



Philosophical Review

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Source: *The Philosophical Review*, Vol. 101, No. 4 (Oct., 1992), pp. 791-825

Published by: Duke University Press on behalf of Philosophical Review

Stable URL: <https://www.jstor.org/stable/2185925>

Accessed: 13-12-2018 11:58 UTC

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Aristotle, Teleology, and Reduction¹

Susan Sauvé Meyer

1. Teleology and Necessity

The thesis of natural teleology is a central tenet of Aristotle's natural philosophy. This is the thesis that nature acts "for something" (*heneka tinos*), by which Aristotle means that the parts of natural organisms develop because of the good ends they serve (*Ph.* 195a23–24, 198b8–9; *Met.* 983a31–32; *PA* 640a36–b1). For example, an animal's teeth develop flat in the back of the mouth and sharp in front because such teeth are suitable for biting and chewing food (*Ph.* 198b24–27); plants grow leaves because they are good for covering fruit, and roots grow down rather than up because they are for nourishment, which is below (199a23–30). This much, at any rate, is clear from what Aristotle says. It is, however, unclear and a matter of considerable controversy exactly how Aristotle intends his teleological claims to be interpreted. In particular, it is disputed whether Aristotle allows that an outcome that happens because it is good might also happen as the causally necessitated result of the activity of the material elements. The question arises because Aristotle defends his thesis of natural teleology against the objections of opponents who claim that the allegedly teleological phenomena result from just such necessitating material causes. He begins his defense of natural teleology in *Physics* ii 8 by attributing such a view to his opponents:

We must first of all say why nature is one of the causes that are "for something" (*heneka tou*). And after that we must discuss necessity and say how it obtains in natural things. For everyone refers to this cause,

¹Previous drafts of this paper were presented at meetings of the Society for Ancient Greek Philosophy and the Philosophy Discussion Club at Cornell University. I have benefited from the discussion on these occasions, as well as from written comments by Julia Annas, Myles Burnyeat, David Charles, Terence Irwin, Roderick Long, and an anonymous referee for the *Philosophical Review*.

saying that since the hot is naturally of this quality—as well as the cold and each of the things of this sort—of necessity these things are and come to be. (*Ph.* 198b10–14)

The opponents whom Aristotle has in mind are the Presocratic natural philosophers (*phusiologoi*)—especially Democritus, Empedocles, and Anaxagoras.² He here homogenizes their views and attributes to them generally the thesis that natural phenomena result of necessity from the activities of the material elements: earth, air, fire, and water—referred to here as “the hot, . . . the cold, and each of the things of this sort” (cf. *Met.* 984a8–9, b6, 993a22). I shall refer to this as “the thesis of necessity.”³

If Aristotle said no more than this in characterizing the opponents of natural teleology, we might well infer that he takes the thesis of necessity to be incompatible with his own thesis of natural teleology. But this is in fact not all he says about the opponents. His opening remarks in *Ph.* ii 8 continue:

And in fact if they mention any other cause (*aitian*)—one saying love and strife, another saying mind—they dismiss it as soon as they touch on it. (198b14–16)

Aristotle’s additional claim is that the opponents of natural teleology do not in practice take seriously the possibility that there are causes other than “necessity.” His particular complaint about

²Empedocles is the only named opponent in *Ph.* ii 8, but Aristotle elsewhere attributes such affirmations of necessity to Democritus (*GA* 789b2–7) and to Anaxagoras (*Met.* 985a18–21) in contexts in which he criticizes their neglect of teleology. He attributes these positions to the *phusiologoi* in general at *GA* 778b7–10; cf. *PA* 640b4–17.

³This thesis of necessity must be distinguished from the weaker thesis that the natural development of organisms merely involves such material necessitation. For a process can involve such material necessitation without being completely determined by such necessitation. Fred Miller and Michael Bradie argue for the compatibility of Aristotle’s natural teleology with this weaker thesis of necessity in “Teleology and Natural Necessity in Aristotle,” *History of Philosophy Quarterly* 1 (1984): 133–46. By contrast, the question of compatibility that concerns me in this paper is whether a teleological process can be completely determined by such antecedent material necessitation. Miller and Bradie, in arguing against what they call “supererogatory compatibilism” defend a negative answer to this question of compatibility.

Empedocles' appeals to love and strife and Anaxagoras's appeals to mind, elaborated upon in *Metaphysics* i 3–7, is that they use these forces as mere efficient causes to do the job that final causes are supposed to do (984b8–985b3, 988b8–11). In citing “necessity” as a cause, such thinkers cite what Aristotle prefers to call material and efficient causes (*Met.* 984b5–8; *GC* 335b16–17, 24–32; *GA* 778a35–b1). So the thesis of necessity he attributes to them amounts to the thesis that material and efficient causes completely determine natural phenomena. And the second claim he makes about their position restates his frequent complaint that of the four kinds of cause he recognizes (formal, material, efficient, and final) the *phusiologoi* recognize only the material and the efficient.⁴ Certainly this second claim Aristotle makes about his opponents attributes to them a view that conflicts with his own thesis of natural teleology, but does he think that the second claim is a consequence of the first? That is, does Aristotle think his thesis of natural teleology is incompatible with the thesis of necessity?⁵

⁴The four Aristotelian causes: *Ph.* 194b16–195a3; *Met.* 983a24–32. The *phusiologoi* recognize only the material and the efficient: *GA* 778b7–10; *Met.* 985a10–13, 988a27–34; *GC* 335b24–29; *PA* 640b5–29.

⁵John Cooper, in “Aristotle on Natural Teleology” (in *Language and Logos*, ed. Malcolm Schofield and Martha Nussbaum (Cambridge: Cambridge University Press, 1982), 197–222), claims that Aristotle defends teleology by denying that “the powers attributable to matter of different kinds [are] sufficient to determine any of the actually observed outcomes” (211). Allan Gotthelf, in the 1986 postscript to “Aristotle’s Conception of Final Causality” (*Review of Metaphysics* 30 (1976): 226–54; reprinted with additional notes and postscript in *Philosophical Issues in Aristotle’s Biology*, ed. Allan Gotthelf and James Lennox (Cambridge: Cambridge University Press, 1987), 204–42), accurately summarizes his 1976 paper as claiming that “if some sum of actualizations of element-potentials were by itself sufficient for the production of some outcome, that outcome would not be subject to teleological explanation for Aristotle” (231; emphasis in original). Jonathan Lear, in *Aristotle: The Desire to Understand* (Cambridge: Cambridge University Press, 1988), claims that Aristotle believes the “actual material structure” of an organism “is in itself insufficient to guarantee [its] normal development” (22). Sarah Waterlow, in *Nature, Change, and Agency* (Oxford: Oxford University Press, Clarendon Press, 1982), characterizes Aristotle’s teleology as implying that an organism’s development does not achieve its characteristic end or form “as a necessary consequence of matter” (69).

Those who claim that Aristotle’s teleology is compatible with the thesis of necessity include David Charles, “Aristotle on Hypothetical Necessity and Irreducibility” (*Pacific Philosophical Quarterly* 69 (1988): 1–53), 1–3; Ter-

I propose to address this question by focusing on the thesis that Aristotle explicitly identifies as the rival to natural teleology in *Ph.* ii 8. This thesis is not the thesis of necessity but the thesis that the development of animals and plants is in some way “accidental.” Aristotle’s argument presupposes that the falsity of this rival thesis is sufficient for the truth of natural teleology. Accordingly, I will address the question of compatibility by considering whether, in Aristotle’s view, the rival thesis is a consequence of the thesis of necessity. I will argue that it is not a consequence.

Once we understand the rival thesis that Aristotle articulates as the opponents’ objection to natural teleology, and the role that rival thesis plays in the broader philosophical issue at stake in Book Two of the *Physics*, we will see that a common interpretation of the general philosophical issue at stake in Aristotle’s defense of natural teleology is mistaken. According to this interpretation, the opponents against whose objections Aristotle defends his thesis of teleology are *reductionists*; that is, they contend that they can explain simply by reference to the causal powers of the material elements all the phenomena that Aristotle claims must be explained teleologically. Many interpreters who disagree over whether Aristotle’s natural teleology is compatible with the thesis of necessity share this conception of the opponents’ position. They disagree over whether the opponents’ alleged reductionism is entailed by the thesis of necessity. However, once we understand the rival thesis that Aristotle explicitly attributes to the opponents of natural teleology, we will see that such reductionism is not the philosophical issue at stake in his defense of natural teleology. Properly understood, the rival thesis is incompatible with such reductionism, for (in a sense that will become clearer later on in my discussion) it denies that the allegedly teleological phenomena are genuine explananda. This denial serves the opponents’ proposal to eliminate from the category of substance (*ousia*) all entities other than the material elements (*Ph.* 193a23–25). The truth of this eliminative ontological

ence Irwin, *Aristotle’s First Principles* (Oxford: Oxford University Press, Clarendon Press, 1988), 109–12; Martha Nussbaum, *Aristotle’s de Motu Animalium* (Princeton: Princeton University Press, 1978), 67–76; and Richard Sorabji, *Necessity, Cause, and Blame* (Ithaca, N.Y.: Cornell University Press, 1980), 153.

proposal is the philosophical issue at stake in Aristotle's defense of natural teleology.

