural ones (*Metaph.* Z.16, 1040b5-10). Animal parts are, I think, included here only for the sake of completeness. The case of elements is dubious, but at least according to the *Physics* they possess a principle of change in themselves, though in a special way (see section 4). This way may not, in the end, be sufficient for attributing to them a nature, thus excluding them from the list.

³ See, for instance, Simplicius *In Phys.* 264, 9-10 (cf. *Phys.* II.3, 194b29-30). However all four causes are principles (*Metaph.* □ .1, 1013a17).

⁴ The word is used extensively in *Physics* I (41 occurrences), but only in one of them it refers to efficient causes (*Phys.* I.6, 189a24-6, referring to the Empedoclean powers of Love and Strife). The word usually refers to the principles of change, such as the subject of change, its form, and its privation (this is also the case when it is used in conjunction with the word *aitia* [cause]: see e.g. *Phys.* I.7, 190b17-20 and I.9 192a13).

ensouled beings,⁵ as a common definition of the soul will not be able to fully track the latter. Even though Aristotle is not explicit about this, I believe that the same methodological considerations that pertain to soul also pertain to nature, especially given that nature, in animate beings, is in fact their soul (*PA* I.1, 641b9; *GA* II.4, 740b37-8). Given Aristotle's remarks about the need to provide more specific definitions of the soul to fill in the more general one already provided in *On the Soul*, we should expect the same to be the case regarding Aristotle's definition of nature in the *Physics*. Hence, we should also expect that the definition Aristotle provides in the *Physics* of nature will be satisfied by different natural beings in different, yet related, ways.

Now, the fullest formulation of the definition introduces two further conditions on nature being a principle of change and rest: namely, that nature is such in that in which it inheres (a) primarily and (b) *per se*, i.e. not *per accidens* (192b21-3). Condition (a) exploits the distinction between something belonging to a subject primarily or immediately and it belonging to a subject non-primarily or non-immediately. An attribute, *F*, belongs to a subject, *s*, *non-primarily* if it belongs to *s*, because there is a further subject, *s'*, such that *F* belongs to *s'* and *s'* belongs to *s*. By contrast, an attribute, *F*, belongs to a subject, *s*, *primarily* if it belongs only to *s* and to no other subject, (or if it belongs to other subjects as well, it belongs to them *because s* is attributed to them). Condition (b), on the other hand, exploits the familiar distinction between belonging to a subject *per se*, i.e. necessarily, and belonging to a subject accidentally, i.e. contingently.⁶

The two distinctions are independent. First, an attribute may belong to a subject *per se* but not primarily, in those cases where it belongs to it in virtue of belonging to some other property which in its turn belongs to the subject *per se*: having the sum of its three angles equal to two right angles belongs *per se* though not *primarily* to isosceles triangle, because it belongs primarily and *per se* to triangle and triangularity in its turn belongs *per se* to isosceles. Second, an attribute may belong primarily to a subject though not *per se*, in those cases where the relation is not mediated by a third term and yet the attribute is not essential to the subject. This is the way white, for instance,

⁵ According to *DA* II.3 there is a single *logos* [account] of soul only in the sense in which there is a single account of the genus 'rectilinear figure'. Since this account is common to all rectilinear figures but not unique to any one of them, Aristotle says it is the definition of none (414b20-8, cf. *DA* I.1, 402b6-9).

⁶ See *Simpl. In Phys.* 267.21- 268.3, followed by Ross (1936: 501).

belongs to a surface. Aristotle provides illustrations for both conditions in his text, namely essentiality and immediacy.

The first condition is used in order to block one way in which things that do not exist by nature may be thought of as possessing an inner principle of change. Aristotle's example is a physician who happens to be ill, and who can thus cure *himself*. The restoration of health is the product of his craft, i.e. medicine, so in this case the principle directing the change belongs to the person who suffers the change. They are one in number, and this may be taken as suggesting that products of craft *may* possess an inner principle of change. Hence, Aristotle needs to explain why the definition does not apply in such cases. He does that by noting that here the agent and the patient, i.e. the source and the subject of the change, may belong to one and the same entity but they belong to it under different causally relevant descriptions. Hence, not only *can* source and subject be separate in number (no physician needs to be a patient and *vice versa*), but they also *must* be separate in definition or essence (*GA* I.18, 724a43-5; II.1, 735a2; II.4, 745b28-9). So, in craft, the principle *may* be internal, accidentally, but *needs* to be external, essentially.

The second condition, i.e. immediacy, is plausibly at work in the following passage:

□n the other hand, a bed and a coat and anything else of that sort do not – in so far as they happen to receive these predicates, and in so far as they are products of craft – have an innate impulse to change. But in so far as they happen [*sumbebēken*]⁷ to be composed of stone or of earth or of a mixture of the two, they do have such an impulse, and [they have it] just to that extent (*Phys.* □□ 1, 192b16-20).

The examples here illustrate a different way in which artifacts may be thought of as possessing a principle of change, compared to the self-doctoring doctor.

