Science in Context **18**(1), 69–91 (2005). Copyright © Cambridge University Press
doi:10.1017/S0269889705000360 Printed in the United Kingdom

The Mysterious Aristotelian Olive

Robert Wardy

St. Catharine's College, The University of Cambridge

Argument

How well does Aristotle's abstract definition of nature in the *Physics* cope with some significant agricultural facts? Are its implications in tension with the workings of artificial teleology? How Aristotle might categorize domesticated plants is problematic: they are neither obviously natural nor obviously artificial. That artificial things generally retain an intrinsic source of change does not help us to settle the status of "living quasi-artefacts." A survey of Theophrastus reveals that many agricultural techniques go against nature, rather than collaborating with it; and, moving from the practical to the theoretical, the *Mechanica* might suggest a scientific program at odds with the Aristotelian tradition of passive observation. Reflection on the *Historia Animalium* exposes difficulties in specifying natural and artificial environments which exacerbate the puzzle, and reinforce the rationale for Aristotelians to adopt an active stance when investigating nature. The Aristotelian olive remains mysterious.

Judged even by the daunting standard set by the rest of his *oeuvre*, Geoffrey Lloyd's work on both the general concept of φύσις in its varied and complex manifestations across the entire range of Greek philosophy and science, and Aristotle's particular, and perhaps uniquely rich, version of "nature" is a magnificent achievement. As I review this work, what strikes me most forcibly is its dialectical and open-ended character. That is to say that although Lloyd is anything but averse to daring hypotheses and never eschews the meticulous presentation of formidable bodies of evidence, as often as not his Aristotle is a natural philosopher enigmatic to a degree. Does Aristotle's scientific practice match his philosophical theory? If not, is it any the worse for that? Do – or should – the methodological strictures he invokes in polemical situations inform or inhibit his own investigations? Lloyd's Aristotle certainly provides answers to such questions; but they tend to be either partial and tantalizing, or, if complete, an occasion for yet further speculation, rather than any sort of last word. The effect is at once to represent Aristotle as an arrestingly dynamic, if occasionally frustrating thinker, and to encourage Lloyd's fellow Aristotelians to follow his example by forgoing pat explanations in the search after more challenging and fruitful interpretative options.

The following is an attempt at a Lloydian essay in the interpretation of Aristotle. I begin on a relatively abstract conceptual plane, with his definition of nature as such, and proceed to a consideration of how some apparent implications of that definition fare when confronted by (un)natural phenomena specified on a relatively concrete level.

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

This evaluative transition will be mirrored by a complementary shift in the textual resources cited, from the *Physics* to the *Historia Animalium*, *Mechanica* and Theophrastus' botanical works. Some scholars will be tempted to regard this as a falling away from philosophical center to (sub-) scientific periphery, from Aristotle's authoritative core theory to the dubious penumbra of the Aristotelian tradition. But it is also thanks to Lloyd that those who might look askance at my progression are much thinner on the ground than before his publications had their impact: no one has insisted to greater effect that the relation of center to periphery, however we identify them, is vital and always repays study; and that we ignore less than canonical texts at our peril. The goal will not be any sort of definitive resolution of the issues addressed; but then Geoffrey Lloyd has always been one to appreciate a budget of good questions. Controversy will not be avoided, nor easy agreement sought: I am looking to start some overlooked hares, not to trap them all. Aristotle's division between nature and artifice has traditionally been allowed to pass muster as fairly unproblematic (at least in a refined formulation). "Unproblematic," that is, for him: it is assumed that however intellectually challenging and morally pressing the implications of modern genetic research and engineering might be for us, only an anachronistic reader would suspect that analogous challenges might beset his division. I shall demonstrate that this belief is mistaken: the Aristotelian olive is indeed mysterious.

Aristotle's conception of nature as a special type of kinetic principle has hardly suffered from neglect: since it has been productively subjected to sustained and intense scrutiny,[1] we can take advantage of these exercises in analysis to set up our own agenda of problems in short order. *Physics* II famously declares:

> Some beings are due to nature, while for others other causes are responsible. Those due to nature are animals and their parts, plants, and the simple bodies such as earth, fire, air, and water: for we say that these and suchlike are due to nature. And they all manifestly differ[2] from things not constituted by nature; for each of them has within itself a source or principle[3] of change and stasis. (192b8–14)

Significant points for us to extract: first, if in the unnatural cases *other* causes are in play,[4] then nature is, of course, itself an αἰτία, a cause, reason or ground. But furthermore it is the factor responsible not merely for some random or superficial assemblage of facts concerning natural entities: rather, since their identity as natural is an essential,

[1] I single out Waterlow Broadie 1982 as a deservedly celebrated contribution to this enterprise.

[2] The rule of thumb dictating that φαίνεσθαι and cognate participle indicates what is patently so, φαίνεσθαι and cognate infinitive, what might prove no more than a specious appearance, allows of many exceptions: but given the thrust of Aristotle's remarks, and his later comment at 193a3–4, it seems safe to construe as I have done, with the majority of translators.

[3] The disjunction to cover ἀρχή: but either way its rendering will not affect my argument.

[4] The usual suggestion of the commentarial tradition that what Aristotle has in mind is artifice, coincidence, and, perhaps, rational choice, is eminently plausible: *cf. Metaphysics* Λ 3, 1070a6–7.

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

defining characteristic, this status explains the deepest facts concerning what they are and do. The implication would seem to be that if *x* is natural, then, on condition that circumstances are favorable – viz., "natural" – its intrinsic source or principle should always figure most prominently, if not exclusively, in any proper account of *x*'s natural condition or behavior.[5] (The final "natural" is not redundant, since we must avoid the crazy implication that reference to *x*'s nature must figure in a proper explanation of *any* bit of behavior *x* might go in for in favorable circumstances: e.g., that you are nonchalantly scratching your ear need not be traced back to φύσις).

Second, that nature is internal is an absolutely crucial feature of the definition (call it "the internality condition"). But just what does the insistence that nature is inherent in what possesses it come to? For sure, "we" ordinary folk (not only card-carrying, paid-up Aristotelians) confidently attribute autonomy and spontaneity to plants and animals, taking it for granted that, left to their own devices, they naturally engage in all manner of changes, growing, moving about, and so forth. Living things furnish an immediate and compelling example of what might be meant by an intrinsic kinetic origin, inasmuch as *self*-changers *a fortiori* satisfy the internality condition. But whether and however Aristotle might modify his view of self-change in response to cosmological pressures,[6] there can be no doubt that his commitment in the course of the argument of *Physics* VIII 4–5 to the existence of natural things conforming to the definition of II 1 remains unswerving; and so it ought to be at least pretty clear that earth, fire, air, and water also meet the internality condition. Since the philosophically untutored will have no idea that, within the Aristotelian system, these are "simple bodies" in the sense of *elemental* bodies, while the philosophically *parti pris* of other parties will indignantly reject the tendentious claim that they are indeed elemental, the position of these items on the list is altogether more problematic than that of animate (ostensible) self-movers. Nevertheless, I think we should resist the suspicion that we have caught Aristotle out in a flagrant act of cajoling or bullying "us" into docile acquiescence. All that is required is our agreement that clods of earth plummet downwards and flames rise without any input or effort on our part: in fact, unless someone or something intervenes to frustrate these inclinations, they are reliably, even invariably, indulged; which reliability demonstrates that such inclinations are fully-fledged "natural" tendencies.

So far, so good: but precisely how far have we got? To rephrase, the first implication would seem to be that satisfaction of the internality condition entails that if not all, at any rate the preponderance of the most weighty causal and explanatory bucks

[5] Cf. "... the nature of a natural substance, as Aristotle conceives it, does not simply make *some* causal contribution to the character of its changes ... but in the primary and central types of case it wholly determines the pattern" (Waterlow Broadie 1982, 28).

[6] Gill and Lennox 1993 is a very useful anthology of tellingly diverse takes on this subject, and much more; Bodnár 1997 is an especially fine discussion focused on the nature of *aether*, and arguing that the case for an incompatibility between the *De Caelo* and the *Physics*, and for an evolution from the one text to the other, is very far from conclusive. For the record, I continue to share Daniel Graham's worry that *Physics* II and VIII cannot be made to fit together properly (Graham 1995).

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

stop at the relevant intrinsic origin. Not exactly a surprise, this, since in Aristotle's technical usage an ἀρχή is just that to which one ultimately appeals as a principle to ground understanding. The idea has both positive and negative implications. Second and positively, tracing *explananda* back to a natural *explanans* should automatically yield valuable insight into what is going on, given that such explanations will be anchored in what the thing in question *is*; and it would be perverse, if not incoherent, to hanker after a deeper spring of understanding than essence.[7] Needless to say, *virtus dormitiva* style pseudo-explanations will not fill the bill; but nothing in real Aristotelianism suggests that they should. Third and negatively, if natural things are (more or less) independent, active causal *loci*, then that might seem to dictate that the student of nature adopt an attitude of careful passivity in the face of the phenomena: since nature is, by definition, apt to do its own thing, any involvement or intervention threatens to constitute obstruction or frustration of the very tendencies we are seeking to apprehend.

To expand on the negative consequences. Scholars generally suppose that they have both metaphysical and methodological aspects: that, in the Aristotelian scheme of things, natural substances[8] will stand saliently proud of their background, rightly so called, since it only permits them to display what comes from within;[9] and that it is no wonder if Aristotle fails to develop and advocate one or another experimental method, if nature is always and everywhere best left alone.[10] Since we shall test

[7] That this consequence overlaps with what I labeled the definition's first implication is neither here nor there, so long as the cumulative repercussions of Aristotle's conception of nature become evident.