I will first argue that the thesis Aristotle identifies as the rival to natural teleology is not the thesis of necessity, but a thesis about accidents (section 2). I will then show that this rival thesis is not a consequence of the thesis of necessity (section 3). I will support my interpretation of the rival thesis by showing that it is a thesis whose falsity would establish the truth of natural teleology (section 4), and that it is a thesis Aristotle fairly attributes to his opponents (section 5). In conclusion, I will draw upon the results of sections 2 and 3 to show that a common argument for the incompatibility of natural teleology with the thesis of necessity fails because it does not accommodate the significance of a distinction central to the proper understanding of the rival thesis (section 6). And I will draw upon the results of sections 3 and 5 in order to show that the philosophical issue at stake in Aristotle's defense of natural teleology is not reductionism but eliminativism (section 7).

2. The Rival Thesis

It is easy to suppose that the rival to the thesis of natural teleology just *is* the thesis of necessity. The opponents of natural teleology clearly espouse the thesis of necessity, and Aristotle states that thesis (198b12–14) immediately after announcing his intention to defend the thesis of natural teleology at the beginning of *Ph.* ii 8. However, if we examine Aristotle's articulation of his opponents' objection to natural teleology, we will see that the rival thesis is not the thesis of necessity. Aristotle first states his opponents' objection as follows:

There is the difficulty (*aporia*), what prevents nature from acting neither for something nor because it is better, but rather as Zeus rains—not in order that the grain will grow, but rather of necessity (for what has risen must become cold, and what has become cold, having turned into water, must come down. When this has happened, it turns out (*sumbainein*) that the grain grows). Similarly, if someone's grain is ruined on the threshing floor it does not rain for the sake of this, so that the corn will be ruined, but rather this simply results (*sumbebêken*). (198b16–23)

In this passage, Aristotle's first statement of the rival to the thesis of natural teleology ("not in order that . . . but of necessity" (b18–19)) suggests that he takes the opponents' objection to the thesis of teleology to be captured by the thesis of necessity. However, the explanation of the rival thesis, in the parenthesis at b19–21, makes no mention of necessity. In fact, this explanation falls short of saying that the crop growth results of necessity from the antecedent occurrences. Aristotle simply says that the growth "results" (*sumbainein*). In keeping with the explanation in the parenthesis, the final sentence in this passage (b21–23) articulates the rival thesis as "not for the sake of this, . . . but rather this simply results" (*sumbebêken*).

Sumbainein and its cognates, as well as the related *sumpiptein*, are the terms Aristotle uses to describe accidental occurrences (*ta kata sumbebêkos*). In the preceding passages I have rendered them by 'it turns out' and 'it simply results'. Aristotle's appeal to this notion in his articulation of the opponents' objection suggests that he thinks the rival to the thesis of natural teleology can be stated thus: The result for the sake of which the process allegedly occurs is, on the contrary, simply an accident. This suggestion is borne out by Aristotle's immediately following remarks, which restate the initial objection:

So what prevents parts in nature from also being like this (sc. like the rain), for example that of necessity the front teeth come up sharp and suitable for tearing, and the molars come up flat and suitable for grinding food, although it does not happen for the sake of this, but rather is an accident (*sumpesein*). (198b23–27)

Here the opponents do claim that the result in question occurs "of necessity" (b24), but the reason they give for denying that the development is teleological is that the result is an accident (*sumpesein*, b27). Aristotle's final statement of his opponents' position, which generalizes the objection to apply to all the parts of animals and plants, does not even mention necessity. He states the rival to the thesis of natural teleology simply as a claim about an accidental occurrence:

And similarly in the case of the other parts to which the "for something" seems to belong. Wherever all (the parts) came together [or:

turned out, *sunebê*] as if they had come to be for something, these (animals and plants) survived, having been constituted suitably by chance⁶ (*apo tou automatou*). But those of whom this is not the case perished and continue to perish—as Empedocles claims human-headed ox progeny do. (198b27–32)

Finally, if we examine Aristotle's actual argument against the opponents, we may confirm conclusively that Aristotle thinks the rival to his teleological explanations is the thesis that the phenomena in question happen by accident. He articulates the dispute as, "So if these things seem to be either accidental (*apo sumptômatos*) or for something . . ." (199a3–4), and his argument in favor of the second alternative is an argument against the first:

So if these things seem to be either accidental (*apo sumptômatos*) or for something, and if they cannot be by accident or by chance (*apo toutomatou*), they would be for something. (199a3–5)

We may conclude that the rival thesis against which Aristotle actually defends natural teleology in *Ph.* ii 8 is the thesis that the results of apparently teleological processes occur by accident. We may also conclude that Aristotle thinks that this rival thesis can be stated without reference to necessity. Of course the rival thesis, so articulated, might simply be a consequence of the thesis of necessity. If so, Aristotle might well conflate these two theses when stating the opponents' objection, and his argument here would indicate that he takes the thesis of necessity to conflict with his thesis of natural teleology. But do we have any reason to suppose that Aristotle would take the rival thesis to be a consequence of the thesis of necessity? To answer this question, we need to see how Aristotle understands the rival thesis. What is it, in his view, for something to occur by accident?

⁶Aristotle here uses 'by chance' (*apo tou automatou*) rather than 'by accident' to formulate the rival thesis, but he uses 'by chance' and 'accidentally' interchangeably in stating the opponents' position. And events due to luck (*tuchê*) or chance (*to automaton*) are a subclass of accidental occurrences (*Ph.* 196b17–33, 198a5–7). I discuss the relation between chance occurrences and other accidental occurrences in section 4.

3. Accidents and Necessity

Aristotle distinguishes two ways in which something can be the cause (*aitia*, *aition*) of a result. It can be the cause in virtue of itself, or intrinsically (*kath' hauto*), or it can be the cause not in virtue of itself but rather accidentally (*kata sumbebêkos*):

Just as beings are some of them intrinsic (*kath' hauto*) and others accidental (*kata sumbebêkos*), so too causes admit of being either intrinsic or accidental. For example, of the house the housebuilder (*to oikodomikon*) is the intrinsic cause, while the pale or the musical is the accidental cause. (*Ph.* 196b24–27)

It is clear from Aristotle's other versions of this example (*Ph.* 195a33–35, 197a14–15, *Met.* 1026b35–1027a2) that the same person is the housebuilder, pale, and musical; yet, he claims that only the housebuilder, and not the pale or the musical, is the intrinsic cause of the house. Thus, Aristotle's intrinsic causal claims are made in intensional contexts. It is only qua housebuilder, not qua pale or qua musical, that the housebuilder is the intrinsic cause of the house. The effects of intrinsic causes are also characterized intensionally. The house built by the builder may be a good investment, but the housebuilder is the intrinsic cause only of the house, and not also of the good investment. Of the good investment, the housebuilder is only the accidental cause (*Met.* 1026b6–10).

It would be a mistake to suppose that Aristotle's distinction between intrinsic and accidental causation amounts to no more than a distinction between two different ways of describing the same causes and effects.⁷ Rather, the distinction reflects Aristotle's practice of individuating causes and effects (and entities in general) very finely.⁸ The house and the good investment are not the same thing, nor are the housebuilder and the pale. In Aristotle's view, it is a fact *in rerum natura* whether the causal relation between two

⁷As, for example, David Charles construes it in *Aristotle's Philosophy of Action* (London: Duckworth, 1984), 46.

⁸See Gareth Matthews, "Accidental Unities," in *Language and Logos*. Cynthia Freeland develops this point in "Accidental Causes and Real Explanations," in *Aristotle's Physics: A Collection of Critical Essays*, ed. Lindsay Judson (Oxford: Oxford University Press, Clarendon Press, 1991).

entities is intrinsic or accidental. And it is also a fact, independent of how we might choose to describe it, whether a given outcome has an intrinsic cause.