⁷ The use of *sumbebēken* for characterizing the way artifacts relate to their matter may suggest that what is at issue here is, again, the distinction between *per accidens* and *per se* belonging. However, this distinction does not block the claim that the matter of artifacts is their nature, since the latter is conditionally necessary and not accidental to them. Hence, it is arguable that they possess *per se* the principle of change in their matter. Further, *Phys.* I.3, 186b18-20 introduced two senses of *sumbebēkos* [attribute]: (a) accidental attributes (the principle of medicine belongs in this way to the patient), and (b) attributes in whose account the subject to which they belong is included (the principle of the matter belongs in this way to the artifact as a compound of matter and form). Cf. *Phys.* VIII.4, 254b8-10 and *Simpl. In Phys.* 1207, 46-56.

The latter exemplifies the coincidence of active and passive powers in one entity. The former focuses on a principle of change belonging to artifacts in virtue of the material they are made of. Indeed, artifacts *may* be thought of as possessing an internal principle, because their matter possesses such a principle (or is itself composed out of matter that possesses one). For instance, a coat will fall to the ground if not hung from a nail; a balloon will fly upwards. However, such motions are not due to formal properties of the artifacts, but rather to the material constituting them. Thus the corresponding principle belongs primarily or immediately to the matter. Since the matter constitutes the composite, its principle belongs to the composite as well, but only in virtue of belonging to the matter, thus non-immediately; therefore it does not belong to the artifact properly speaking. We may take then the two examples as introducing two independent conditions for possessing a nature: essentiality and immediacy.

The need for two independent conditions becomes relevant if we turn to the second part of *Physics* II.1, where Aristotle rehearses the competing arguments for identifying nature with either matter or form (193a9-b21). The argument in favor of matter suggests that the matter of natural beings belongs both essentially and immediately to them, while the matter of artifacts satisfies only the former condition. If so, then both conditions are needed for describing the special role of matter in animate beings and for understanding how it contributes to their nature. The argument proceeds from the claim that the nature of any material being is its first constituent, which in itself does not possess the arrangement of what it constitutes, as wood does not possess the arrangement of bed. Two characteristics of this constituent matter support the claim: first, matter by being able to survive the loss of what it constitutes, has some ontological priority over the compound; second, if matter had a power to generate anything, it would generate something similar to itself rather than something similar to the compound, suggesting again that the principle of change belongs to it rather than to the arrangement of the compound (193a9-11, cf. 193a29). The first aspect turns on a criterion of survivability, while the second attributes a generative power and principle to what propagates itself.

It is the second one that reflects a radical difference between artifacts and natural beings.⁸

The first criterion, survivability, does not seem to be a necessary condition concerning the contribution of matter that Aristotle endorses. For there are cases where Aristotle claims that the matter that survives the perishing of a compound is the same only in name or 'homonymously'.⁹ So this principle of homonymy seems to go against survivability, if the latter means that the matter persists as the same type of thing throughout in all cases. And even if Aristotle only endorses a weaker version of survivability, it seems that both artifacts and natural beings can satisfy it. Aristotle therefore needs a second criterion to further distinguish natural beings from artifacts.

Aristotle's example of the wooden bed shows that the matter of artifacts fails to satisfy this second criterion, while the fact that the matter of natural beings does satisfy it was already suggested by Aristotle's claim that the underlying thing out of which a compound is constituted is the first thing out of which the constitution proceeds, which in animate beings is identified with their seed (or embryo: *Phys.* I.7, 190b2-3; I.9, 191a25-31). Now the seed's power is analogous to the imagined generative power in the wood: it generates another being similar to the one it itself comes from. Thus, the nature of what gets generated can be partly identified with this matter that is its first constituent. Given this identity, the principle that immediately belongs to the first constituent will immediately belong to what it is the first constituent of. And if so, the matter of natural things satisfies the condition of immediacy as well, although properly speaking the generative principle merely resides in the matter (as we learn from Aristotle's *GA*, it is the *formal* principle in the matter that generates; this specification is not pursued here). However, all this shows is that the matter of artifacts fails to satisfy the immediacy criterion. Aristotle also wants to claim though that artifacts also

⁸ Even if we grant that wood, perhaps qua plant, generates wood, it seems weird to make the same claim for earth. Still, Aristotle argues in *GC* that generation by reproduction of a specifically similar individual, as when human generates human, is on a par with the production of something generically the same, as when fire generates fire (I.5, 320b19-21). The argument here, however, does not require that natural entities literally reproduce themselves: it aims to show that if the matter of artifacts could generate something, what will be common between 'parent' and 'offspring' will be the material and not the arrangement. The fact that artifacts made out of, say, stone will remain stone even if their arrangement is changed does not contradict this point.

⁹ This principle applies to the matter of animate beings (*Metaph.* Z.10, 1035b25, *PA* I.1, 641a1), but possibly also, in a weaker way, to artifacts (see *Pol.* 1253a22, *DA* 412b15, *Metaph.* 1034a22-1034b1, *Mete.* IV.12 390a12).

do not possess a nature because their efficient cause fails to satisfy the essentiality criterion (that is, their active and passive causes of changes are *always* separate).