[8] As is well known, *Metaphysics* Z 16 eliminates organic parts (which cannot exist separately) and the simple bodies (which are unstructured "heaps") from the final list of recognized substances (1040b5 ff.); but this will make no difference to my argument.

[9] "If the nature of a natural substance is exhibited in the changes whose character it autonomously determines, then in these changes the only rôle left to the external conditions is that of permitting the change or not hindering it. It follows that if the conditions do hinder it, the resulting situation, whether it is a new change or a quiescent state, does not exhibit the substantial nature" (Waterlow Broadie 1982, 29); and: "favouring conditions do not reveal the character of the substance; they only enable *it* to reveal *itself* in autonomous behaviour. Their positive description is not important, since their function is only to provide an arena" (ibid., 33). Cf. "natural forms are ontologically basic, and each thing having a nature has such a principle within itself. Moreover, the principle which directs the growth, development, and characteristic activity of a natural organism exists in the organism itself. The environment only supplies a backdrop against which an organism acts out the drama of its life" (Lear 1988, 25; in fact the citations are probably connected, since Lear leans heavily on Waterlow Broadie's monograph).

[10] "It is Aristotle's view that substance-typifying changes are as a rule successfully realised in the natural environment. Most of the conditions in which most individual natural substances find themselves are such as to permit their self-characterising behaviour, or at least most of the time. It is therefore senseless to place a substance under artificial conditions for better observation. This cannot enable us to identify the typifying behaviour in a given case; nor, if we believe that we have identified it, can it help us to study it better. For if the substance still exhibits the behaviour in question this teaches us no more about its nature than we could have learned through observing it in the natural context. But the artificial conditions are more likely than not to obstruct the typifying behaviour, and in that case we learn nothing at all about the substantial nature, since this could only have been revealed through changes other than those which are taking place" (Waterlow Broadie 1982, 34).

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

these perceptions on the concrete level, it is enough to take note of them for now.[11]

To expand on the positive consequences. Why should we rest content with the assurance that deeply informative, substantive explanations framed in terms of natural essence[12] are waiting to be discovered by investigators of sufficient intelligence and industry? Why should natural substances prove to be as substantial, so to speak, as all that? A swift empirical reply might or might not be available in the variable fortunes of Aristotelian science, depending on whether one reads its career as a partial success story, or a nearly unmitigated tale of failure. A more appropriate metaphysical reply – appropriate in this context, since we have not yet left the abstract conceptual plane – would draw on how Aristotle expresses a supplementary contrast between the natural and the artificial (192b16–32): if this is designated a *natural x*, then the designation implies that *x* possesses its capacity for natural behavior primarily and *per se*; if that is designated an artificial *y*, then the designation implies that *y*'s residual innate sources of change or *stasis* are adventitious, *per accidens* to *y* under its proper, artificial description. Accurately taking on board the nice technical signification of Aristotle's vocabulary here would serve no purpose;[13] what gets us further is recognition that in this passage he

[11] Related themes receive magisterial treatment in "Measurement and Mystification" (Lloyd 1987); the companion issue of the presence or absence of idealizing and abstractive techniques is handled in "Idealisations and Elisions," and the topic is carried forward into much later historical territory by Funkenstein 1986.

[12] This is an opportune juncture at which to take issue with Nancy Cartwright's recent self-portrait as a sort of Aristotelian. The guiding motive for this characterization is her confidence that "a concept like Aristotle's notion of nature is far more suitable than the concepts of law, regularity and occurrent property to describe the kind of knowledge we have in modern science . . . " (Cartwright 1999, 78). She certainly thinks the connection is anything but superficial, citing *Physics* II's definition of nature with unqualified approval (ibid., 81), and imagines that her capacities, irreducible to an occurrent property or set of occurrent properties, are more or less the same thing as Aristotelian natures (e.g., ibid., 85). True, she is careful to emphasize differences as well: "first, . . . we assign natures not to substances but rather to collections or configurations of properties, or to structures. Second, . . . modern physics supposes that the 'springs of motion' are hidden behind the phenomena and that what appears on the surface is a result of the complex interaction of natures . . . Third, having made the empiricist turn, we no longer identify natures with essences" (ibid., 81). Admittedly, Cartwright's self-positioning makes good sense as an antidote against her primary target, neo-Humean empiricists, and assorted reductionists (e.g., Peter King takes it for granted that, in contrast to venerable ancient and mediaeval assumptions about causality, "the modern regulative ideal of physical explanation" directs us to " . . . assume an external causal explanation unless forced to grant self-change" [King 1993, 278, n. 81]). But her downplaying of huge disparities is misleading: an Aristotelian natural essence is very much more than one or another capacity of interest to scientific researchers; Aristotelian "springs of motion" are not quite the surface phenomena she supposes; and the conjunction of the Aristotelian concept with some extremely recondite experimental procedures (her chapter is actually entitled "Aristotelian Natures and the Modern Experimental Method") should rightly take us aback.

[13] However, Simplicius' excellent gloss through contrast with an artificial situation is worthy of quotation: εἰ δὲ ἡ ναῦς ἐν ἑαυτῇ τὸν κινοῦντα κυβερνήτην ἔχει, ἀλλ' οὐ καθ' αὑτήν. οὐδὲ γὰρ συμπληροῖ τὴν αὑτῆς φύσιν, ἐπεὶ πᾶσα ἂν ναῦς εὐθὺ τῷ εἶναι ναῦς οὐκ ἂν ἐδεῖτο ἔξωθεν τοῦ κινήσοντος, οὔτ' ἂν ἦν χωριστὸς αὐτῆς ὁ κυβερνήτης. οὐδὲν γὰρ τῶν καθ' αὑτὸ ὑπαρχόντων τινὶ σῳζομένου ἐκείνου χωρίζεται ἀπ' αὐτοῦ. κἂν κινῇ δὲ ἑαυτὸν ὁ κυβερνήτης κινῶν τὴν ναῦν οὔτε καθ' αὑτὸ οὔτε πρώτως κινεῖ (Simplicius 1882, 268.7–12): "But if the ship has the helmsman within itself moving it, it does not have him *per se*. For he does not complete its nature, since any ship, just to be a ship, would have no need of someone outside to move it; its helmsman

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

couples repetition of the internality condition with the demand that the proper subject of natural properties is and can be nothing other than *x* itself, under the proper – natural – description.

But why is this any better than a piece of transparently arbitrary legislation? It is much better than that – although whether it should be judged really good enough is a desperately difficult question. An Aristotelian natural substance is no mere congeries of kinetic impulses: they must so complement one another as jointly to comprise a coherent behavioral pattern unique to the substance manifesting them. The intractability of the question whether this really works is based in the obscurity of such questions as e.g., whether judgments of "coherence" could ever amount to more than feeble, *ex post facto* stabs at justification, as in "since we already know that cats and dogs are natural substances, feline and canine natural history must – surely – exhibit the requisite kind and degree of meaningful articulation and organisation." Be that as it may, a fourth implication would seem to follow: that primary and *per se* possession of a kinetic principle guarantees that its possessor is so unified in what it is and does that no reductive approach could possibly do it justice ("the unity condition"). A proper explanatory account would have to be couched in terms of the co-operating properties and capacities of that very natural substance, never referring completely and without remainder to anything less than it, e.g., its material constituents, or behavior flowing *directly* from material properties (as in "explaining" the structure of a wall by adducing the relative weights of its components, 200a1–5). One might venture to speculate that whatever the obscurities which continue to plague the postulate that natural substances are irreducibly unified, it does perhaps help to make sense of the internality condition. After all, were we at liberty to gather together any old group of things into a natural collective, as it were, then the internality condition would prove trivially easy to satisfy: enlarge the boundaries until whatever you like is "inside";[14] but, as it is, the need for real natural unification rules out any such dodge.

Gauging the significance of nature's being an intrinsic source of not only change, but also stasis, delivers our fifth and final implication, albeit by way of moderately speculative extrapolation. Why "of stasis" too? Let us consider forging a link to the marked teleological cast of Aristotelian natural changes, whether genetic or expressive

could otherwise not be removed. For none of the things that belong to anything *per se* can be separated from it if the thing itself is to remain what it is. And even if the helmsman, in moving the ship, moves himself, he does not do so either *per se* or primarily" (Simplicius 1997, 21).

[14] "Once we have taken into account *all* the factors that determine an externally determined change in a given object, why should we not regard these, together with the changing object itself, as forming a single (even if not necessarily a stable) entity which changes as a whole because part of it changes through external determination by other parts . . . *Ex hypothesi* this 'single' changing entity changes 'of itself,' i.e. not through external determinants, because all the determinants have been included within it" (Waterlow Broadie 1982, 50); and a similar scenario for self-movers: " . . . in general if *A* moves *B*, then the mereological sum of *A* and *B* in some sense moves itself, or some of itself. Some 'self-movement,' then, is other-movement; some 'self-movement' is movement-by-another; and some non-'self-movement' is self-movement after all" (Thompson 1995, 264).