Some things that happen, Aristotle claims, do not have intrinsic causes. These things are accidents, or happen by accident. They have only accidental causes (*Met.* 1027a5–8; cf. *PA* 640a27–32). For example:

A fancy-cook (*opsopoios*), while aiming at pleasure, might produce something healthy for someone, but not according to (*kata*) the craft of cookery (*opsopoiêtikên*). That is why we say it happened by accident (*sunebê*). There is a sense in which he produces it, but without qualification he does not. (*Met.* 1027a2–5)

The fancy-cook produces some food that is both pleasant-tasting to someone and healthy for her. The fancy-cook is the intrinsic cause of the pleasant-tasting food, but not of the healthy food; the fancy cook is only the accidental cause of this. The healthy food, if it had an intrinsic cause, would be the intrinsic effect of a doctor (cf. *Met.* 1026b37–1027a2). But there was no doctor involved in its production; hence it is an accident that healthy food is produced.

The rival thesis to Aristotle's natural teleology states that apparently teleological phenomena occur by accident. Since something that happens by accident has no intrinsic cause, the rival thesis should be understood as the thesis that these phenomena do not have intrinsic causes. In order to determine whether the rival thesis, so understood, is entailed by the thesis of necessity, we need to investigate further the conditions in which Aristotle thinks something is the intrinsic cause of a result.

Aristotle regularly claims that an intrinsic cause of a result “always or for the most part” or “of necessity or for the most part” produces that result, while an accidental cause does not stand in this relation to its accidental effect (*Met.* 1025a20, 1027a9; cf. *APst.* 87b20–21). For example:

What belongs to something truly but neither of necessity nor for the most part is accidental—for instance, if someone digging a ditch for a plant should find a treasure. Now this, finding a treasure, is accidental to the digger of the ditch, for it does not come from this or after this of necessity, nor does someone planting for the most part find treasure. (*Met.* 1025a14–19)

Such claims are reasonably interpreted as quantifications over tokens of the same type as the cause, and over tokens of the same type as the effect. They affirm or deny that tokens of the same type as the cause regularly produce tokens of the same type as the effect. For example, fancy-cooks regularly produce pleasant-tasting food, but they do not regularly produce healthy food (since most pleasant-tasting food is not healthy).⁹

Another way in which Aristotle describes the relation between an intrinsic cause and its effect is in terms of the efficient causal powers of the intrinsic cause. For example, the housebuilder (*oikodemos*) is the intrinsic cause of the house in virtue of his skill of housebuilding (*hê oikodomikê*, *Ph.* 195b23–25). This skill is productive (*poiêtikê*) of houses, but not of good investments (*Met.* 1026b7–10). The healthy food of which the fancy-cook (*opsopoios*) is the accidental cause is not produced “according to the skill of cookery” (*kata tèn opsopoiêtikên*, 1027a4). The doctor, who is the intrinsic cause of health, is “naturally productive” (*pephuke poiein*) of health (1027a1–2).¹⁰

Aristotle does not explicitly connect these two different sorts of claims about intrinsic causation, but several of his views about ef-

⁹Aristotle, in making such claims, is not claiming simply that there is a statistical regularity between tokens of the same type as the intrinsic cause and tokens of the same type as its intrinsic effect, for he regularly substitutes ‘of necessity’ for ‘always’ in the locution ‘always or for the most part’. This is not to reduce modal and causal regularities to statistical regularities, for he explicitly distinguishes regularities that obtain “always” (*aei*) from those that merely hold “of every case” (*kata pantos*). A regularity that obtains always is a universal (*katholou*) regularity (*APst.* 96a8–11), and a universal regularity holds not only of every case (*kata pantos*), but also intrinsically (*kath’ hauto*) and of necessity (73b26–28). And a regularity is *kath’ hauto* only if one of the regularly conjoined items is because of (*dia* + accusative) the other (73b10–16). The regularity that Aristotle requires between intrinsic causes and their effects is therefore irreducibly modal and causal. ‘Always or for the most part’ is a quantifier over counterfactual as well as actual cases, and the connection that obtains in these cases must be causal.

¹⁰I call the skills of housebuilding, cookery, and medicine “efficient causal powers” on the grounds that these capacities (*dunameis*) are “origins of change in another or in something qua other” (*Met.* 1019a15–20, 1046a6–11), while Aristotle’s so-called “efficient cause” is “that from which the origin of change” is (*Ph.* 194b29), and his standard example of such a cause is the possessor of such a causal power: the sculptor, the builder, etc. (e.g., *Ph.* 194b31–32, 195a34, b3–6).

ficient causal powers illuminate the connection between them. For example, Aristotle thinks that each efficient causal power has certain conditions appropriate for its exercise, and that when these conditions obtain the change of which the efficient cause is naturally productive begins of necessity (*Met.* 1047b35–1048a7). Aristotle also regularly claims that the change (*kinêsis*) originated by an efficient causal power will achieve a certain result unless something impedes it (*Ph.* 199b15–18, 215a20–22; cf. *Met.* 1048a16–21). In the light of these remarks, it is reasonable to interpret as follows Aristotle's claim that an intrinsic efficient cause of a result always or for the most part produces such a result. In all or most of the actual or counterfactual situations in which the conditions are appropriate for the exercise of an efficient causal power, the possessor of such an efficient causal power will succeed in producing a result of the type it "naturally produces" (*pephuke poiein*). For example, the conditions appropriate for the exercise of the fancy-cook's efficient causal power (*opsopoiêtikê*) are ones in which there are available ingredients and instruments from which a delicious meal can be made. In all or most of the conditions in which such ingredients and instruments are available to a fancy-cook, the fancy-cook will, if he so desires,¹¹ succeed in producing a delicious meal.

Since an intrinsic efficient cause has a certain range of circumstances in which it reliably produces its intrinsic effect, not all of the conditions that obtain on a given occasion in which its causal power is exercised successfully are necessary for its success. Some features are such that, had they been different, the efficient cause would still have succeeded in producing its characteristic effect. For example, the skilled cook has the ability to produce pleasant-tasting food out of a wide range of ingredients. On a given occasion, he might produce beef Wellington and a lemon soufflé for dinner. But had there been no meat or eggs available, he still would have succeeded in producing pleasant-tasting food—perhaps eggplant

¹¹When the efficient causal power is a rational capacity, as in the present example, Aristotle claims that the exercise of that capacity in causing change follows of necessity only when the possessor of that capacity desires to exercise it (*Met.* 1048a7–15). But this extra condition is not necessary for the exercise of nonrational capacities, and the capacities involved in the allegedly teleological processes in *Ph.* ii 8 are nonrational (cf. *Ph.* 199b26–33).

Parmesan and apple pie. There is a very wide range of combinations of ingredients from which a skilled cook can make a delicious dinner.

The general moral to draw from the preceding account of intrinsic causation is that when something happens as a result of an intrinsic cause—that is, not by accident—it is a fairly stable feature of the situation in which it occurs. Everything didn't have to happen in exactly the way it did for the result to happen. Given that an intrinsic efficient cause of the effect was operating, a reasonable range of things could have been different, and yet a result of the same type would still have occurred. Something that happens by accident, however, has a different status. An accidental result is not produced by a cause that is such as to produce results of that type always or for the most part. So there is no cause operating in the production of an accidental result such that for all the ways in which things could have been different without affecting the conditions appropriate for its exercise, the result in question would still probably have occurred. This is why Aristotle says that an accidental occurrence is unstable (*abebaion*, *Ph.* 197a30–33). By contrast, a nonaccidental occurrence is overdetermined,¹² and hence stable.

Consider, for example, the accidental meeting Aristotle describes in *Ph.* ii 5: two people meet in the marketplace, one of whom owes money to the other and has with him sufficient money to repay the debt; as a result, the lender recovers his money from the borrower. The recovery of the money is not an accidental result of the meeting, but the meeting itself is an accident. The lender wanted to get to the market to sell his olives. The borrower was going through the market in order to get to the theater, where he had decided to spend the afternoon. Neither the lender nor the borrower knew where the other would be. There was an intrinsic cause of the lender's being in the market, and an intrinsic cause of the borrower's being in the market—their respective decisions. But neither of these decisions was an intrinsic cause of the meeting.

¹²The result is not overdetermined by the presence of several causes, each sufficient to produce the effect even if the other(s) were not effective. Rather, it is overdetermined by the fact that its intrinsic cause would still have succeeded in bringing it about even if circumstances had been different.