II Aristotle's account of why artifacts cannot produce themselves

Artifacts and natural beings are contrasted in terms of the efficient cause involved in their production: 'None of them [sc. artifacts] has in itself the principle of its own production' (*Phys.* II.1, 192a27-8). Since the production referred to here is a substantial change, the intended contrast seems to be that artifacts do not generate themselves, while natural beings do. However, even if this is in some sense true of natural beings, it is true only in a qualified sense. Strictly speaking, animate beings do not generate themselves. Thus Aristotle's reason for denying that artifacts have a nature cannot merely be that they do not generate themselves. So what can it be? And whatever this reason is, will it also be able to exclude artifacts such as miraculous *automata* that can reproduce themselves as natural beings?

The reason lies in the way Aristotle understands art as an exclusively human activity. This view surfaces in *Physics* II, but is formulated explicitly in other texts. For instance, in the *Nicomachean Ethics* Aristotle distinguishes art [*poiesis*] from action [*praxis*] by defining the former as 'a productive disposition accompanied by true rational prescription [*logoi*]' (VI.4, 1140a10-1). Artifacts are produced by changes that stem from a disposition, i.e. some sort of psychological state in an agent that involves a capacity to attend to true *logoi*. And one can attend to such *logoi* in virtue of having a soul that is receptive to them in some way or another (*Int.* 1, 16a9-11). And this in its turn suggests, first, that any craft contains an epistemic component, and second, that to the extent that only human souls possess such an intellectual capacity, it is only humans that are able to invent, or internalize through learning, the principles that define a certain craft. Consequently, only humans can act as principles and efficient causes of artificial production.¹⁰ This feature then differentiates artificial production from natural generation, in a way that puts the source of production in crafts *necessarily* in something separate from what is produced.

¹⁰ See *Phys.* II.8, 199a20-23 and *Metaph.* A.1, 980b25-28. The dependence of craft on practical wisdom and the tension this generates for Aristotle's analogy of craft with nature, see Broadie 1990.

Aristotle comes to this view because of a conviction he shares with the materialist, namely that matter cannot organize itself so as to take the form of an artifact (except accidentally). The principles that reside in matter are not capable of effecting changes that will result in something that qualifies as the product of craft. At least not intrinsically and regularly so, for in some cases, such as the restoration of health, this may be happen by accident. Aristotle makes this point in *Phys.* II.8, 198b15-17 when he claims that art generally either [a] completes what nature cannot bring to a finish, or [b] imitates nature. In cases under [a], what seems to be missing is an appropriate natural principle that can effect the necessary changes resulting in the corresponding end. Craft is described in *Metaph.* A.1 as the result of the discovery of such principles that will realize specific ends, promoting utility or recreation.¹¹ What is essential for such a discovery is a piece of knowledge that is universal and explanatory, explaining what such and such material changes are good for. Cases under [b] on the other hand, are cases where the corresponding principle can be found in the domain of nature. A typical example is the restoration of health. Health can be the result of a spontaneous, accidental change, but it is more regularly and intrinsically produced by medicine. What differentiates these two cases is not the material changes in the body, but rather that in the latter case these changes are conceived, planned and effected as something good for restoring the healthy state. Thus medicine is described as comprising an intellectual, deliberative component as well as a productive one (*Metaph.* Z.7, 1032b6-10, b15-23). The first component works towards discovering the principles that govern the production of health, while the second follows the opposite course by producing the healthy bodily state. Again, what differentiates the two is the intellectual grasp of the principles that govern the artistic process (and which is absent in the spontaneous case) and which can produce regular beneficial results.¹² If this is so, then the

11 According to *Metaph.* A.1, 981b13-17, the first inventors were admired mainly because they were thought to be wiser, since they discovered something new, beyond the common perceptions. The object of their discovery must have been some universal and explanatory principle. See Cambiano 2013: 34.

12 *Phys.* II.2. distinguishes two kinds of craft that involve knowledge, (1) one that uses the product and (2) one that directs its production: (1) is directive in that it involves knowledge of the use and the form, while (2) is directive in that it involves knowledge of how the matter can acquire the qualities necessary for producing something appropriate for this use (194a36-b7). (2) also directs a further component, namely (3), the executing side of the craft or the actual manual labor needed. On this, see Pellegrin 2000: 1-26; cf. also *Politics* III.11, 1282a2-5. In *Metaph.* A.1, (1) is distinguished from (3), which is relegated to the level of mere experience

dependency of crafts on knowledge of principles in what produces artifacts divorces the efficient cause of artificial production from what they produce, and entails that artifacts do not possess their principle *per se* or essentially (*NE* VI.5, 1140b6). Further, any other changes they can undergo *qua* products of such a principle, will not belong to them essentially, for these changes will ultimately be explained by reference to the principle of their production.