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

of mature character: they don't stop just anywhere, but rather, when successful – the natural norm – where they should, once the τέλος is realized.[15] If this is on the right track, the implication would be that the coherent rôle acted out by a natural substance against its enabling background has a teleological structure; furthermore, that perhaps the irreducibility imposed by "the unity condition" derives at least in part from the hierarchical organization of teleology (the goal "is responsible for the matter, but the matter is not responsible for the goal," 200a33–4).[16]

The first stage of this essay is now complete. Its exercise in analysis has no pretensions to originality (although it would be highly unrealistic to expect that any assessment of such fertile and provocative doctrines could be uncontentious in every respect). Indeed, the *raison d'être* of this preamble has been to rehearse a set of thoroughly familiar, if not universally endorsed, convictions about the conceptual heart of Aristotle's natural philosophy, so as to confront them with various phenomena whose relation to that heart is apparently either indeterminate or even recalcitrant. The intention is not necessarily simply to unsettle well-entrenched convictions; I entertain the further hope of gaining thereby a more profound sense of where the conceptual apparatus Aristotle deploys in the study of φύσις functions smoothly; and also of where it either spins freely or operates all too roughly. There can be no reasonable grounds for complaint against such an undertaking, since, as is widely recognized, the *Physics* is in the business of putting together, inspecting and repairing a kit of intellectual tools either essential for the study of nature, or at least "good to think with."

The first phase of the next stage is to explore certain potential tensions with the workings of artificial teleology. "Art imitates nature," one of the best-known Aristotelian catchphrases, of course implies a general heuristic principle, that inspection or analysis of the artificial ought to teach us about the natural.[17] But how to put the principle to work? *What* about art, artists, and artefacts is truly analogous to nature, natural processes and natural objects? From the Aristotelian perspective, the most immediately conspicuous, safest answer is to refer to the generic "*logic*" of teleology exemplified in its natural and artificial species.[18] We are told that "the successive things

[15] Cf.: οὐ γὰρ μόνον κινήσεώς ἐσταν ἀρχὴ ἡ φύσις, ἀλλὰ καὶ στάσεως. κινεῖ μὲν γὰρ ἵνα εἰς τὸ εἶδος ἀγάγῃ, ἵστηοι δὲ ἵνα φυλάξῃ ἐν τῷ εἴδει (Philoponus 1887, 196.13–15: *cf.* 196.21–4): "For nature is a source not only of change but also of stability; for it moves [things] in order to bring them into [the state of possessing] the form and halts them in order to preserve them in [the state of possessing] the form" (Philoponus 1993, 11).

[16] Cf.: "the condition for predicating *per se* unity of a complex natural being is identical with the condition for applying teleological explanation as Aristotle understands it. This condition is that the properties and behaviour of the complex being are not wholly explicable as the product of a *per accidens* combination of simpler components and their respective behavings" (Waterlow Broadie 1982, 69–70).

[17] "Both particulars [art and nature] fall under a general rule for which he believes he has ample grounds. Art can be used to illustrate nature because both domains manifest certain general principles, concerning, for example, the adaptation of form to function, the hierarchisation of ends, and the relationship between the end to be attained and the character of the matter necessary to attain it" (Lloyd 1987, 188).

[18] "As artificer stands to the artificially induced change, so natural substance stands to natural change, *except that* in the former case the source and the subject of change are different, save *per accidens*, while in the latter they are

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

which go before are done for the sake of the end" (199a8–10; *cf.* 199b15–17); if art is for the sake of something, then, by the same token, so is nature (199a17–20). Again, the occurrence of mistakes in both realms, so far from an embarrassment, is grist to Aristotle's mill, since teleology gone awry is teleology all the same: that there have been errors goes to show that there was a goal there to be missed (199a33–b4). But could there be more to it than that? Aristotle is fond of the counterfactual supposition that, were artefacts to come about naturally, or *vice versa*, the generative sequences would remain approximately the same (199a12–15, 199b28–9): this is suggestive evidence for a more than formal, substantive parallel between natural and artificial teleology.

The case for a substantive relationship would seem to be clinched by the further contention that art rounds off nature: "generally, in some cases artifice completes what nature is incapable of bringing to perfection; in others, it imitates nature" (ὅλως δὲ ἡ τέχνη τὰ μὲν ἐπιτελεῖ ἃ ἡ φύσις ἀδυνατεῖ ἀπεργάσασθαι, τὰ δὲ μιμεῖται, 199a15–17) – the helpmate will be at work on the very same tasks, taking up where nature left off, but continuing towards a naturally prescribed goal, an extension or enhancement of naturally established patterns of teleological change. The star instance of skill discharging this function is medicine:[19] and this is because it is so easy to make ready sense of the idea that the job of the doctor is to serve as ailing nature's auxiliary. Granted, as Geoffrey Lloyd has copiously and vividly documented, some Hippocratic doctors were not shy to impose aggressive, invasive, even violent regimes on their hapless patients: nevertheless, the constant target is health; even if the means employed might have been deplorably "unnatural," what one aims at remain independently specified conditions.[20] This seems to be a view Aristotle espoused from early in his career, as a notable fragment of the *Protrepticus* testifies:

> but that which comes into being according to nature does so for a purpose, and its constitution is always superior to that of the products of art; for nature does not imitate art, but art nature, and art exists to aid nature and fill up what nature leaves undone. For some things nature seems able to complete by itself without assistance, but others with difficulty, or cannot do at all. An example close to hand is what happens when something

necessarily the same. In putting the matter thus I may seem to underestimate the fundamental difference, but I mean only to display this against the background of equally fundamental analogy" (Waterlow Broadie 1982, 28).

[19] Both Simplicius (1882, 378.6–9) and Philoponus (1887, 316.21–2) fasten on to this example; for the imitative category, cooking, which copies digestion (*Meteorologica* 381b3–9), is the obvious choice: or is it rather that the culinary arts fall into both artificial categories at once, since they not only break down and prepare what we are to eat on the model of our digestive system, but also do so because our unaided stomachs cannot cope with raw foodstuffs?

[20] This is not to say that what health consists in is either dead obvious, or not a charged, theoretical matter: but no one is going to pretend that what medicine should be striving to achieve is, to any significant degree, a subjective decision at the doctor's discretion; and one cannot afford to champion technical criteria for good condition which are too *outré*, if anyone is to be wooed into the surgery.

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

> comes into being: some seeds obviously generate without protection, whatever ground they fall into, but others need the art of farming as well . . . .[21]

Taking our cue from the *Protrepticus*, we should consider agricultural phenomena closely.

On the one hand, it might seem blindingly evident that farming should share pride of place with medicine: it supplies palatable nutrition, and we do indeed need to eat and drink, not only to survive, but also to lead the good life; and surely we are *helping*, not *making*, the crops grow? But on the other hand, as we shall now see, both the kind and the extent of artificial intervention involved in agriculture might give us pause when we come to judge whether Aristotle's theory can accommodate these phenomena. Since we seem to have suffered the sad loss of Aristotle's own botanical treatise(s), we shall have to rely on the plentiful information provided by Theophrastus and other sources;[22] but we have no reason to doubt that these and similar phenomena would have been very familiar to Aristotle himself.

Our point of departure is a piece of knowledge which must have been very common currency: recognition that wild and domesticated varieties of plant are indeed cousins (that they are related but not the same is sometimes reflected in nomenclature, e.g., ἐλάα = "olive," ἀγριέλαιος or κότινος = "wild olive"):[23] so how might Aristotle best categorize domesticated plants? They are not *obviously* natural, since, left to themselves – which our collection of definitional implications suggested is just how best to observe flourishing natural substances – they will, of course, swiftly run riot and go to seed: when it comes to crops, neglect is almost never benign. But then again, they are certainly not *obviously* artificial. Perhaps domesticated plants might be thought of as natural things trained into an artificial rôle. Compare a "naturally" free citizen captured in battle and sold into a life of slavery. In the artificial conditions of subjugation under which he is forced to labor (e.g., the lash of the whip) he does reluctantly go on in a subservient way; but, once fortunately liberated from his captivity, he reverts to type as his nature re-expresses itself. One accommodates both sides of the "natural/artificial" dichotomy by saying that while the substance is natural, the rôle or situation is artificial. This pertinent thought has real merit, and will be taken up in our concluding morals.

[21] ἀλλὰ μὴν τὸ κατά γε φύσιν ἕνεκά του γίγνεται, καὶ βελτίονος ἕνεκεν ἀεὶ συνίσταται ἢ καθάπερ τὸ διὰ τέχνης· μιμεῖται γὰρ οὐ τὴν τέχνην ἡ φύσις ἀλλ' αὐτὴ τὴν φύσιν, καὶ ἔστιν ἐπὶ τῷ βοηθεῖν καὶ τὰ παραλειπόμενα τῆς φύσεως ἀναπληροῦν. τὰ μὲν γὰρ ἔοικεν αὐτὴ δύνασθαι δι' αὑτῆς ἡ φύσις ἐπιτελεῖν καὶ βοηθείας οὐδὲν δεῖσθαι, τὰ δὲ μόλις ἢ παντελῶς ἀδυνατεῖν, οἷον αὐτάρκα καὶ περὶ τὰς γενέσεις. ἔνια μὲν δήπου τῶν σπερμάτων εἰς ὁποίαν <ἂν> ἐμπέσῃ γῆν ἄνευ φυλακῆς γεννῶσιν, ἔνια δὲ προσδεῖται τῆς γεωργικῆς τέχνης . . . (Aristotle 1961, fr.13, 52–3).

[22] If Theophrastus was in fact deputized to handle botany, my case would be even stronger; but no such assumption is necessary.