This is because there are many ways in which things could have been different that (a) would not have impeded the execution of these decisions, but (b) would have kept the meeting from occurring. The lender, for example, might have stopped to talk to a friend for a few minutes on his way to the market (after all, he had the whole afternoon to sell his olives). He would thereby have missed meeting the borrower as the latter passed through the market. Or the borrower might have left home a few minutes earlier than he actually did (he had no particular reason for leaving exactly when he did), in which case he would have passed through the market before the lender arrived and the meeting would not have happened. Pretty well everything had to happen in exactly the way it did for the meeting to occur; being accidental, the meeting is unstable, and could easily not have occurred.

We have been investigating the nature of the accidental in order to understand the thesis that Aristotle articulates in *Ph.* ii 8 as the rival to his thesis of natural teleology. This is the thesis that the parts of animals and plants develop by accident. We can now see that in attributing this thesis to the opponents of teleology Aristotle attributes to them the claim that the development of animals and plants is like the accidental meeting in the marketplace—that everything happened “just right” for the development of, for example, teeth suitable for biting and chewing, but that no causal power operating in the production of such teeth made that development a stable, overdetermined, feature of the situation. It is important not to lose sight of the fact that the rival thesis, so interpreted, is perfectly compatible with the opponents’ thesis of necessity. (In claiming that the parts of animals and plants develop of necessity, the opponents claim that the natural activities of the material elements causally determine the development of such parts. In claiming that such parts develop by accident, they deny that the development is *overdetermined*. These two claims are perfectly compatible.)¹³ But a more important question for our present purposes is whether the rival thesis is a consequence of the thesis of necessity.¹⁴ For if it is a consequence, then we must conclude that Aris-

¹³I develop this argument in more detail in section 6.

¹⁴Interpreters who think it is a consequence include Gotthelf (222, esp.

totle's thesis of natural teleology is incompatible with the thesis of necessity. But the preceding account of the accidental allows us to see that it is not a consequence.

The thesis of necessity entails that the natural activities of the basic material elements are causally sufficient for the development of the parts of animals and plants. But the mere fact that certain conditions are causally sufficient for a result does not entail that the result is an accident. A result happens by accident just in case none of the causes involved in its production is such as to overdetermine it in the way that an intrinsic cause overdetermines its result. Whether a cause has this property depends on what would happen in counterfactual situations in which not all the initial conditions are the same. From the fact that (i) a given cause is part of a set of conditions that are causally sufficient for a given result it does not follow that (ii) a result of this type would not have occurred if that cause had been operating in a different set of conditions. In general, the fact that a given set of conditions is sufficient for a result does not entail that each, or any, of the conditions in the set is necessary for that result. We are entitled to conclude that the thesis of necessity affirmed by the opponents of teleology does not, in Aristotle's view, entail the thesis that he explicitly identifies as the rival to natural teleology—the thesis that the phenomena in question happen by accident. If the thesis of necessity does not entail the rival thesis, it is compatible with the falsity of the rival thesis. Aristotle thinks the falsity of the rival thesis is sufficient for the truth of natural teleology. Therefore, we may conclude that he thinks natural teleology is compatible with the thesis of necessity.

One might well wonder why Aristotle bothers to introduce the thesis of necessity when stating his opponents' objection to teleology in *Ph.* ii 8 if he thinks that the thesis of necessity is compatible with the thesis of natural teleology. But the puzzle is easily solved by noting, as I pointed out in section 1, that the thesis of necessity is only one half of the position he attributes to the opponents. In addition to maintaining that biological organisms develop as the necessitated results of the activities of the material elements (*Ph.* 198b12–14), these opponents also effectively deny that any causes

n. 38), and Lear (36–37). Those who do not think it is a consequence include Charles ("Hypothetical Necessity," 21–23) and Cooper (207–8).

other than these material and efficient causes are involved in the development (198b14–16; cf. *Met.* 984b5–8, 985a10–b3). While the thesis of necessity on its own does not entail the rival thesis that the development in question is accidental, the conjunction of the thesis of necessity with the denial of causes other than the material and efficient does entail the rival thesis. For this denial entails that the allegedly teleological phenomena do not have final causes, and this in turn entails (in Aristotle's view) that they happen by accident (*Ph.* 199a3–5).

4. Teleology and Efficient Causation

In my argument that Aristotle's thesis of natural teleology is compatible with the thesis of necessity, I have interpreted the rival thesis—that the allegedly teleological phenomena happen by accident—as maintaining that there is a defect in the efficient causation of these phenomena.¹⁵ When the opponents claim that it is an accident that animals and plants develop parts that are good for them, they mean that it is an accident that animals and plants develop their characteristic parts. For example, in claiming that it is an accident that an animal's "front teeth come up sharp and suitable for tearing, and the molars come up flat and suitable for grinding food" (*Ph.* 198b24–27), they mean that it is an accident that the animal develops sharp front teeth and flat rear teeth. In general, these opponents oppose Aristotle's thesis of natural teleology by supposing that the characteristic morphogenesis of plants and animals is accidental, that there is no intrinsic efficient cause for the development of their characteristic and beneficial parts.

Many readers of Aristotle would object to this interpretation of the rival thesis precisely because it takes the truth of Aristotle's teleological thesis to depend simply on the truth of an efficient causal claim. The falsity of the rival thesis, as I interpret it, would establish that the parts of animals and plants develop as the result of intrinsic efficient causes. But the distinctive and controversial feature of Aristotle's teleological thesis is the claim that these parts

¹⁵The alleged defect is not, of course, the absence of causal determination, but rather the lack of a particular intrinsic efficient cause.

develop because they are good (*Ph.* 198b17). Surely, an objector will insist, Aristotle cannot establish the latter, teleological, thesis simply by establishing the former efficient-causal thesis. According to this objection, when the opponents claim that the allegedly teleological development is accidental, they do not mean that there is no intrinsic efficient cause of an animal's or plant's characteristic morphogenesis. Rather, they mean simply that this morphogenesis does not happen because it is good.¹⁶

By way of preliminary response to the objection, it is worth noting that Aristotle does clearly attribute to the opponents of natural teleology the denial of intrinsic efficient causal claims. For example, in *De Partibus Animalium* i 1, Aristotle contrasts his thesis that nature is teleological with the view that a parent is only the accidental producer of a child and that a seed is only the accidental producer of the organism that develops from it:

For not just any chance thing (*ho ti etuchen*) comes to be from a particular seed, but rather this from that. Nor does any chance seed (*sperma to tuchon*) come from any chance body, for the seed is the productive principle (*archê ara kai poiêtikon*) of what comes from it. (*PA* 641b26–29)

In *Ph.* ii 8, he explicitly attributes such a view to the only named opponent of natural teleology, Empedocles. Empedocles, he claims, thinks that there can be human-headed offspring from oxen (198b32), denies that animals and plants must develop first from seeds (*spermata*, 199b7–9), and is committed to allowing that olives can grow on grape vines (199b10–13). His general characterization of the view to which Empedocles is committed is “things happen among seeds as chance has it” (*hopôs etuchen*, 199b13–14)—a thesis that he immediately contrasts with his own claim that nature is teleological (199b14–18).¹⁷ So Aristotle explicitly attrib-

¹⁶I take this to be the force of Cooper's remark: “it is essential . . . to notice that the opponents are represented as saying that the organs are *formed* as they are by necessity, but are *good* by coincidence” (208 n. 6; emphasis in original).

¹⁷Similarly in *PA* i 1, Aristotle attributes to Empedocles the view that the formation of a particular backbone is accidental in an efficient causal way, a view he contrasts with his own thesis that the *sperma* from which the

utes to the opponents of natural teleology in *Ph.* ii 8 the denial of an intrinsic efficient causal claim about the development of the parts of animals and plants. He takes these opponents to reject his ubiquitous slogan that “man generates man, and because the parent is so, so is the child” (*PA* 640a25–26; cf. 640b1–4; *Ph.* 193b8, 194b13).

To deny this slogan is not, of course, to deny that necessity is involved in the generation of animals and plants. The sort of necessitation affirmed in the thesis of necessity can obtain even if the sort of overdetermination affirmed in the intrinsic causal claim expressed by the slogan (overdetermination of morphogenesis by the causal powers of parent or seed) does not. Neither, of course, does the denial of the slogan in itself amount to an affirmation of the rival thesis, which denies that there is *any* intrinsic efficient cause of the morphogenesis in question. In denying the slogan, the opponents of teleology thereby deny only that Aristotle’s preferred candidates (the parent and the seed) are the intrinsic efficient causes. Consistent with this denial the opponents may suppose that there is some other intrinsic efficient cause of the morphogenesis—for example, the material elements. Therefore, I have not yet disproved the objector’s proposal that Aristotle takes his opponents to allow that the morphogenesis has an intrinsic efficient cause but deny that it occurs because it is good. But it is still worth noting that Aristotle takes his opponents to deny the intrinsic efficient causal claim expressed by the slogan. For if it turns out that the objector’s proposal is false, and Aristotle does take the truth of an intrinsic efficient causal claim to establish his thesis of natural teleology, then we have good reason to believe that the intrinsic efficient causal claim he thinks is sufficient for the truth of natural teleology is the one expressed by the slogan.