To conclude, craft is primarily an intellectual capacity. The manual work necessary for artificial production is not a sufficient condition for the product to qualify as craft.¹³ Master craft, i.e. art proper, must include, and is primarily identified with universal and explanatory knowledge. In that sense it is necessarily separate (a) from the material changes directed towards the production of some particular artifact, and (b) from that particular artifact. For the case of miraculous *automata* this means that even if some particular craft could indeed produce artifacts which are able to effect their own changes, including reproducing themselves, these *automata* would not possess the principle of their changes in themselves *per se*. For their source is a principle that ultimately lies in human intelligence.

III Differentiating the principle of nature from efficient causation

Artifacts, it was proposed, do not possess a nature because their principle is always external. The principle of their matter does not belong immediately to them. The principle effecting the production of their form, and its several functions, does not belong essentially (and need not belong immediately) to them. Thus the first principle of the changes they undergo is never something internal (except incidentally), and this is a consequence of the role of efficient causation in their production. This may suggest again that the internal principle in natural entities must be an internal efficient cause of their changes. However, a problem for this reading is that several changes of natural bodies are caused by external efficient causes. For instance, the locomotion of simple bodies is initiated by external causes, and simple bodies

[*empeiria*] (980b5-12; b15-16), as lower-level manual workers act mechanically like inanimate tools (981b2-5).

¹³ This is confirmed by the fact that productive activity in other animals does not qualify as craft because it is not the result of inquiry or deliberation: see *Phys.* II.8, 199a20-1; cf. *HA* VII (VIII).1, 588a29.

and their mixtures suffer a number of natural qualitative or quantitative changes that are triggered by external efficient causes. Furthermore, animate beings seem to rely on external bodies for exercising some of their own natural capacities, e.g. nutrition, perception and locomotion, and are thus at least in some sense moved by external efficient causes.¹⁴ Of course, one could deny either (a) that the movements in question have *per se* and external efficient causes, or (b) that they are natural, i.e. depend on the nature of the being in question in an absolute sense.¹⁵ Neither of these options, though, seem to fit with Aristotle's text.¹⁶ A third option (c) – and one that has recently been defended by Sean Kelsey – would be to deny the claim that possessing an internal efficient cause is necessary for possessing a nature that qualifies as a principle of change. I believe that option (c) is the most promising one, so let us explore Kelsey's alternative further.

Kelsey's suggestion is to understand *principle* of change in terms of the following definition offered in *Metaph.* □.1 (1013a10-13): 'that in accordance with whose will what is moved is moved and what is changed changes'. This definition of principle points to some kind of authority the principle has over what it is a principle of. In the *Politics* we find two types of authority-relations between ruler and ruled, and Kelsey exploits them for distinguishing nature from craft, in a way that can accommodate the claim that some natural bodies are not self-movers. The first authority relation, which Kelsey labels '*despotic*', is exemplified in the relation between master and slave, while the second, the '*non-despotic*' one, is exemplified in the relation between teacher and student (*Pol.* III.6, 1278b30-1279a8). The relevant difference between them concerns the location of the good the authority relation aims at, what Kelsey names the *proper subject of the good produced*: despotic authority relations aim at the good of the ruler, while non-despotic ones aim at the good of the ruled (Kelsey 2003: 76–77). Thus in the changes undertaken in non-despotic authority relations, although the efficient cause is external to the proper subject of the

¹⁴ *Phys.* VIII.4 argues that elements are not self-movers. For animate beings, see VIII.6, 259b6-20. See Johansen (2012: 128-145) for a detailed defense of the claim that soul is part of the efficient causal story in nutrition, perception and locomotion in a way that does not threaten their possessing a nature.

¹⁵ For the former view see Waterlow 1988 and Graham 1999; for the latter, see Matthen 2001.

¹⁶ Aristotle's claim that the movement of simple bodies is by nature and according to nature seems to rule out (b) (*Phys.* II.1, 193a1); the conclusion of *Phys.* VIII.4, 255b33-34, that they require external efficient causes of their movement rules out (a). Alternative (c) is also followed by Scharle (2008: 171-2) who argues that elemental natures are principles of being changed and thus not principles as an efficient cause.

change (i.e. the ruler who represents the active side of the relation is external to the ruled or passive side), the passive side is still the subject and source of the changes undertaken, in the sense that the good of the relation must be located in it. Thus, a body can suffer a natural change without it needing to possess the efficient cause of that change internally. The change is natural to the extent that the body is the proper subject of the good produced by the change, in the context of the corresponding authority relation.¹⁷ The minimum requirement then for possessing a nature is to be the passive subject of a change undertaken in the context of a relation where the good is located on the passive side of the change. An elemental body, for instance, which is moved by an external efficient cause naturally possesses an internal principle for that change, because the movement and the good produced is located in that body, as the passive subject of it. In this way, Kelsey's interpretation can accommodate natural motions due to external efficient causes.

This proposal remedies the problem of natural changes that are not self-motions. Further, by interpreting nature in terms of a relation (and thereby classifying it in the category of relatives), it is easier to accommodate changes that are due to nature and at the same time necessarily involve external objects. For each of the capacities constituting the nature of a body, whether active or passive ones, will be related to a counterpart principle either in the material of the compound or to an external object.¹⁸ However, I would like to amend the proposal in two respects.