[23] If the quotation is accurate, and his diction not casual, Eudemus seems to have been happy to introduce the *domesticated* olive as an exemplary natural item, since ἐλαία appears in his own enumeration of natural kinds, which adds particular examples of the plants and animals left anonymous in Aristotle's *Physics* II 1 list (citation from the first book of Eudemus' *Physics* by Simplicius 1887, 263.20–4 [=Wehrli fr.50]).

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

However, it is insufficient on its own to dissolve the puzzle, since, as we shall see, the alienating rôles or situations in which natural items might find themselves embedded or entrapped bring a host of further difficulties in their train.

When Aristotle is setting up his basic contrast between art and nature, he concedes that artefacts may well retain an intrinsic source of change, but nevertheless still fail the internality condition, inasmuch as it is not under artificial description *y* that this is so, but only under natural description *x*, which applies solely to natural ingredients enduring as such within the artefact (*Physics* II 1, 192b16–20).[24] For example, it is perfectly true that my marble statue will, if unsupported, fall; take away the plinth, and it topples over. However, it would be a poor joke for you to solicit my thanks for removing an obstruction which, you say, impeded my prize possession's natural inclinations: the inclination of the marble, not the statue, was frustrated (which is, of course, why the plinth is a support, not an obstacle). None of this seems to be transferable to the obvious agricultural examples. True, one reads of spectacular products of fancy grafting and other "unnatural" techniques: "among the procedures of art and care, on the other hand, there is one set that collaborates with the plant's nature to bring about good and abundant fruit, and another directed to producing fruit of a special and extraordinary character (for instance to grow a grape cluster that has no stones, or a black and a white cluster on the same twig, or black and white grapes in the same cluster, and all such other results as are obtained, for there are a number of them)" (*De Causis Plantarum* V 1.1).[25] It is plausible that if, let us imagine, the white grapes were to ripen more quickly than their black neighbors within the same cluster, that would be because at least some of their natural impulses and reactions have endured. But this cannot be said of less exotic domestic samples: the ἐλάα does not differ from the ἀγριέλαιος or κότινος on account of the artificial association[26] of distinct and divergent natures,[27] but rather

[24] "Now an artefact is a combination of simpler objects put together in such a way that when each part behaves *according to its nature*, the whole system comes to be in a certain desired condition, or changes in a certain desired way" (Waterlow Broadie 1982, 51; emphasis added).

[25] τῶν δὲ ἐκ τέχνης καὶ θεραπείας τὸ μέν ἐστι συνεργοῦν τῇ φύσει πρὸς εὐκαρπίαν καὶ πλῆθος, τὸ δὲ εἰς ἰδιότητα καὶ τὸ περιττὸν τῶν καρπῶν (οἷον τὸ ποιῆσαι βότρυν ἀγίγαρτον, ἢ ἐκ τοῦ αὐτοῦ κλήματος μέλανα καὶ λευκὸν φέρειν, ἢ καὶ ἐν αὐτῷ τῷ βότρυϊ, καὶ ὅσα δὴ τοιαῦθ' ἕτερα ποιοῦσι, πλείω γάρ ἐστιν (Theophrastus 1976). Aristotle himself does mention grafting (e.g., *On youth and old age, life and death*, 468b17–28), but not in a way helpful to us.

[26] Although this could well happen: "domesticated scions were frequently grafted onto wild stocks" (Hornblower and Spawforth 1996, s.v. "olive," 1064).

[27] The less divergence, the more likely the graft is to succeed: most of all when scion and stock have the same bark – in which case the graft is little more than a μετάθεσις, a "shift in position" – with the prospects for success diminishing as growth patterns, etc. become disharmonious (Theophrastus, *CP* I 6.2). To insertion or grafting in the vegetable case corresponds cross-breeding in the animal case, a possibility of which Aristotle is aware: the offspring of Molossian and Laconian hounds display hybrid features derived from each parent (*HA* VIII 1, 608a31–2: inevitably, animal cross-breeding will always be the analogue of very closely related scion and stock). We must attend to the degree of difference between the combined plant lines: if there is a difference in species, the expectation is that the breeding will not succeed; the hybrid would not, or could not, generate. If, however, the plants differ only as "families" or "breeds," as in the canine case, their hybrid offspring would be

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

because its nature has been "tweaked," so to speak.[28] One might hazard the guess that because the φύσις of the ἐλάα has been subjected to a host of artificial influences, an Aristotelian might, *faute de mieux*, put it and the like under the provisional rubric "living quasi-artefact"; and should then explain just what that means.

One might protest that I am seeing difficulties where there are none, or anyway molehills rather than mountains. Surely the exotica are a bit of decadent fun which Theophrastus distinguishes from mainstream techniques designed to *collaborate* with nature: if the goal is an abundant yield of *de luxe* fruit, do the agriculturalist's intentions not dovetail nicely with what the plant strives for naturally? But this conclusion is not nearly so obvious as it might initially appear:

> to wild trees, as compared with cultivated ones, belong the special properties of fruiting late, of greater vigour, of abundance of fruit, produced if not matured; for they ripen their fruit later, and in general their time of flowering and making growth is later; also they are more vigorous in growth, and so, though they produce more fruit, they ripen it less; if this is not universally true, at least it holds good of the wild olive and pear as compared with the cultivated forms of these trees (*De Historia Plantarum* III 2.1).[29]

The wild tree maximizes quantity of fruit, some of which we sacrifice so as to enhance quality: but who is to say that this is an enhancement of the tree's φύσις as opposed to our exploiting a deviation from nature which we have imposed? "For the wild kinds appear to bear more fruit, for instance, the wild pear and wild olive, but the cultivated plants better fruit, having even flavours which are sweeter and pleasanter and in general better blended, if one may so say" (*HP* I 4.1):[30] the cautious ὡς εἰπεῖν signals Theophrastus' chariness of sliding from "better (for us)" to "better" *tout court*.

Were Aristotelian teleology anthropocentric, some of the mystery surrounding "living quasi-artefacts" would dissipate, since they would be naturally open to exploitation. But it is not, and that is just as well: for it would be rash indeed to assume that the ἀχράς or κότινος would benefit, were they to produce pears or olives

fertile. But if, as I suggest, such fertility lapses – or is thought to lapse – without the farmer's constant efforts, such plants seem to defy Aristotle's system of classification. (I am grateful to an anonymous reader for soliciting clarification of this point.) The phenomena of ancient genetic engineering generate a further set of problems for the Aristotelian theorist, but I shall not pursue the matter further on this occasion.

[28] I am not presuming that any particular story, mythological or rational, about a historical process of domestication need have been entertained, or indeed that a pre-domestication era is assumed; but even without such assumptions, all would grant that it is bizarre verging on incoherent to suppose that one "tweaks" cultivated varieties to create wild ones.

[29] ἴδια δὲ πρὸς τὰ ἥμερα τῶν ἀγρίων ὀψικαρπία τε καὶ ἰσχὺς καὶ πολυκαρπία τῷ προφαίνειν· πεπαίνει τε γὰρ ὀψιαίτερον καὶ τὸ ὅλον ἀνθεῖ καὶ βλαστάνει ὡς ἐπὶ τὸ πᾶν· καὶ ἰσχυρότερα τῇ φύσει· καὶ προφαίνει μὲν πλείω καρπὸν ἐκπέττει δ' ἧττον, εἰ μὴ καὶ πάντα ἀλλά γε τὰ ὁμογενῆ, οἷον ἐλάας καὶ ἀπίου κότινος καὶ ἀχράς (Theophrastus 1916).

[30] πλείω μὲν γὰρ δοκεῖ τὰ ἄγρια φέρειν, ὥσπερ ἀχρὰς κότινος, καλλίω δὲ τὰ ἥμερα καὶ τοὺς χυλοὺς δὲ αὐτοὺς γλυκυτέρους καὶ ἡδίους καὶ τὸ ὅλον ὡς εἰπεῖν εὐκράτους μᾶλλον (Theophrastus 1916).

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

more palatable to human beings; perhaps they would actually suffer from a reduction in yield of relatively inferior fruit ("inferior" from our point of view).[31] Something like this seems to be Theophrastus' position: "all plants do not have the same goal for the concoction and potency of their fruits, but each has instead its own natural goal in point of flavour, odour and the rest," to be distinguished from "*our own uses*," τὴν ἡμετέραν χρείαν (*CP* III 1.2).[32] We human beings enjoy the "pericarpion" (viz. pulp as opposed to seeds); but although "there is to be sure a concoction of the pericarpion, there is another of the fruit proper; and the former concoction serves to provide man with food, the latter serves the generation and perpetuation of the tree, *this being what fruit and seed are for*" (*CP* I 16.1).[33] Most striking of all: "each of the two concoctions *interferes* in a way with the other" (*CP* I 16.1):[34] one could not ask for a more honest confession of discomfort on the part of Aristotle's greatest disciple, wedded on the one hand to the "collaborative" model of artifice, the legacy of his teacher, but driven on the other to confess that the model is not true to the phenomena. Husbandry was devised to restrain natural exuberance (*CP* I 16.2):[35] but such restraint goes against nature, in contravention of the inherited model.