Let us now consider whether the objector is right in assuming that Aristotle thinks his opponents can deny that the species-typical morphogenesis happens because it is good without denying that the morphogenesis has an intrinsic efficient cause. That is, does Aristotle allow that a good outcome (such as flat teeth in the back of the mouth and sharp ones in front) might have an intrinsic

animal develops has a capacity (*dunamis*) for developing into this form (*PA* 640a19–26).

efficient cause, yet still not happen because it is good? If we examine Aristotle's account of chance in *Ph.* ii 4–6, we will see that he does not allow this possibility.

Aristotle nowhere gives an explicit account of what it is for a result to happen because it is good. But his account of chance (*tuchê*) is an account of the conditions in which a good event does not happen because it is good.¹⁸ This account locates chance occurrences (*ta apo tuchês*) unequivocally within the category of accidental occurrences:

Of things that happen, some happen for something while others do not (some of the former happen according to choice while others do not, but both kinds are for something). So it is clear that among things that are neither necessary nor for the most part some admit of being for something. Whatever might be done from thought or from nature is for something. So such things, when they happen by accident, happen by chance, we say. (*Ph.* 196b17–24)

Aristotle here uses “for something” with wider scope than he does outside of *Ph.* ii 4–6. In this wider sense, events are “for something” if they “admit of being for something” (b21).¹⁹ Presumably, these events are good occurrences, and are “for something” in this wider sense because we may legitimately raise the question of whether they happen because they are good. Chance events, Aristotle tells us here, are events of this sort that happen by accident (b23)—which presumably means they do not happen because they are good. If Aristotle thinks that the accidental causal relation distinctive of a chance event is something other than an efficient-causal one, we should expect him to say so when he explains the clause ‘when they happen by accident’ (b23) in this definition of chance. But while Aristotle does proceed immediately to explain this clause of the definition (b24–31), the explanation he offers (b24–29) men-

¹⁸For an alternative view of Aristotle's account of chance, see Lindsay Judson, “Chance and ‘Always or For the Most Part’ in Aristotle” in *Essays on Aristotle's Physics*.

¹⁹“*peri ha endechetai huparchein to heneka tou*” (196b21). At 197b19 Aristotle refers to such events as “*haplôs heneka tou*”; presumably the same point is captured by the optatives in 196b22 and 198a6. On this wider use of ‘for something’ see James Lennox, “Aristotle on Chance,” *Archiv für Geschichte der Philosophie* 66 (1984): 52–60.

tions only accidental efficient causation. Indeed, Aristotle's remark at 196b21–22 (cf. 198a5–7), that events are for something if they happen from thought (*apo dianoias*) or from nature (*apo phuseôs*), indicates that features of an event's efficient causation are sufficient to render it teleological.²⁰

We have seen that Aristotle's general account of chance at 196b17–31 fails to explain the accidental nature of chance occurrences by reference to anything other than efficient causation. The failure is not peculiar to this passage. Later on in the discussion of chance, when Aristotle applies his account of chance to sort out the true from the false in prevalent beliefs about chance, he again claims that chance events happen by accident. And again, the accidental causes he lists in explanation of this claim are all efficient causes or features of efficient causes:

Things do happen by chance—for they happen accidentally, and chance is an accidental cause. For example, the builder is the cause of the house, while the flutist is the cause accidentally. And the causes of someone's going and recovering the money when he did not go for the sake of this are indefinitely many—for wanting to see someone, or going to court, or going to the theater (sc. might be the cause accidentally). (197a12–18)

Finally, at 198a2–4, Aristotle indicates that of the four types (*tropoi*) of causes he distinguishes, chance belongs in the type (*tropos*) of the efficient cause. If we combine this claim with his assertion, in the passage just quoted, that “chance is an accidental cause” (197a13–14), we must conclude that chance occurrences result from accidental efficient causes.

Aristotle's account of chance gives every indication that the accidental causal relation that makes a good event a chance occurrence is an *efficient* causal relation. His theoretical remarks about chance events do not seem to leave open the possibility that there can be an intrinsic efficient cause of a chance outcome. Nor do his examples of chance occurrences provide a counterexample. In none of these examples does the event that does not happen be-

²⁰*Ph.* 198a2–4 indicates that both thought and nature are efficient causes (*hōthen hē archē tēs kinēseôs*). On thought (*dianoia*—here used for *prohairesis*; cf. 197b8) as an efficient cause, see *EN* 1139a31–32.

cause it is good nonetheless have an intrinsic efficient cause. The chance meeting in the marketplace does not occur because of its good result (197a1–2), but it is also true that the meeting occurs by accident. The stool that lands on its feet when it falls (197b16–18) does not land on its feet because this position is suitable for sitting on, but it is also an accident that it lands on its feet. The stone that falls and lands on the head of a passerby does not fall in order to hit him on the head (197b30–32), but it is also an accident that it hits him on the head. The friend who arrives in time to pay the ransom but did not come for that purpose (199b20–22) arrives in time to pay the ransom only accidentally.

In each of these examples of chance, there is something that results from an intrinsic efficient cause. For example, it is not an accident that the stone falls (since this is its nature), and it is not an accident that the friend arrives at the house he intends to visit. But these outcomes are only accidentally related to the chance outcomes. The chance outcome is not the stone's falling, but its hitting someone on the head. It is not by chance that the friend arrives where he does, but that he arrives in time to pay the ransom. These chance outcomes (hitting so and so on the head, arriving in time to pay the ransom) are the good outcomes that do not happen because they are good. But they also lack intrinsic efficient causes. Aristotle's examples of chance occurrences fail to provide an example of chance event that is nonaccidentally produced by an efficient cause.

We have been considering the objection that Aristotle thinks the opponents of natural teleology can allow that the allegedly teleological phenomena have intrinsic efficient causes but simply deny that they happen because they are good. Our examination of Aristotle's discussion of chance does not support the objection. On the contrary, Aristotle's discussion of chance gives every indication that my interpretation of the rival thesis is correct. A result that happens by chance does not have an intrinsic efficient cause. Aristotle does think intrinsic efficient causal claims can be sufficient for the truth of a final causal claim. What makes something happen because it is good, on Aristotle's view, is something about its antecedent efficient causation. It is important to recognize that this result does not conflict with Aristotle's very clear intention to distinguish between efficient causation and final causation (cf. *Ph.* 195a10–11, 198a33–35; *Met.* 983a30–32; *EN* 1139a31–32), or even with his

regular criticism of putative teleological explanations for being merely efficient-causal (*Met.* 984b20–22, 988b8–11). My conclusion is not that something's efficient cause is its final cause; nor is it that anything with an intrinsic efficient cause thereby has or is a final cause. Rather, my conclusion is simply that some intrinsic efficient causal claims are sufficient for the truth of final-causal claims. This conclusion does not violate Aristotle's distinction between final and efficient causation. Still, we might well be puzzled as to how it could be true. However, if we focus on the particular intrinsic efficient causal claims whose denial Aristotle attributes to the opponents of teleology, the view will become less strange.

We have seen that Aristotle attributes to the opponents of natural teleology the denial of a slogan that is ubiquitous in his discussions of teleology: "man generates man, and because the parent is so, so is the child" (*PA* 640a25–27; cf. 640b1–4, *Ph.* 193b8, 194b13). We therefore have good reason to believe that Aristotle thinks the truth of this slogan (or at any rate its generalization to cover all animals and plants) is sufficient for the truth of his thesis of natural teleology. The slogan amounts to the efficient causal claim that an individual organism passes on its species-typical parts to its offspring. Why should Aristotle think that this entails that the offspring has these species-typical parts because they are good? The following scenario would provide a reason. The species-typical parts are good not only for the child but also for the parent. The benefit that the parent receives from such parts is responsible for the fact that it survives to maturity. (Both Aristotle and the opponents agree that survival is the benefit conferred on an organism by its good parts (*Ph.* 198b29–31)). But if the parent had not survived to maturity, it would not have reproduced its species-typical parts in the offspring. So if such parts were not good for a member of the species, they would not have been reproduced in the offspring.²¹ The offspring therefore has such parts because such parts are good.