First, the proposal seems to require too little by tying natural change to the subject of the good produced by that change. There are natural changes that have external efficient causes, especially in inanimate bodies, but the result is not some good for the proper, passive subject of the change. Rather, the result produced is a quality or form in the compound, the passive capacity for which belongs to the matter, but which is ultimately determined by its form (*Met.* IV.2, 379b25-32; Aristotle mentions tears becoming rheum as an example). Aristotle explains that changes in inanimate bodies (such as

¹⁷ Kelsey writes (2003:79): 'The suggestion then is that when Aristotle says that natural things have an internal principle of movement, he means that they are the proper subjects of their movements; by contrast, to say that artefacts have an external principle of movement would be to say that the proper subject of their movements is precisely not they themselves but something else distinct from them.'

¹⁸ On the classification of nature of living beings under the category of relatives, see Johansen 2011: 81-3.

solidification or liquefaction) involve two causes, besides the material cause, namely the efficient cause and the quality in the sense of form (IV.5 382a28-30). The efficient cause is associated with the powers of heat and cold, while the dry and the moist are the passive powers that constitute composite bodies as matter, either directly or through the primary bodies, earth and water (IV.4, 382a1-7). It is by means of hot and cold that bodies suffer their several changes (IV.5, 382a31-2). Indeed, the passive and active factors of a change must belong to one genus, as the pairs wet/dry and heat/cold do (GC I.7, 323b31-2). However, we can also refer to what possesses these material properties – i.e. the compound constituted by the wet and dry – as the passive side of the change (GC I.7, 323a15-21). For an affection of its material properties brings about a change in the compound: for instance, fiery heat affects solid bodies – such as horn or iron – which consist of mostly earth and some moisture and makes them soft (*Mete.* IV.9, 385b6-11). Softness (or hardness) itself is not a quality of the elemental material (GC II.2, 329b8-12), but a quality of what this material constitutes. In other words, the quality is the realization of a dispositional property, which is itself a characteristic differentia of bodies consisting of varying proportions of wet and dry (*Mete.* IV.4, 381b24-6; 8, 385a1-8). Although matter is the passive subject on which the heating or cooling agent acts, it does not determine the limits within which the dispositional property is expressed. Otherwise, there would be no limit to the kind of change each body could suffer under the influence of heat or cold. What this suggests is that inanimate bodies possess a number of dispositional properties as part of their formal natures, and that such natures have some priority as principles of the corresponding changes.¹⁹ If so the inanimate body is a passive source of the change *ultimately* because of its form, and this form can thus be identified as the internal principle.²⁰

Second, the proposal is also too generous. For it seems that being the proper subject of change, in the intended sense, applies not only to subjects of natural changes but also to subjects of spontaneous changes. Typically

¹⁹ Such dispositional properties may be good for the compound, if the latter possesses them according to its end and function (*Mete.* IV.12, 389b29-30). In the case of inanimate compounds it might be difficult to tell what this function is, but Aristotle insists that they have one (*Mete.* IV.12, 390a3-20).

²⁰ The passive capacities of living beings seem amenable to a similar analysis. Sense modalities, such as hearing, are triggered by external proper objects, such as sounds. However, the limits in these cases depend on the constitution of the organs, since extremely strong sounds etc. can destroy them (*DA* II.12, 424a32).

changes that result spontaneously resemble natural ones, for they bring about an end-state, standardly achieved by an efficient cause aiming at that end-state, but differ in that the efficient cause was not aiming at this end in their case. So, for instance, the cure of a patient, standardly the result of the exercise of medical craft, can also be the product of a spontaneous process caused by, for instance, environmental conditions. The difference between natural and spontaneous cases, then, lies in the relation of the efficient cause producing that change and the good that results for the entity suffering the change. In spontaneous cases the efficient cause and the end produced are related *per accidens*, while in standard, natural cases the relation is *per se*. Now, if an entity suffers a natural change only in virtue of being the proper subject of the good the change produces, then it is not clear how to differentiate between causes that relate *per se* and causes that relate *per accidens* to the good produced, and hence between standard and spontaneous cases. For in both cases, the proper subject of the good produced is the entity that constitutes the passive side of the change, e.g. a generated organism, and both cases the processes seem to count as natural.²¹

For an account of nature that can accommodate the above difference we need to turn to *Physics* II.1, 193a30-b18, where Aristotle gives three arguments for the claim that nature must be identified with form rather than matter. Aristotle there specifies three different aspects of forms, being an actuality, an efficient, and a final cause, but we only need to focus on the latter two, since they apply exclusively to the forms of living beings.