Now one might argue that in *CP* I 16.10–13, we see Theophrastus emerging from his honest perplexity: for in this section he formally propounds the ἀπορία, whether wild or cultivated plants are natural, and consequently which class is the fit (or fitter) object of study? The title of the wild varieties cannot be impugned, since Theophrastus acknowledges the validity of the internality condition, which they indubitably satisfy. And what of the cultivated plants? First, Theophrastus invokes the conception of husbandry as auxiliary artifice – feebly, one might have thought, in the light of his earlier admission that the two concoctions might conflict. But he introduces a novel and audacious argument: if the environment supplies the plant with *extrinsic* aid without thwarting its nature, *a fortiori* the effect of farming is also perfectly natural, since it works *intrinsically* – that is, diversion of nutriment to the pericarpion is an internal effect (ἡ δὲ γεωργία καὶ ἐν αὐτοῖς μετακινεῖ καὶ μετατίθησιν). The argument is compressed and the train of thought is not easy to follow, but I take Theophrastus to be saying that since agriculture "gets inside," as it were, it effects a radical transformation of the very nature of the plant. This is not a felicitous solution. First, we can agree that diversion of nutriment is significantly different from e.g. pruning; the plant itself does this from within. However, that its *autonomous* processes are turned to our advantage

[31] David Sedley's 1991 answers "yes"; my reply (Wardy 1992) answers "no." Sedley correctly maintains that agriculture is a major testing-ground for ancient teleological theory; I agree, and welcome the opportunity to return to our dispute from a new angle.

[32] . . . μηδ' αὖ πᾶσι ταὐτὸ τέλος τῆς πέψεως καὶ δυνάμεως τῶν καρπῶν, ἀλλ' ἑκάστου πρὸς ὃ πέφυκεν καὶ χυλοῖς καὶ ὀσμαῖς καὶ τοῖς ἄλλοις (Theophrastus 1976).

[33] ἡ δ' αὐτῶν τῶν καρπῶν, καὶ ἡ μὲν πρὸς τὰς ἡμετέρας τροφάς, ἡ δὲ πρὸς γέννησιν καὶ διαμονὴν τῶν δένδρων, οἱ γὰρ καρποὶ καὶ τὰ σπέρματα τούτων χάριν (Theophrastus 1976).

[34] ἑκατέρα δέ πως ἐναντιοῦται πρὸς τὴν ἑτέραν (Theophrastus 1976).

[35] πρὸς ὃ δὴ καὶ ἡ γεωργία μεμηχάνηται, κωλύουσα τὴν τούτων αὔξησιν καὶ τροφήν (Theophrastus 1976).

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

cannot establish that this is a natural phenomenon. Compare our maliciously training an enemy to consume junk food voraciously: that he, not we, does the digesting does not mean that we have not habituated him in an unnatural vice. Second, if there is a new domesticated nature, why, without constant attention, is it in danger of reverting to its wild ways? Third, Theophrastus concludes that nature turns out to be a twin concept, not φύσις but φύσεις, wild and tame: but he has not shown convincingly that they cohere properly. My suspicion that he has lapsed from honest puzzlement into sophistical ingenuity may be prematurely unfair, but doing him more complete justice would take us too far beyond the scope of this essay.

And we would also do well to register how elaborate, intensive, prolonged and intrusive many ancient agricultural techniques were. To return to grafting: cultivators "... bandage the site with layers of lime bark and then plaster mud over it mixed with hair; to make the fluid remain and keep sun, rain and cold from doing any harm. So too after slitting the stock and giving the scion a wedge-like shape they drive it in with a mallet to make the fit as tight as possible" (*CP* I 6.7–8). Some examples from the two Mediterranean staples, the grape and the olive: viticulture was (and remains) especially demanding, from ploughing, digging over and the establishment of irrigation, to securing the vines properly, manuring, and, last but not least, pruning: "pruning, then, is most universally applied to the vine and most clearly seen in its case, since all resort to it and all dress the vine, as if they were compelled to do so by its very nature, owing to the rapid and abundant sprouting" (*CP* III 7.5 - ὥσπερ ὑπ' αὐτῆς ἀναγκαζόμενοι τῆς φύσεως is a deft touch, almost attributing a "cruel to be kind" attitude to the industrious vineyard keepers). To select a single instance from a wealth of material: Ischomachus insists that Socrates must be perfectly well acquainted with the various techniques for planting olives, among which he mentions such specialties as smearing clay on the tips of the plants for their protection, and covering the lot with *ostraka* (Xenophon, *Oeconomicus* XIX 13–14). The unmistakable message of the phenomena could not be clearer: agriculture is a precarious affair because nature tamed is nature more or less awkwardly constrained, that is, deceived by human ingenuity and compelled by brute force (preferably that of the domesticated animals, themselves bent to our wills) into enormously convenient deformations.

To return to the problem of categorization. The cultivated olive and the like are not straightforwardly natural; nor are they any sort of machine. The phrase "living quasi-artefact" was intended as no more than a place-holder. If conceptual oddities, they are not τέρατα, "monsters," as defined by Aristotle ("monsters may be boss shots at that which is for something," 199b4).[36] Now, were olives, etc., non-substantial,[37] this would not forthwith entail their not being either (i) natural *things* or, more broadly,

[36] Charlton's palmary version (Aristotle 1970).

[37] Katayama sums up his examination of *Metaphysics* A 9 and B 4: "... the form of an artefact is not both eternal and in actuality; hence, it cannot exist apart from the composite in the way in which substances (which are both eternal and in actuality) do; hence, it is possible that an artefact is not a substance" (Katayama 1999, 53).

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

(ii) natural *phenomena* (φύσει). Against an unqualified acceptance of (i): the nutritive soul of plants and animals *complete* in nature enables them to reproduce true to kind;[38] thus the nature of the olive is, at the least, seriously deficient. Therefore one might tentatively infer that domesticated plants are the vegetable counterpart of e.g. mules (*GA* I 20, 728b10–11; II 7, 746b14–16; II 8, 747a24–5). However, the analogy is limited: while mules, etc., are sterile, "tweaked" plants, if left alone – that is, neglected – will reproduce, but only by reverting to the related wild type (there is a distant parallel in Antiphon's thought-experiment, *Physics* II 1, 193a12–14). And against (ii): suppose our assiduous Attic farmer brings in a new crop of olives. Since he produces this generation only by dint of his unremitting husbandry, its appearance here and now is *eo ipso* anything but φύσει.[39] When an Aristotelian carpenter manufactures a bed, its form pre-exists in his mind. What, if anything, does the Aristotelian farmer "have in mind"? That no answer is forthcoming is a large part of the reason why "living quasi-artefact" remains an unsatisfactory place-holder.

Scholars have been insensitive to the difficulty;[40] but it is anything but minor. First, the very fact of categorical uncertainty should not be minimized:[41] if we are prompted by Aristotle to get a negative fix on nature by means of the contrast with artifice, the unexpected emergence of this curious *tertium quid* should disturb us. Second, our fifth implication drawn from the definition of nature was that a natural substance's coherent performance has a teleological structure. Our findings do not directly undermine that implication. Nevertheless, the (partial) falsehood of the thesis that a more than formal, substantive parallel obtains between natural and artificial teleology, which has come to light through the demise of Aristotle's "collaborative" model of artifice in spite of Theophrastus' valiant defensive tactics, is disconcerting. In particular, we floated the

He also judiciously upholds the controversial thesis that not all living things (e.g., mules, or the spontaneously generated) are substances.

[38] τοῦτο [τὸ θρεπτικόν] δ' ἔστι τὸ γεννητικὸν ἑτέρου οἷον αὐτό· τοῦτο γὰρ παντὸς φύσει τελείου ἔργον καὶ ζώου καὶ φυτοῦ (*GA* II 1, 735a17–19). Cf. "the functions of the nutritive soul are reproduction and the use of food; for this is the most natural of functions for as many living things as are perfect and not maimed, or do not have spontaneous generation: viz to produce another like itself, an animal an animal, a plant a plant . . . " (ἧς ἐστὶν ἔργα γεννῆσαι καὶ τροφῇ χρῆσθαι· φυσικώτατον γὰρ τῶν ἔργων τοῖς ζῶσιν, ὅσα τέλεια καὶ μὴ πηρώματα, ἢ τὴν γένεσιν αὐτομάτην ἔχει, τὸ ποιῆσαι ἕτερον οἷον αὐτό, ζῷον μὲν ζῷον, φυτὸν δὲ φυτόν [*DA* II 4, 415a26–9]).

[39] Sarah Broadie proposes a heavily anthropocentric solution. Consider the analogy in ethics: basic human nature, if left to itself without habituation guided by parental practical νοῦς, etc., which are at least initially external factors, will not move towards the human τέλος of εὐδαιμονία as understood by Aristotle – but we do not think of well-brought up human beings as sort-of artefacts. Likewise, the training and breeding of vines etc. might be conceived of as the expression of technical νοῦς needed to bring the wild vine to its *true* fulfillment of being a less tough and vigorous, but better-wine-producing, cultivated vine. All the uncultivated ones have missed their destiny. But when inverted this analogy, so often used the other way round to illustrate moral training, fails: given that we are intelligent social animals, it is unnatural for human nature to be neglected, natural for it to be educated and acquire "culture"; just the reverse is true of the plants.

[40] Such comments as "perhaps completion is the development by an art of the raw material provided by nature, so that the material may become suitable for the construction of artefacts" (Granger 1993, 171–2) are inadequate, since they get "completion" wrong: art should complete what nature has already begun.

[41] As Geoffrey Lloyd has argued in another context: see "Dualisers in Aristotle's Zoology" (Lloyd 1983, 44–53).