²¹This is not to say that in the counterfactual case, different parts would be developed by later members of the species, but rather that later members of the species would not have been produced at all. The kind of teleological explanation I sketch does not account for the origins of species, but rather for their continued existence. My proposal, like Cooper's, supposes that the permanence of the species plays a central role in Aristotle's teleology. But unlike Cooper's, my proposal takes this permanence

Of course, Aristotle nowhere explicitly indicates that these are his reasons for thinking that an animal's or plant's parts develop because they are good. He might have a different scenario in mind, or no particular scenario in mind. I sketch this scenario simply to give a concrete illustration of why Aristotle might believe something that we have independent reason to suppose he believes, namely, that intrinsic efficient causal claims can be sufficient for the truth of his thesis of natural teleology. We have already seen that such intrinsic efficient causal claims are compatible with the thesis of necessity. So we may reaffirm our original conclusion that Aristotle's natural teleology is compatible with the thesis of necessity.

5. Accidents and Ontology

One might object to the scenario I have just sketched in elucidation of Aristotle's view on the grounds that it attributes to Aristotle a theory that really belongs to the opponents of teleology. Aristotle, in describing the objections of his opponents, attributes to Empedocles the view that

[w]herever all (the parts of animals) came together [or: turned out, *sunebê*] as if they had come to be for something, these (animals) survived, having been constituted suitably by chance (*apo tou automatou*). But those of whom this is not the case perished and continue to perish—as Empedocles claims human-headed ox progeny do. (198b29–32)

This passage is sometimes interpreted as attributing to Empedocles an evolutionary theory of speciation and natural selection. According to such a view, the benefits of animal parts to ancestors explain why descendants possess such parts.²² However, we have seen that

to be explicable; the reliability of the mechanism that perpetuates the species explains the species' permanence.

²²Such an interpretation is proposed, for example, by W. D. Ross, *Aristotle* (New York: Charles Scribner's Sons, 1924), 78, and criticized by W. Charlton, *Aristotle's Physics I, II* (Oxford: Oxford University Press, Claren-

the position Aristotle attributes to his opponents in *Ph.* ii 8 is incompatible with such a view. These opponents, in claiming that animals develop by accident, deny that parents pass on their species-typical characteristics to their offspring. These are the opponents who claim that “any chance thing” (*to tuchon*) comes from a particular seed or embryo, and that any chance seed or embryo comes from a given individual (*PA* 641b26–29; cf. *Ph.* 199b7–15). Aristotle, not his opponents, is entitled to the preceding account of natural teleology. At this point, however, one might well wonder what motivation Aristotle’s opponents could have for claiming that “any chance thing” comes from a given seed or embryo. Why should they claim that it is an accident that a particular animal or plant undergoes its species-typical morphogenesis? The motivation for such a claim will become clear once we examine the ontological issues at stake in Book Two of the *Physics* and the role played in the resolution of those issues by the dispute over natural teleology in *Ph.* ii 8.

The central issue disputed in *Ph.* ii by Aristotle and his opponents—the Presocratic natural philosophers (*phusiologoi*)—is the question of whether matter alone, or form as well, is nature. This question is disputed as a means to settling the question, raised at the end of *Ph.* i 7, of whether matter or form is substance (*ousia*) (191a19–20). Aristotle and the *phusiologoi* agree, according to *Ph.* ii 1, that anything that has a nature is a substance (192b32–33), and that anything that does not have a nature is not a substance (193a21–26). Their disagreement is over which entities satisfy this criterion for being a substance:

Some say that fire, others that earth, others that air, others that water, others that some of these, others that all of these are the nature of things. For whatever of these someone posits to be of this sort (whether one or more than one), he claims that this and no more than this is all of substance, while all other things are qualities, states or arrangements of these. (193a21–26)

Of the entities that Aristotle lists as natural at the beginning of *Ph.* ii 1 (animals, plants, their parts, and the four elements (192b9–12)),

don Press, 1970), 121–22. See Sorabji (176–81) for a fuller discussion of the evidence against this interpretation of Empedocles’ position.

the *phusiologoi* allow that only the material elements are natural, and hence that only these are substances. Plants and animals, they claim, are merely “qualities, states, or arrangements of these” (193a25–26)—which is to say, according to the ontology of the *Categories*, that plants and animals are accidents of substance: non-basic entities that depend for their existence on substances (*Catg.* 2b5–6), properties that substances acquire and lose when they undergo change (4a10–21). So according to the *phusiologoi* of *Ph.* ii 1, the development of the parts of animals and plants is correctly described as a process whereby certain substances (the material elements) acquire certain accidental properties (qualities and arrangements). This is the contention that Aristotle is concerned to deny in *Ph.* i 7, and that he must deny in order to defend his thesis, in *Ph.* ii 1, that animals and plants are substances rather than accidents of substance.

In *Ph.* ii 1 Aristotle proposes to defend this thesis by establishing that animals and plants are natural. His strategy is presumably to show that the change whereby the animal comes into being is natural; for this is the change that appears to support his opponents’ contention that the animal is an accident of some other substances (the material elements) and not a substance in its own right. It is beyond the scope of the present paper to assess the merits of this strategy. For our present purpose, which is to explain why Aristotle should attribute to the opponents of teleology in *Ph.* ii 8 the thesis that animals and plants develop by accident, it will be sufficient to show how this thesis entails that animals and plants do not come to be by nature and thereby supports the contention that Aristotle attributes to the *phusiologoi*: that animals and plants are not substances.²³

It is clear that Aristotle thinks that the dispute over teleology in *Ph.* ii 8 captures the dispute about nature in *Ph.* ii 1. The issue, as articulated in *Ph.* ii 8, is whether the parts of animals and plants develop for something, or rather by chance. In *Ph.* ii 5, as we have seen, he claims that a chance outcome is one that (a) would have

²³Waterlow (48–56) also explores the ontological issues at stake in *Ph.* ii 8. She argues, however, that Aristotle defends his candidates for substance by denying the thesis of necessity (68–70). Lear (25) also discusses the ontological implications of the dispute over teleology.

been for something if it had happened by nature or by thought, but (b) in fact happened neither by nature nor by thought but by accident (196b17–31; cf. 198a5–7). Neither Aristotle nor his opponents think that the parts of animals develop by thought. So Aristotle must understand the issue articulated in *Ph.* ii 8—whether these parts develop by chance—as the issue of whether the parts of animals and plants develop by nature. The opponents of teleology, he thinks, deny that these parts develop by nature and hence deny that animals and plants exist by nature.

But precisely how does the rival thesis as it is articulated in *Ph.* ii 8—the thesis that the parts of animals and plants develop by accident—entail the opponents’ contention in *Ph.* ii 1: that animals and plants do not exist by nature? Aristotle’s account of nature in *Ph.* ii 1 shows that the entailment is quite straightforward. According to Aristotle, a nature (*phusis*) is an “origin of change” (*archê kinêseôs*), and something has a nature (or is “by nature”—*phusei*) if it has in itself an origin of change to which it is subject (*Ph.* 192b12–23). Such an “origin” must be in the natural entity nonaccidentally, Aristotle insists (b22–23), and he explains this claim in detail:

I mean by “not accidentally” that someone who is a doctor might be responsible for his own health, but he does not have the art of medicine in the respect (*katho*) in which he is cured, for it is an accident that the same person is a doctor and a patient—which is why these are sometimes separate from each other. And similarly in the case of the other things that are made. None of them has in itself the origin of (its own) production. In some cases the origin is in something else and external—as in the case of a house and the other products of craft. Others have the origin in themselves, but not intrinsically, so they are accidentally the causes for themselves. (*Ph.* 192b23–32)

The final sentence of this passage indicates that a natural entity is the cause nonaccidentally of its own change. This passage also makes it clear that the “origin of change” that must be internal to a natural entity is an origin of production (*archê . . . tês poiêseôs*, b28–29), which is the mark of an efficient cause, the sort of cause Aristotle defines as

that from which the primary origin of change or of rest is (*hothen hê archê tês metabolês hê prôtê . . .*). For example the advisor is a cause in this way, and the father is of the child and in general the maker of the

thing made (*to poioun tou poioumenou*) and the changer of the thing changed. (*Ph.* 194b29–32)

So, on Aristotle's view, something that has a nature (*archê tês kinêseôs*) is the efficient cause (*hothen hê archê tês kinêseôs*) nonaccidentally of its own natural changes. This entails that a change that occurs by nature has an intrinsic efficient cause, and hence does not happen by accident. For example, if an animal's teeth come up flat in the back and sharp in front by nature, then these teeth do not develop in this way by accident. But if they do develop by accident, as the opponents of teleology claim in *Ph.* ii 8, then their development is not by nature.