The second argument revisits the claim that nature must be identified with what persists throughout generation and corruption. But the thought implicit earlier, and equally present here, is that the nature of an entity is the element common between it and what generated it, since its persistence might be taken as evidence for locating the efficient cause of the change in it. This common element in animal generation is an animal of the same kind whose nature is identified with its form (as argued in the previous argument, 193b3-4). So the nature of an animate being includes its form in its role as an efficient cause in generation. However, this nature acts as an efficient cause for generating a different specimen, and thus numerically it must be an *external*

²¹ The proposal creates problems for other changes as well: for instance, any change of place an animal undergoes, where it is the proper subject of the good produced by that change, e.g. Daedalus flying from Crete to Icaria, would qualify as natural.

principle of what is generated. Hence this efficient cause is no part of its original nature. The third argument contrasts changes produced by nature to those produced by craft. The latter do not lead to the craft itself but to a different form in the subject suffering that change, e.g. medicine starts a change that leads not to medicine but to the recovery of health. Natural generations, by contrast, proceed to nature and thus what grows should be identified with what it will become, and this is its form. The exact reference of Aristotle's mention of the thing that grows (*phuomenon*) is not certain,²² but *Metaph.* □.4, 1014b20-2 informs us of the following: those things are said to grow which derive augmentation from something else by contact and organic unity, or by organic adhesion as in the case of embryos. It is thus plausible that Aristotle here has in mind animal embryos formed out of semen and catamenia (as well as the seeds of plants). What defines organic unities is that there is something identical to both parts of the unity that makes them grow together and makes them become one with respect to continuity (*Metaph.* □.4, 1014b23-5, cf. *Phys.* V.3, 227a10-16).

If this is the stage of generation Aristotle has in mind here, it is one he touches upon in his detailed account in the *GA*, where we are told that seeds and fetations not yet separated from the parent possess nutritive soul only potentially. They do so actually when they start drawing nourishment to themselves (II.3, 736b8-10), and this happens once their first principle has become distinct, in the form of the heart in blooded animals or in the form of shoot and root in plants (II.4, 739b34-740a4). Previously, the growing thing was only potentially separate, while actually it was a unity with the parent as the comment on growth from *Metaph.* □ suggests. But now that comment is connected with the following sense of nature: 'the source from which the primary movement in each natural object is present in it in virtue of itself' (1014b18-20). If the embryo which is not yet actually separated is a unity with what generates it, and, additionally, if the principle of its primary movement belongs to what generates it in virtue of itself, it follows that the principle must, somehow, belong to it. Further, the principle of this movement is, by the lights of the second argument, the form in the generating substance. So the embryo has as its principle a form that is also the form of the unity in

²² The word is used primarily for plants (e.g. *DA* II.1, 413a25, *GA* I.23, 731a8, and *HA* VIII.19, 601b12), but could also refer to animal fetuses (e.g. *GA* II.3, 736a34-5).

which it participates. This should not lead us to the thought that the growing thing possesses its own internal efficient cause. It indicates, though, that by forming a unity with what generates it, it shares in the form of that entity. And in *that* sense it, arguably, possesses an internal principle of change. To conclude, although the third argument aims to establish that the growing thing's nature is its final cause, the association of the growing thing in conception with its efficient cause as the form in the parent also suggests, together with the second argument, an explanation of why this may be the case, but also why it is always an *internal* principle that determines the growing thing.²³

Therefore, in order to differentiate natural from spontaneous generation, we must allow that the form as an efficient cause is part of the nature of animate natural beings. They are not mere passive subjects of the change, but they share the same form with that which acts as their efficient cause. To be sure, even if we amend the proposal in this way, the proposal results in a merely sufficient condition for possessing a nature, not in a necessary one. For, as argued earlier, inanimate beings are not, at least not universally, efficient causes of the changes they undergo. From this we should conclude, not that efficient causation must be excluded from our understanding the principle of change for all natural beings, but rather that nature must be understood non-uniformly. The remaining question, of course, is whether, despite their differences, the principles in question share sufficient similarity, such that they can legitimately be grouped together under a general conception of what it means to possess a nature. The most difficult case our interpretation needs to accommodate as a case of *natural* motion is the motion of the elements. So let us turn to this case.

IV The natural motion of the four elements and their mixtures²⁴

Aristotle denies that elements are self-movers, and holds that their local motion has an external efficient cause (i.e. the active power that moves them

²³ See *PA* I.1, 641b32-5 (and Lennox 2001 comments ad loc.) on a similar account of why the end can be called a nature, building on the dual nature of seed involved in natural generation: 'for the seed is a seed in two ways, as that *from* which and that *of* which; that is, it is a seed both of what it came from... and it is a seed of what will be from it.'

²⁴ The interpretation offered here is indebted to Bodnár 1997 and Gill 2009. For other interpretations, see Cohen 1994, Matthen 2001 & 2009, Scharle 2008, Katayama 2011. I offer a more elaborate defense of my reading in Stavrianeas, 'The nature of the elements' (in preparation).

is always external), while they themselves possess merely a passive principle of change (*Phys.* VIII.4, 255a6-18). Their movers are external efficient causes that move them either *per se* or *per accidens* (256a1-2). Despite this, Aristotle holds that their motion is natural. This seems to lead to an *aporia* (VIII.4, 254b33): the elements move naturally in one direction on the axis of up and down, but yet do not qualify as self-movers.