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

possibility that "the unity condition" of the fourth implication might borrow some credibility from an independently motivated teleological condition: this possibility would now seem to be less likely. For if there are plentiful natural/artificial "dualizers" essential to human life, then some of our faith in their evincing behavioral coherence will and should be eroded: in Aristotle's world, these doubts might stir with every taste of olive oil or sip of wine – which is to say all the time.

If Theophrastus tries to finesse the problem of squaring the phenomena with the "collaborative" model of artifice, the author of the Peripatetic *Mechanica* has no qualms about abandoning conciliation in favor of a refreshingly *anti*-natural, as it were "heroic" conception of τέχνη:

> remarkable things occur in accordance with nature, the cause of which is unknown, and others occur contrary to nature, which are produced by skill for the benefit of mankind. For in many cases nature produces effects against our advantage; for nature always acts consistently and simply, but our advantage changes in many ways. When, then, we have to produce an effect contrary to nature, we are at a loss, because of the difficulty, and require skill. Therefore we call that part of skill which assists such difficulties, a device. For as the poet Antiphon wrote, this is true: "we by skill gain mastery over things in which we are conquered by nature" (*Mechanica* 847a12–28).[42]

The author posits a sort of adversarial relationship between the simplicity and unidirectionality of natural processes, and the shifting, multiple character of human interests: thus the straight equation, if not of all τέχνη, at least of its noteworthy, ingenious contrivances, with τὰ παρὰ φύσιν. We cater for human well-being by ambitiously overcoming, rather than abetting, what otherwise would happen naturally and to our disadvantage. Two concessions: first, the remarkable and exceptional is being talked up, while our items are the agricultural norm. Second, since the technological marvels in question are e.g. machines which work by leverage, metaphysically speaking they are the familiar artefacts which incorporate parts retaining (some of) their own natural capacities and impulses (resistance and so forth): therefore it will be no easier to assimilate "living quasi-artefacts" to them than to such humdrum articles as a cloak or table. But it remains the case that the ringing declaration of the *Mechanica* at the least suggests an alternative technological paradigm, one which could warrant aggressive intervention in and against nature for our sake.

[42] θαυμάζεται τῶν μὲν κατὰ φύσιν συμβαινόντων, ὅσων ἀγνοεῖται τὸ αἴτιον, τῶν δὲ παρὰ φύσιν, ὅσα γίνεται διὰ τέχνην πρὸς τὸ συμφέρον τοῖς ἀνθρώποις· ἐν πολλοῖς γὰρ ἡ φύσις ὑπεναντίον πρὸς τὸ χρήσιμον ἡμῖν ποιεῖ· ἡ μὲν γὰρ φύσις ἀεὶ τὸν αὐτὸν ἔχει τρόπον καὶ ἁπλῶς, τὸ δὲ χρήσιμον μεταβάλλει πολλαχῶς. ὅταν οὖν δέῃ τι παρὰ φύσιν πρᾶξαι, διὰ τὸ χαλεπὸν ἀπορίαν παρέχει καὶ δεῖται τέχνης. διὸ καὶ καλοῦμεν τῆς τέχνης τὸ πρὸς τὰς τοιαύτας ἀπορίας βοηθοῦν μέρος μηχανήν. καθάπερ γὰρ ἐποίησεν Ἀντιφῶν ὁ ποιητής, οὕτω καὶ ἔχει· τέχνῃ γὰρ κρατοῦμεν, ὧν φύσει νικώμεθα (Aristotle 1936).

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

That would be practical involvement: what about a corresponding paradigm of theoretical involvement, to carry out observations?[43] That is, were one to give free rein to the aspirations of the *Mechanica*, would our third, negative implication, that the Aristotelian scientist should remain carefully aloof in the study of self-revelatory natural phenomena, continue to hold water? This is, of course, not to say that the historians of science have got it wrong, that as a matter of fact Aristotelians did develop and apply an experimental method. The point is rather that the third implication is intended as a rationale, explaining and excusing what has been decried as a massive historical shortcoming on the grounds that methodological passivity is integral to the Aristotelian system, not a lamentable oversight. The critique which we have now completed delivers the conjectural verdict that this rationale is not fully credible; this judgment will be reinforced in the sequel.

The final part of this second stage of the essay is devoted to teasing away at certain puzzles for Aristotelian natural philosophy which arise in connection with what I dub "environmental issues."[44] The transition is not abrupt, since we begin by taking further stock of a feature of agricultural setups to which I have already alluded: namely the sheer instability of much cultivated nature, and hence its heavy reliance on an artificially created and controlled environment.[45] Remember that Theophrastus feels that wild varieties are always naturally more vigorous, ἰσχυρότερα τῇ φύσει: this is often cashed out with reference to cultivated varieties' constant reliance on a multiplicity of delicate relationships with their surroundings; and one anticipates that wild plants are similarly reliant, only less so, and much more tolerant of shortcomings and (temporary) displacement.[46] But we must not leap to the conclusion that because these latter environments are "natural," they therefore fall unproblematically into "natural" kinds:[47]

[43] The author of the *Mechanica*, for one, does not restrict his remit to practical know-how, where "practical" excludes "theoretical." His devices are marvelous because so far unexplained, and their explanation is explicitly said to span fields of enquiry: "these [mechanical problems] are not altogether identical with physical problems, nor are they entirely separate from them, but they have a share in both mathematical and physical speculations, for the method is demonstrated by mathematics, but the practical application belongs to physics" (*Mechanica* 847a24–8: ἔστι δὲ ταῦτα [τὰ προβλήματα μηχανικά] τοῖς φυσικοῖς προβλήμασιν οὔτε ταὐτὰ πάμπαν οὔτε κεχωρισμένα λίαν, ἀλλὰ κοινὰ τῶν τε μαθηματικῶν θεωρημάτων καὶ τῶν φυσικῶν· τὸ μὲν γὰρ ὡς διὰ τῶν μαθηματικῶν δῆλον, τὸ δὲ περὶ ὃ διὰ τῶν φυσικῶν). Even a glance at the text confirms that it is largely what we would call a theoretical treatise.

[44] Aristotle's word for "environment" is τὸ περιέχον. Theophrastus always recommends that we take proper account of the location of plants in "appropriate regions," οἱ οἰκεῖοι τόποι – which is where they not only do best, but also should be studied (e.g., *CP* I 16.11).

[45] The *Protrepticus* again: "some seeds obviously generate without protection, whatever ground they fall into, but others need the art of farming as well."

[46] When it comes to animals, Aristotle is inclined to ascribe health to robust resistance to invasion from a potentially hostile environment: *Physics* VII 3, 246b3–20/246a29–b27; *Categories* 9a21–4; *Meteorologica* IV 1, 379a11–22.

[47] Recollect that Aristotle strenuously insists that the existence of plenty of natural things as he has defined them is "obvious," φανερόν (193a3–4: always an alarming word to read in Aristotle). My argument will be that the *self*-evidence of natural existence stands or falls with our ease and confidence in identifying natural environments.

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

what *is* an environment? What is the *relevant* natural environment? The occasional, even reliably recurrent rain shower doth not a micro-climate make.

Obviously the secure existence and steady revelation of natures are supposed to be fully compatible with their possessors' dependence on a whole gamut of enabling conditions (e.g., *in primis* the influence of the sun is necessary for the cyclical flourishing of the sublunary world):[48] the trick will be to distinguish between dependence which nevertheless plausibly leaves natural autonomy intact, and more extreme varieties of intervention which render something unnatural, artificial, or of worryingly uncertain status. It may not have escaped the reader's notice that my descriptions of Aristotelian natural capacity and performance have always included hedging expressions: "on condition that circumstances are favorable"; "unless someone or something intervenes"; "(more or less) independent"; "when successful – the natural norm . . . " Of course this little catalogue is meant to respect Aristotle's routine addition of a caveat to descriptions of teleological processes:[49] call this "the absent defeaters clause." It would be quite wrong to shrug this off as the truism that all causal claims are conditional on *ceteris paribus* clauses, whether or not one bothers to formulate them:[50] first, since Aristotelian natures endow their possessors with capacities and inclinations, dispositional properties, triggers must be present to actualize such potentials; second, because the behavioral manifestations will nearly always be teleological, only some circumstances will be favorable, and so permit full actualization. Does Aristotle say enough on this score? If not, can we see how to plug the gaps in his theory?

To start with plants: they don't get around much. Indeed, rootedness might make us hesitate to say exactly where to draw the boundary between the plant and its environment. They lack a stomach because terrestrial heat pre-digests their nourishment (*PA* II 3, 650a21–2),[51] and also take in some vital heat from their environment's atmosphere (*De iuv.* 6, 470a20–2). Plants are, well, *planted*: rip them out and they perish, without the environmental resources which go proxy for an animal's internally integrated organs. This conception goes far to compromise the integrity of plant life: if, unlike the simple bodies, they are never demoted all the way off the list

[48] A puzzle: if the senses are *natural* capacities, how is it that they are triggered by *other* things, given that *x*'s nature is supposed to produce change *in x* (*Metaphysics* Θ 8, 1049b9–10)? The solution is to distinguish between criteria for being natural (the internality condition, etc.) and criteria for being a potentiality as such: thus the senses are natural *qua* being part of the makeup of uninjured animals, potentialities *qua* receptive of actualization by perceptible objects. That *x* possesses natural capacities which are passive allows some welcome decoupling of the concepts of natural change and self-change (as seen by scholars at work on the causal (in)dependence of the Aristotelian elements).