Since a process of development occurs by nature only if it does not occur by accident, the rival thesis in *Ph.* ii 8, which claims that the development of plants and animals is accidental, entails the opponents' contention in *Ph.* ii 1: that animals and plants are not by nature. According to these opponents, the only nature operating in the development of plants and animals is material nature—the nature of the material elements. This nature, while sufficient to causally determine these processes of development, is only their accidental cause.

We may conclude that Aristotle fairly articulates his dispute with the opponents of natural teleology when he attributes to them in *Ph.* ii 8 the view that animals and plants develop by accident. And we have already established that, so articulated, the dispute over natural teleology is not a dispute over the thesis of necessity.

6. The Standard Incompatibilist Argument

I have now completed my positive argument that Aristotle's thesis of natural teleology is compatible with the thesis of necessity. In the course of that argument I have not addressed directly the standard argument for the incompatibility of these two theses. The preceding discussion has, however, provided us with the tools to assess the plausibility of that argument. We are now in a position to see not only that the argument fails, but also that it has misidentified the nature of the dispute between Aristotle and the opponents of teleology. Let us first consider the argument.

The standard argument that Aristotle's teleology is incompatible with the thesis of necessity (henceforth "the standard incompatibilist argument") rests on an interpretation of Aristotle's often repeated denial that matter is the cause (*aition*) of a teleologically explicable result. He makes such denials in the course of his discussion of hypothetical necessity—a kind of necessity he claims is consequent upon natural teleology (*Ph.* 200a6, 9, 33–34; cf. *GA* 778b5–6, 789b6–7). He also makes such denials in passages such as *De Anima* 416a9–18 and *De Generatione Animalium* 734b27–735a4. In the former passage, Aristotle denies that fire or its nature is the cause (*aitia* or *aition*) of organic growth and nutrition (*DA* 416a10, 13–15). In the latter passage, he denies that heat and cold (the properties of the material elements fire and earth) make (*poiein*) the parts of animals (*GA* 734b31–34), which is to deny that these material elements are the efficient cause—the *aition* that Aristotle identifies as the maker (*poioun*, *Ph.* 194b31). The standard incompatibilist argument assumes that the thesis of necessity entails the truth of the causal claims that Aristotle in these passages denies.²⁴ But we are in a position to see that this interpretation is not sound, for such denials are denials of intrinsic causal claims, and the thesis of necessity does not entail the truth of such claims.

Our examination of Aristotle's views about the accidental has shown us that Aristotle distinguishes two types of cause or *aition*—accidental (*kata sumbebêkos*) and intrinsic (*kath' hautō*) ones. Although he indicates that all four of his causes (*aitia*) are things "because of which" (*di' ho*, *Ph.* 194b16–20, 198a14–21; *Met.* 983a28–29), he regularly restricts this claim to apply only to intrinsic causes. A result does not happen because of (*dia*) its accidental cause (*APst.* 73b10–16; *Ph.* 255b24–27; *Met.* 1025a25–27). And only the intrinsic cause is a cause properly speaking (*oikeiōs legomenon*, *Ph.* 195b3–4). Therefore, when Aristotle denies that one thing is the cause (*aition*) of another, he need only be denying that the former is the intrinsic cause of the latter; such denials can be true even if the former is the accidental cause of the latter. This is precisely what he is doing in the passages to which the standard incompatibilist argument appeals.

²⁴For example, Cooper offers such an interpretation of the claims made in connection with hypothetical necessity in *Ph.* ii 9. Gotthelf offers such an interpretation of the claims made in *DA* 416a9–18 and *GA* 734b28–735a3.

In his discussion of hypothetical necessity in *Ph.* ii 9, Aristotle does not explicitly restrict his denial that matter is the cause to apply only to intrinsic causation. However, I can think of no place in the Aristotelian corpus where Aristotle denies that one thing is caused by, or because of, another where he means to deny that even an accidental causal relation obtains.²⁵ There is therefore some presumption that his denials in *Ph.* ii 9 are simply denials of intrinsic causation. In *DA* 416a9–18 and *GA* 734b27–735a4, Aristotle provides independent evidence that his denials of causation are to be interpreted in this way.

In *DA* 416a9–18, Aristotle's precise claim is that fire is not the cause *haplôs* (without qualification) of nutrition and growth (416a10, 14). The "cause *haplôs*" is one of Aristotle's ways of referring to the intrinsic (*kath' hauto*) cause—as for example at *Ph.* 197a11–14 where he infers from the fact that chance is an accidental cause to the conclusion that it is a cause in a way, but not *haplôs* (cf. *Met.* 1027a5).²⁶ So all Aristotle claims in this passage is that fire is not the intrinsic cause of nutrition and growth. In *GA* 734b27–735a4, Aristotle denies that fire and earth "make" or "produce" (*poiein*) the parts of animals, but at *Met.* 1027a2–5, he indicates that *poiein* applies without qualification (*haplôs*) only to the activity of the intrinsic efficient cause. He says there that there is a sense in which the fancy cook, who is the accidental cause of the healthy food, "produces" the healthy food (*estin hôs poiei*) but that he does not do so without qualification (*haplôs d'ou*). So in denying that material elements produce (*poiein*) the parts of animals, all Aristotle need be denying is that fire and earth are the intrinsic causes of these parts. Aristotle's positive claim in this passage clearly cites intrinsic efficient causes of the parts. He says that what really "produces" these parts is the change proceeding from the parent in the way the artisan's skill produces the sword (734b35–735a4). The relation between an artisan and his product is Aristo-

²⁵Consider, for example, Aristotle's claim in the *Poetics* that a good tragic plot must have a beginning (*archê*) that does not necessarily result from what went before (1450b27–28). The context indicates that the "of necessity" he has in mind is the "of necessity" of intrinsic causation. (I thank Myles Burnyeat for suggesting this illustration.)

²⁶On the use of *haplôs* for *kath' hauto*, see *EN* 1151b2–3.

tle's favorite example of intrinsic efficient causation.²⁷ So we have reason to believe that in this passage, as in *DA* 416a9–18, Aristotle simply denies that the material elements are the intrinsic causes of the biological phenomena under consideration.

Aristotle's denials that material elements cause teleological phenomena are denials that the material elements are the intrinsic causes of these phenomena. The standard incompatibilist argument interprets these denials of intrinsic causation as denials of the sort of causal sufficiency entailed by the thesis of necessity. This interpretation is correct only if the fact that material interactions are sufficient for a result entails that material elements are the intrinsic causes of that result. But, as I pointed out in section 3, the claim about intrinsic causation does not follow from the claim about antecedent causal sufficiency.

Aristotle's notion of intrinsic efficient causation does not license the inference from the fact that a particular spatiotemporal collection of material elements is sufficient for the occurrence of a result to the conclusion that there is an intrinsic cause of that result, let alone that material elements are the intrinsic cause. A result that is intrinsically caused is not an accident, and has been overdetermined in the way described in section 3. But the thesis of necessity entails only that biological phenomena are causally determined by matter. And it does not follow from the fact that a given result is causally determined that it is overdetermined in the way it would be if it had an intrinsic cause. A good illustration of the gap between causal sufficiency and intrinsic causation in Aristotle's view is his paradigmatic example of an accident: the meeting in the marketplace between borrower and lender. The respective activities of the borrower and lender, together with the conditions in which they act, are sufficient for the occurrence of the meeting between borrower and lender; however, the meeting is, on Aristotle's view, still an accident, and hence has no intrinsic cause. In spite of the fact that there are antecedent conditions sufficient for the meeting, Aristotle is not prepared to claim that any of these con-

²⁷For example, *Ph.* 195a33–34, 196b26; *Met.* 1026b37–1027a5; cf. *PA* 640a27–33.

ditions, or even their totality, is an intrinsic cause of the meeting.²⁸ Since Aristotle's various denials that matter is the cause of teleological phenomena are simply denials of intrinsic causation, we can conclude that these denials do not conflict with the thesis of necessity. The incompatibilist argument to the contrary mistakes Aristotle's denials of intrinsic causation for denials of causal sufficiency.

7. Teleology, Reductionism, and Eliminativism

A proper understanding of the thesis that Aristotle explicitly identifies as the rival to natural teleology has allowed us to see why Aristotle's natural teleology is compatible with the thesis of necessity, and why the standard argument to the contrary fails. A proper understanding of the rival thesis will also show us that a common interpretation of the philosophical issue at stake in Aristotle's defense of natural teleology is mistaken. The rival thesis against which Aristotle defends natural teleology is not reductionism but a variety of eliminativism.