The resolution of this *aporia* comes in two stages. The first introduces a distinction between causes, while the second does so with regard to potentiality. At the first stage, Aristotle notes that as with movers we must distinguish those that *move* naturally from those that do unnaturally, so with things *moved* we must distinguish those that are moved naturally from those that do so unnaturally. He explains that what is potentially of a certain quality or quantity or in a certain place is naturally *movable* when it contains the corresponding principle in itself and not accidentally (VIII.5, 255a24-6). So the movement of fire or earth is natural 'when they are potentially in their proper actualities' (VIII.5, 255a29-30). We should ask though: what causes does Aristotle have in mind here? The point about natural versus unnatural movers concerns efficient causation; but the point about naturally versus unnaturally movable things concerns, it seems, formal causation: movables move naturally when they are 'potentially in their own actuality'. This potentiality cannot be their potentiality to move, for they are already moving. Rather, it is a potentiality that belongs to them while they are moving to their proper places. And to be in their proper place is – at least part of – their form. However, even if we grant that this actuality is their principle in the sense of form, the moving portion is not in its proper place yet, so how can it be said that it possesses this principle already? The second stage of the resolution may be read as addressing this point. Aristotle suggests that in order to grasp what moves the elements, we need to specify the particular sense in which the potentiality/actuality distinction applies to their movement:

[1] One who is learning a science knows potentially in a different way from [2] one who while already possessing the knowledge is not actually exercising it. Wherever [3] something capable of acting and something capable of being acted on are together, what is potential becomes actual, e.g. the learner becomes from one potential something another potential something (for one who possesses knowledge of a

science but is not actually exercising it knows the science potentially in a sense, though not in the same sense as before he learnt it). And [4] when he is in this condition, if something does not prevent him, he actively exercises his knowledge: otherwise he would be in the contradictory state of not knowing. (*Phys.* VIII.4, 255a33-b5, ROT)

Sections [1] & [2] divide two senses of potentiality, while [3] and [4] describe the corresponding actualities. For instance, the first level potentiality to become hot [1], belongs to a portion of an element that is not hot, but cold, such as earth. Once a cold portion is transformed into something hot, such as fire, the first level potentiality becomes actual [3], and from then on the generated portion of fire possesses the actuality of being hot. At the same time, it also possesses a second level potentiality [2] to heat, if not impeded. The exercise of this second level potentiality constitutes a second level actuality that is on a par with the exercise of the power to theorize [4], i.e. with the exercise of a capacity (255b6-7). Let us see then how this schema applies to elemental motion and how it resolves the *aporia*.

The power of fire to be light, i.e. to be up, belongs as a first level potentiality [1] to something that is actually heavy, e.g. earth. Once the latter is transformed into something light, i.e. earth into fire, this potentiality is fulfilled and the element must, according to this schema, possess a capacity [2] which is similar to its capacity to heat. But it seems that the two capacities behave differently with respect to their transition to their respective actualities [4]. Indeed the distinction of efficient from formal causes in the first stage of the resolution of the *aporia* prepares us to expect just that: the key to understanding their difference is to unpack the qualification Aristotle adds concerning their activity, namely that they are active *if not impeded*.

All that is needed for impeding the capacity of fire to heat is that no suitable subject is found in its surroundings; then its capacity is inactive. In any other situation, fire is active and heats the proximate bodies. No change in the fire is involved in this transition from capacity to activity. The capacity of fire to be up, on the other hand, is impeded, we are told, whenever fire is not in its proper place. But this may be so not just because it is held there by force, but simply because it was generated there. We may be tempted to think that it is impeded while still moving towards its proper place, but even if one

holds that the capacity of the naturally moving portion is inactive in some sense, still this state seems to be quite different from the inactive capacity of fire to heat. That is perhaps why Aristotle concludes the *aporia* by saying that the portion of fire is already light, and will realize its proper activity as soon as it is generated (VIII.5, 255b10-11). And he states as much a few lines below: 'if what hinders it [sc. the portion of air] is removed, it realizes its activity and continues to rise higher (255b20-21).' Aristotle's reference to successively higher places that air can occupy might suggest that this type of realization is subject to degrees, but it is important to note that the activity of rising higher is *of the same type* as the exercise of the capacity of the mathematician or the capacity of fire to heat. As suggested above, Aristotle's motivation might be that the two capacities differ in the way they are realized, and one must look at the two corresponding activities, namely to be up and to heat, in different ways. The former includes a local change and resembles, partly, the actuality of a first level potential, as potential, i.e. as something incomplete, while the latter does not. In the light of this, however, it remains puzzling why Aristotle insists on linking elemental locomotion to the transition from a second level potentiality to the corresponding actuality (which is a transition that standardly does not involve change) rather than to the transition from a first level potentiality.