[49] E.g., ἂν μή τι ἐμποδίσῃ (199a10–11; *cf.* 199b18, 26). However, when explaining the conditions wherein a rational capacity will be actualized, Aristotle nonchalantly denies any need to specify explicitly that there are no external hindrances, on the grounds that this absence is always implicit anyway in the positive conditions for exercise of the capacity in question (*Metaphysics* Θ 5, 1048a16–21).

[50] A truism, but chronically difficult to analyze satisfactorily: the modern classic still remains Mackie 1974.

[51] Contrariwise, the animal stomach and intestines have the δύναμις of roots in earth (IV 4, 678a13–15), and the stomach is a sort of internal, portable earth (II 3, 650a25).

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

of substances, their lack of autonomy and vagueness at the edges explain why they are the poor cousins of animals. And if substance comes in degrees, why should we not say the same about nature, with plants (especially cultivated ones) earning low marks? But once we have made every allowance for the difficulty of extricating plants from their settings, whether ἐν λόγῳ or by pulling them up by the roots, is there any reason to think that the identification of their environments presents a further difficulty? Yes, because they are difficult but not impossible to extricate; and, in Theophrastus, this difficulty is compounded by the additional complication that "habit is second nature" (γέγονεν γὰρ οἷον φύσις ἤδη τὸ ἔθος). The sort of *explanandum* he tackles is e.g. the continued inclination of varieties of wheat transplanted to new locales to sprout when they did in their original home (*CP* IV 11.5).[52] One might think that this is merely another instance of my straining after largely imaginary difficulties: if the transplanted species is visibly out of sync. with its locale, is that not unambiguous evidence that it has been removed from its original and natural environment? No, because when habit becomes truly ingrained and "natural," the possibilities for synchronization and harmonization are great. "Animals have their most important starting-points in themselves, whereas the seed of the plant gets its impulsions in general from the air (at least the ones that make it sprout and in general bring it to birth or destroy it)" (*CP* IV 11.9):[53] so change the air – not by too much – and eventually the colonist will seem very much at home, even to the most diligent and scrupulous observational botanist.

To continue with animals. I shall be culling my facts of natural history from the *Historia Animalium*. Some might object to this undertaking both because portions of its purported data are rum stuff, and on the suspicion that bits of it might not be authentic Aristotle: neither is a good reason to dismiss the credentials of the *HA*. Like it or not, the ambition is to create a data base ("... our object being to determine first of all the differences that exist and the actual facts in the case of all of them" [*HA* I 6, 491a9–10]);[54] and, as in the case of the other sources we have tapped, the exact provenance does not matter, so long as we remain confident that this or this sort of

[52] Indicating, by the way, that Theophrastus at least tends to view soil and climate as "habituating" rather than directly "natural" factors, since the persistence is ascribed to ἔθος not φύσις.

[53] ἐκεῖνα μὲν γὰρ ἐν ἑαυτοῖς ἔχει τὰς ἀρχὰς τὰς κυριωτάτας, τὸ δὲ σπέρμα καὶ ὅλως ἐν τῷ ἀέρι μᾶλλον, εἰ δὲ μή, τάς γε πρὸς βλάστησιν, καὶ ὅλως γένεσιν καὶ διαφθοράν. What one might call "maxims of accommodation and habituation" operate at all levels in Theophrastus, from fundamental principles to the *minutiae* of gardening. For example, he is acutely aware of the importance not only of soil and climate, but also of what other vegetation is present in the environment. Why did it happen to a fellow that his vines withered when he removed fig-trees interspersed amongst them, despite the fact that the fig is in general a "bad neighbor" for the vine? "The reason is that he made too great a change, the vines having by then grown to the tops of the trees and been brought up in their society, for a single nature (as it were) had come about from the long time spent together. But if he removed the trees when the vines were still young, far from making them wither, he would have made them faster-growing and finer vines" (*CP* III 10.8: αἴτιον δ' ὅτι μεγάλην ἐποίησεν μεταβολήν, συνηυξημένων ἤδη καὶ συνεκτεθραμμένων, ὥσπερ γὰρ μία φύσις ἐγεγένητο διὰ τὸν χρόνον . . . ; cf. V 5.4).

[54] . . . ἵνα πρῶτον τὰς ὑπαρχούσας διαφορὰς καὶ τὰ συμβεβηκότα πᾶσι λάβωμεν (Aristotle 1965): Peck's translation is over-egged, but not intolerably so.

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

phenomenon would (or should) have been familiar to Aristotle, and so constitutes a legitimate part of the *explananda*.

Where animals live is a cardinal zoological *differentia*.[55] And if their "activities and lives differ according to their characters and nutrition" (*HA* VII 1, 588a17–19),[56] then it follows that since animals find food in their habitat, their natural patterns of foraging, hunting, and so forth will be congruous with what is locally available to them in the way of food: but, since locomotion is a defining trait of animals, the territorial limits of e.g. a wide-roaming predator might well prove elastic and hard to determine, let alone the "natural" space occupied by a migratory animal – are we dealing with a single, disjoint environment, or a plurality of habitats each tailored to a seasonal subset of activities?[57] The *HA* offers lavish and very detailed confirmation of how profoundly the good and bad points of a given natural location affect the behavior and welfare of animals: e.g., on the whole weed-eating fish tend, not surprisingly, to thrive in weedy locales, which benefit the carnivorous fish preying on them turn to their own advantage (*HA* VII 19, 602a16–22).

There might seem to be a whiff of paradox here. Being someone else's lunch is never in your interest: wouldn't the weed-eaters be better off getting by on less, but living to eat another day? Rival evolutionary theories tender alternative answers to such questions; for Aristotle, although he himself did not trouble to articulate a non-evolutionary response, it would seem that in principle one appealing to hypothetical necessity should be in the offing, say along the lines of "living the (good) life typical of just this species of fish demands lots of weed; but getting fat on weed unfortunately attracts killers, etc." In any case, in the Aristotelian natural world, competition is the rule rather than the exception: "now there is a war against each other among all animals that occupy the same places and get their living from the same things. For if their food is scarce, even those of the same breed fight against each other . . . " (*HA* VIII 1, 608b19–22);[58] and carnivores are, of course, the enemies of all the rest (608b26–7). The long roll of natural enemies (*HA* VIII 1–2, 609a4 ff.) is punctuated by a very few friends, but even in these relationships amity is predicated in *realpolitik* fashion on enmity towards a third party. Raven and fox are friendly, but only on the principle of "my enemy's enemy . . . ": a raven will give aid to a fox under attack from its own antagonist, the merlin (609b32–4). I wrap up this quick survey with a choicely ironic example: by day small birds are wont to "admire" (ὃ καλεῖται θαυμάζειν), that is, mob,

[55] . . . διῄρηνται δὲ κατὰ τοὺς τόπους· τὰ μὲν γὰρ πεζὰ τὰ δ' ἔνυδρα τῶν ζώων ἐστίν (*HA* VII 2, 589a10–11).

[56] αἱ δὲ πράξεις καὶ οἱ βίοι κατὰ τὰ ἤθη καὶ τὰς τροφὰς διαφέρουσιν (translation from Aristotle 1991).

[57] *HA* VII 12–17 discuss migration and various strategems falling under Aristotle's rubric of "retirement" or "concealement" (φωλεία), which includes both hibernation and aestivation in reaction to seasonal change.

[58] πόλεμος μὲν οὖν πρὸς ἄλληλα τοῖς ζώοις ἐστὶν ὅσα τοὺς αὐτούς τε κατέχει τόπους καὶ ἀπὸ τῶν αὐτῶν ποιεῖται τὴν ζωήν. ἐὰν γὰρ ᾖ σπάνιος ἡ τροφή, καὶ πρὸς ἄλληλα τὰ ὁμόφυλα μάχεται . . . That scarcity is not only a sufficient, but also a necessary condition for such "warfare" follows from an intriguing counterfactual: were there always and everywhere food in abundance, all animals would behave tamely towards us and one another (608b30–3).

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

their enemy the owl; hence bird-catchers are able to exploit the owl as a sort of living tool, a decoy for trapping its foes (609a14–17).

Morals: first, as we have seen, exponents of the third definitional implication go in for theatrical metaphors featuring the natural substance as a solo act in a "drama of life" performed in an "arena," a stark venue unimportant in itself, against an almost invisible environmental "backdrop." But the impression one takes away from the *HA* is that the theatre of life is a theatre of war. Most of the time living action is ruthlessly competitive interaction;[59] and a proper natural history narrating the stratagems and outcomes of such struggles will never isolate a single, glorious combatant (consider that writing "winner's history" is no option, since these Aristotelian wars are perpetual). If we put together the fluid dynamism of animal warfare with the relatively static but intricate nexus of natural and habitual relations binding plants to their environment, we should, at a minimum, feel disinclined to assent *immediately* to Aristotle's proposition that the existence of natural things is "obvious." This will seem plain only through improper neglect of environmental issues: it all depends on whether we can be certain that we are deciding on the naturalness of a thing rightly judged in its environment, where discerning *the* environment is no mean achievement.