The answer is found in what differentiates the two levels of potentiality/actuality pairs: the learner becomes from one potential something another potential something, while the knower will exercise his capacity, if nothing impedes, i.e. whenever he wills to exercise it, for otherwise he would be in the contradictory state of not knowing. Transitions at the first level consist in moving from one state to another state (possibly its contradictory state).²⁵ Now, in one sense, this is true of elemental locomotion, which is a change to the natural place from its contrary one. However, unlike other local changes, say a stone thrown upwards, movement to the natural place is not accidental to the elements. Rather, it is a constant and regular feature, and it expresses what each element is.²⁶ If this change, then, consisted in the destruction of a contrary, its result would be the annihilation of what is essential to the moving entity. Far from this being the case, Aristotle claims

25 Cf. *DA* II.6 417a20 ff.

26 See Gill (2009: 151) on this.

that the element in moving to its proper place remains unchanged and gets united with its like. So its potentiality to be in its proper place by becoming active preserves its nature by bringing it closer to its form. In this respect the locomotion of the elements resembles cases at the second level of the actuality/potentiality distinction.²⁷ Therefore, an activity of this kind may be attributed to a principle that something possesses in itself *per se*, even if it has an external efficient cause.²⁸

But there is one last crucial aspect in which elemental motion is similar to second level activities and to the exercise of natural capacities. For there is no internal obstruction that can form an obstacle, given the simplicity of the element's constitution; no process within it can stop its capacity from being constantly active. In other words, Aristotle's qualification 'if nothing impedes' should be understood as 'if nothing *external* impedes'. And this seems to be a standard feature of capacities.²⁹ To be sure natural capacities in animate beings form part of a complex network of potentialities whose exercises may interfere with each other. Moreover, they belong to ensouled bodies where a formal and a material side may be antagonizing each other. Regardless, Aristotle's point is that considered on its own, each capacity is *internally indefeasible*. No impediment can come from a normally functioning capacity such as to block its being exercised. This similarity offers one more reason to interpret the movement of elements as realizing a capacity that is part of their nature.

At this point, however, the similarity between capacities in animate beings and their counterparts in elements and their mixtures breaks down. The former are capacities for complex activities, while the latter are for a

27 On the other hand, the fact that this motion is an activity of some kind justifies, to some extent, the thought that it is not a mere capacity for a corresponding actuality or activity, but that it is rather itself an actuality.

28 This is confirmed by Aristotle's illustration in *On the Heavens*: 'to ask why fire moves upward and earth downward is the same as to ask why the healable, when moved and changed *qua* healable, attains health and not whiteness' (*DC* IV.3 310b15-17; cf. 310b27-30). The healable that is already moved *qua* healable, i.e. as something that has the potentiality to be healthy, is already on its way to being healthy, in the sense that it already possesses the form of health (*Metaph.* Z.7, 1032b25-7; see also *DA* II.2, 414a10). Similarly the fire moving up is partly realizing its form in moving towards it, as it occupies successively different locations that are gradually nearer to its proper place, even though none of them *is* its proper place.

29 The exercise of a capacity seems to be compromised only by something external: see *Metaph.* □.7 1049a7; 1049a13-4; and *MA* 8, 702a17. This means that when the external conditions are right, the capacity itself is sufficient for explaining the changes its exercise will be involved in. Thus it makes sense to say that what possesses such a capacity, possesses in itself a principle for the corresponding changes, which can be understood as its internal principle of change, its nature.

simple and uniform change. The transition to activity does not depend on a complex process involving changes in other material beings (such as in the activity of nourishing oneself) or in the entity itself (such as in the activity of moving one's own body locally). We could qualify such activities as *homogeneous* or *non-plastic*. For this reason too, it may be that a passive principle seems sufficient for governing the motion of elemental portions, as well as for governing changes of inanimate beings in other categories of change.³⁰

In sum, elemental locomotion is crucially similar to transitions from capacities to their corresponding activities. For it is not a standard local change, but part of the realization of their formal nature. But since, as we just saw, this capacity differs from capacities in animate beings by being active from the start, its *per se* efficient cause must be something external.³¹ However, this does not make it a capacity to be changed by something else, for it is already active, nor is it a capacity to be changed by itself *qua* other, due to the simplicity of elemental body. What it is is a capacity to be changed in itself *qua* itself and therefore something that satisfies in one way of defining nature. Possessing a nature does not require possessing an internal efficient cause.

V Conclusion

We may conclude then that we should not insist on an exclusive understanding of what a principle of change is or on constraining our interpretation of nature as a principle to the role of efficient causation in all natural phenomena. The absence of an internal efficient cause does not disqualify a change as natural, as in the case of elemental locomotion, nor does its presence alone qualify a change as natural, as in the case of miraculous *automata*. Rather, what matters are the specific capacities that characterize natural kinds and whose exercise regularly produce changes that preserve the nature of the entities of those kinds. In these changes, entities can play active or passive roles, as long as they are in conformity to their form. With respect to *Physics* II.1, then, it is neither necessary nor desirable to read it as proposing a complete and finished definition of what nature is. Rather, Aristotle offers up an initial account of what differentiates natural beings as a

³⁰ Note that the model applied to the motion of the elements holds similarly of their qualitative and quantitative alterations: *Phys.* VIII.5, 255b12-3.

³¹ Simpl. *In Phys.* 1220.20.

first conception or general description, while providing further developments and qualifications in the remaining, more specific natural treatises where what is distinctive of each natural kind can be captured. The main aim of *Physics* II.1 is, on the other hand, to delineate the domain that natural bodies populate and which natural science investigates.