Second: one might try discarding the first moral on the basis of a distinction. The difficulty of the environmental issues shows not that we should be skeptical about the existence of natures, but rather and only that we should be agnostic about particular shots at identification. If, for the sake of argument, we partially concede the point, we should nevertheless think harder about how to proceed in any given instance where *x* might or might not be a natural substance. Agnostic capitulation as a matter of course – which would spell the doom of Aristotelian science – should only be a despairing last resort. But I submit that the best way forward would take us down an experimental road: to a program not of contrived manipulation in an artificial environment engineered to screen out irrelevant factors, but rather of systematic displacement of our possible natural substance into a series of carefully selected alternative settings, with a view to rigorous differential observation of its behavior therein. To recur to our rejection of the excusing rationale for methodological passivity. One should strengthen that earlier result: not only would it be quite in order for the Aristotelian scientist to observe untouched natural examples across a range of environments; the inclusion of *observanda* which had possibly been "interfered" with would also be a pretty obvious extension of this policy. That the "unnaturally" enslaved man acts up (is impudent and "uppitty," runs off if left unchained), or that cultivated stocks degenerate (from our point of view)

[59] I concur enthusiastically with the claim that "this system [=the natural world] is comprised of individual objects with their own distinctive natures, to be sure; even so, it is a mistake to conceive of these natures 'atomistically,' as if they could be articulated without making essential reference to elements of the environment in which they operate. This environment does not just provide the setting against the backdrop of which the story of a thing's natural movement unfolds; it furnishes characters with active rôles in that story, in the absence of which the behaviour of the protagonist is fundamentally unintelligible" (Kelsey).

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

in a less than domesticated environment, just goes to show that there *is* an original φύσις there. Since the sources of the original nature's frustration, repression, obscurity or occlusion can be disparate, a series of cleverly designed displacement trials might bring it back into the light: this would be a "collaborative" model for theoretical science rather than artifice.[60] The first, non-Aristotelian program of experimentation is "exclusivist" in intention; the second is "inclusivist" – and should have been pursued by Aristotelian researchers alive to how inchoate and problematic the presumption that natures come in systems might be.[61]

Third and final moral: readers of a philosophical disposition might fondly conjecture that my messy forays into the history of science throw up empirical problems, but leave the Aristotelian concept of nature as such inviolate; if criteria for its application are indefinite or questionable, *tant pis*. This will not do. Aristotle himself would never take refuge in such an excuse: one solid reason for his rank as patron (if not master) of those who know is his powerful integration of philosophical analysis, methodological reflection, and scientific practice. The conclusion might seem resolutely downbeat: I have raised the specter of a most unwelcome paradox, that "nature" might be exposed as an ill-formed, "unnatural" concept. The first and second apparent implications of the definition of nature say that intrinsic principles will be explanatorily dominant; but the very idea of a natural principle falls apart, as the seemingly modest premise that environments in the background are an unproblematic "given" unravels. Not so. Environments are not arbitrary fictions,[62] but they doubtless do merge, often seamlessly, one into another; and for sure the realization that a pivotal scientific concept is vague

[60] That Aristotle expends so much energy on the study of deviant political constitutions is perhaps an anthropological move in this direction.

[61] One might look to Mohan Matthen for a case on Aristotle's behalf, since he urges that "Aristotle's universe is appropriately considered to be a composite substance . . . an individual thing that has a nature or form of its own but comprehends other substances which have their own natures and forms" (Matthen 1997, 171–2): would this not be a natural system with a vengeance? But whatever the merits of Matthen's arguments, they never descend below the cosmic level, and thus remain far too schematic to command assent when it comes to cosmic sub-systems.

[62] The *intuition*, of course, is that e.g., "the rose and maple are subjects of processes of their own, which . . . meteorological or physical events merely complete or continue: the formation of leaves of a certain character, come spring, and the fixation of carbon in those leaves, once illuminated" (Thompson 1995, 260). The avowedly "simplest" explanation of this " . . . would involve a prior idea of events as coming respectively 'from outside' and 'from within' the thing stimulated and responding" (ibid., 261) – that is, the internality condition from which Aristotelians begin! This is said not to express any dissatisfaction with Thompson, but rather just because his immensely sophisticated disquisition on the "logic" of life, so far from settling our issues, serves to underline that they remain wide open. For example: "if a thing is alive, if it is an *organism*, then some particular vital operations and processes must go on in it from time to time . . . if any of these things *is there*, or *is happening*, then this is not something fixed or determined by anything in the organism considered in its particularity or as occupying a certain region of space. That they are there or happening, and thus that we have an organism at all, presupposes the existence of a certain 'wider context': it is this that stamps these several characters on to things" (ibid., 274–5). Thompson's advocacy of Anscombe's contextual insight is sound; but the presupposition of such a "wider context" is only a logical preliminary to the enterprise of establishing the contours of reasonably determinate environments to house Aristotelian natural substances.

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

may not be reassuring. Yet much as Aristotle might officially deprecate vagueness, the fitting complexity of nature on his conception might reconcile us to working with an intellectual toolkit whose instruments, like the Lesbian rule, bend to match what they measure.

Acknowledgments

For their helpful comments and criticism, thanks are due to Sarah Broadie, Myles Burnyeat, Stephen Makin, two anonymous readers for *Science in Context*, and my audience at the King's Centre for Philosophical Studies in London, where some of this material was presented.

References

Aristotle. 1936. *Minor Works*. Translated by W. S. Hett. London: Loeb Classical Library.

Aristotle. 1961. *Aristotle's* Protrepticus: *An Attempt at Reconstruction*. Edited by Ingemar Düring. Göteborg: Acta Universitatis Gothoburgensis.

Aristotle. 1965. *Historia Animalium* volume I, *Books I-III*. Translated by A. L. Peck. London: Loeb Classical Library.

Aristotle. 1970. *Aristotle's* Physics I, II, *Translated with Introduction and Notes*. Translated by W. Charlton. Oxford: Clarendon Press.

Aristotle. 1991. *Historia Animalium* volume III, *Books VII-X*. Edited and translated by D. M. Balme. London: Loeb Classical Library.

Bodnár, I. 1997. "Movers and Elemental Motions in Aristotle." *Oxford Studies in Ancient Philosophy* 15:81–117.

Cartwright, N. 1999. *The Dappled World: A Study of the Boundaries of Science*. Cambridge: Cambridge University Press.

Funkenstein, A. 1986. *Theology and the Scientific Imagination from the Middle Ages to the Seventeenth Century*. Princeton: Princeton University Press.

Gill, M. L. and J. G. Lennox, eds. 1993. *Self-Motion from Aristotle to Newton*. Princeton: Princeton University Press.

Graham, D. 1995. "The Metaphysics of Motion: Natural Motion in *Physics* II and *Physics* VIII." In *Aristotle's Philosophical Development: Problems and Prospects*, edited by W. Wians, 171–92. London: Rowman & Littlefield Publishers.

Granger, H. 1993. "Aristotle on the Analogy between Action and Nature." *Classical Quarterly* 43:168–76.

Hornblower, S. and A. Spawforth, eds. 1996. *The Oxford Classical Dictionary*, 3d. ed. Oxford: Clarendon Press.

Katayama, E. G. 1999. *Aristotle on Artifacts: A Metaphysical Puzzle*. Albany: State University of New York Presses Marketing.

Kelsey, S. Forthcoming. "Aristotle's definition of nature." *Oxford Studies in Ancient Philosophy.*

King, P. 1993. "Duns Scotus on the Reality of Self-Change." In Gill and Lennox 1993, 227–90.

Lear, J. 1988. *Aristotle: The Desire to Understand*. Cambridge: Cambridge University Press.

Lloyd, G. E. R. 1983. *Science, Folklore and Ideology: Studies in the Life Sciences in Ancient Greece*. Cambridge: Cambridge University Press.

Lloyd, G. E. R. 1987. *The Revolutions of Wisdom: Studies in the Claims and Practice of Ancient Greek Science*. Berkeley: University of California Press.

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press

Mackie, J. L. 1974. *The Cement of the Universe: A Study of Causation*. Oxford: Clarendon Press.
Matthen, M. 1997. "The Holistic Presuppositions of Aristotle's Cosmology." *Oxford Studies in Ancient Philosophy* 15:171–99.
Philoponus. 1887. *Ioannis Philoponi in Aristotelis Physicorum libros tres priores commentaria*. Edited by Girolamo Vitelli. Berlin: Reimer (=Preussische Akademie der Wissenschaften, Commentaria in Aristotelem Graeca, vol. 16).
Philoponus. 1993. *On Aristotle* Physics *2*. Translated by A. R. Lacy. London: Duckworth.
Sedley, D. 1991. "Is Aristotle's Teleology Anthropocentric?" *Phronesis* 36:179–96.
Simplicius. 1882. *Simplicii in Aristotelis Physicorum libros quattuor priores commentaria*. Edited by Hermann Diels. Berlin: Reimer (Preussische Akademie der Wissenschaften, Commentaria in Aristotelem Graeca, vol. 9).
Simplicius. 1997. *On Aristotle* Physics *2*. Translated by B. Fleet. London: Duckworth.
Theophrastus. 1916. *De Historia Plantarum*. Translated by A. Hort. London: Loeb Classical Library.
Theophrastus. 1976. *De Causis Plantarum*. Translated by B. Einarson and G. K. K. Link. London: Loeb Classical Library.
Thompson, M. 1995. "The Representation of Life." In *Virtues and Reasons: Philippa Foot and Moral Theory*, edited by R. Hursthouse, G. Lawrence and W. Quinn, 247–96. Oxford: Clarendon Press.
Wardy, R. 1992. "Aristotelian Rainfall or the Lore of Averages." *Phronesis* 38:18–30.
Waterlow Broadie, S. 1982. *Nature, Change and Agency in Aristotle's* Physics: *A Philosophical Study*. Oxford: Clarendon Press.

https://doi.org/10.1017/S0269889705000360 Published online by Cambridge University Press