It is generally agreed among contemporary interpreters of Aristotle that his defense of natural teleology is a defense of the thesis that formal properties must be invoked in order to explain the behavior of natural organisms.²⁹ This agreement is well founded,

²⁸An objector might agree that the thesis of necessity does not entail that (a) some subset of the material sufficient conditions is the intrinsic cause of the result, but still maintain that (b) the complete spatiotemporal collection of material conditions sufficient for that result would be its intrinsic cause. In this connection it is significant to note that, in *DA* 416a9–18 and *GA* 734b28–735a3, Aristotle considers only intrinsic causal claims of the former sort. One might think that the latter sort of claim is true, on the grounds that such a sufficient condition “always or for the most part” results in the biological phenomenon in question. Although Aristotle does not explicitly argue against such a claim, he clearly thinks it is false; and he has the resources to explain why it is false. He can, for example, appeal to his requirements that (a) an effect must be because of (*dia* + accusative) its intrinsic cause (*APst.* 73b10–16), and that (b) if A is because of B, then if B had not occurred A would not have occurred either (*APst.* 78b15–23). It does not follow from the fact that a given set of material conditions is sufficient for the development of certain animal parts that that set of conditions is necessary for that development.

²⁹This is agreed upon by most contemporary interpreters—for exam-

for Aristotle's defense of the thesis that nature is "for something" in *Ph.* ii 8 is clearly intended to be part of his strategy for establishing the thesis of *Ph.* ii 1: that an organism's form is more its nature than its matter is. The opponents against whom he defends the latter thesis are the same opponents against whose objections Aristotle defends the thesis of natural teleology in *Ph.* ii 8. It is therefore reasonable to construe the debate over natural teleology in *Ph.* ii 8 as part of a debate over whether formal properties (such as biological capacities) need be invoked in explanations, or whether on the other hand only material properties (the properties of the material elements) need be invoked.

It is also generally supposed that the opponents against whom Aristotle defends the thesis of natural teleology (and thereby defends the necessity of invoking formal properties in explanations) are offering to explain, with reference solely to material properties, everything that Aristotle thinks formal properties must be invoked to explain. This conception of the opponents' position construes Aristotle's defense of natural teleology as an argument against a certain kind of *reductionism*—a proposal that higher-order explanations, such as those that invoke biological properties, can be replaced by explanations that invoke more basic material properties. This conception of the opponents' position is shared by commentators who disagree over whether Aristotle's teleology is compatible with the thesis of necessity.³⁰ But this conception of the opponents' position, and hence of the philosophical issue at stake in Aristotle's defense of natural teleology, is mistaken.

Even though Aristotle's defense of natural teleology commits him to the rejection of the reductionist thesis generally attributed to his opponents, it does not follow from this that he attributes the reductionist thesis to his opponents; for the reductionist thesis is

ple, Cooper (198–210), Gotthelf (212), Charles, "Hypothetical Necessity" (1), and Nussbaum (67–74).

³⁰The view that Aristotle takes his opponents to be offering material explanations of allegedly teleological phenomena is shared by Cooper (205–8), Waterlow (67), Lear (38), Gotthelf (222), Nussbaum (67–68), and Charles, "Hypothetical Necessity" (1–5). Gotthelf, Nussbaum, and Charles explicitly identify the disputed thesis as a thesis of reductionism. Charles articulates the interpretive dispute as a dispute over whether reductionism is entailed by the thesis of necessity, and argues that the latter does not entail the former.

not the only way in which one might object to Aristotle's thesis that formal properties must be invoked in explanations. Certainly one way to deny Aristotle's thesis is to claim that material properties can explain everything that formal properties are supposed to explain. To do this is to affirm the reductive thesis generally attributed to Aristotle's opponents. But another way to deny Aristotle's thesis is to claim that nothing explains the phenomena that formal properties are supposed to explain. This second alternative, while sufficient to preclude the necessity of invoking formal properties in explanations, entails the falsity of the reductionist thesis. For if nothing explains a phenomenon, material properties certainly do not explain it.

The objection against which Aristotle actually defends natural teleology in his official argument for natural teleology in *Ph.* ii 8 is clearly a version of this second alternative. To see this, we need only note that the sorts of explanation whose necessity Aristotle defends and whose necessity the opponents of natural teleology deny are explanations in terms of intrinsic causes, not merely accidental causes. The only explanations of concern to science (*epistēmē*), Aristotle routinely insists, are explanations that state intrinsic, not accidental, causes.³¹ To deny that something has an intrinsic cause is therefore to deny that it has an explanation. The thesis that Aristotle identifies as the rival to natural teleology is, we have seen, the thesis that animals and plants develop their species-typical parts by accident. This means that there is no intrinsic cause for the development of such parts, and therefore that nothing explains it. It is a consequence of this thesis that the causal powers of the material elements do not explain the development of such parts. Therefore the opponents against whose objections Aristotle defends the thesis of natural teleology in *Ph.* ii 8 do not espouse the reductionist thesis generally attributed to them. Those who interpret these opponents as reductionists construe the rival thesis, that the parts develop by accident, as a *proposed explanation* of the de-

³¹*APst.* 71b9–12, 87b19–27; *Met.* 1026b4–5; cf. *EE* 1221b3–6. Sorabji (10–12) brings out well the explanatory aspect of intrinsic causal relations, although his suggestion that explanation is relative to the needs of a questioner is at odds with the objectivity of the intrinsic causal relation.

velopment that Aristotle rejects as inadequate.³² But such a construal misses the point of the opponents' claim that the parts develop by accident. The point is to deny that there is any explanation of the development. One can hardly take such opponents to task for failing to provide an adequate explanation of the development.

One might object that Aristotle's opponents—Democritus, Empedocles, and Anaxagoras—do in fact offer materialist explanations of the phenomena that Aristotle thinks must be explained teleologically. For they claim that these phenomena result of necessity from the activities of the material elements, and such claims amount to proposed explanations. In response, it must be conceded that there is an intuitive and familiar conception of explanation according to which the objector's claim is true. On this conception of explanation, to identify the conditions sufficient for a phenomenon is to explain it. But this conception of explanation is not Aristotle's, and the question at issue is not how *we* might characterize the views of the thinkers whom Aristotle identifies as the opponents to his teleological thesis. The question is how Aristotle conceives their objection to natural teleology. In Aristotle's view, a genuine explanation cites an intrinsic cause. And he goes to some trouble to point out, in the passages the standard incompatibilist argument tends to cite, that the materialists' proposals fail to satisfy his conditions for intrinsic causation. In such contexts, Aristotle is clearly concerned to point out that the thesis of necessity does not entail the kind of reductionism that would make otiose his own appeals to formal causes such as the soul. And one might suppose, on the basis of such passages, that he attributes such reductionism to the opponents of natural teleology. But this supposition is proved false by an examination of the chapter (*Ph.* ii 8) in which Aristotle actually articulates the rival thesis to natural teleology. There, we have seen, he attributes to his opponents the view that the apparently teleological processes happen by accident; and this is to attribute to them a view that entails the falsity of the reductionist thesis.

³²This construal is common to both incompatibilist and compatibilist interpreters of Aristotle's teleology—for example, Cooper (207–8), Charles, "Hypothetical Necessity" (23), and Nussbaum (79 n. 22).

It is true that Aristotle's thesis of natural teleology commits him to the rejection of the reductionist thesis that is usually attributed to his opponents. And in fact we have seen, in examining why the standard incompatibilist argument fails, that Aristotle can respond successfully to such a thesis without rejecting the thesis of necessity.³³ But in order to identify the philosophical issue at stake in the dialectical context in which Aristotle actually argues for his thesis of natural teleology, we need to identify the thesis that Aristotle himself takes to be the rival to the thesis of natural teleology. Having done so, we must conclude that the issue at stake is not the truth of reductionism. Aristotle's dispute with these opponents is not over whether matter explains biological phenomena. The parties to the dispute take it for granted that this reductionist thesis is false; they disagree over whether something other than the material elements explains the phenomena in question.

It is important to recognize that although Aristotle's opponents admit that their own thesis of necessity cannot explain the development of animals and plants, they do not thereby admit the thesis of necessity to be incomplete or inadequate as a scientific theory. In claiming that such development is accidental, Aristotle's opponents relegate it to a category of entity beyond the scope of science, for science does not deal with the accidental (*APst.* 87b19–22; *Met.* 1026b4–5). This is not to admit that the development is due to supernatural causes, for they can specify material causes sufficient for its occurrence. Rather, it is to claim that if we consider the development of an animal (or plant) to be something other than the simple conjunction of independent activities of the material elements, there really isn't anything there to explain. This is why Aristotle says that accidents are close to nonbeing (*Met.* 1026b14–15); they do not exist or occur in their own right, but only insofar as something else exists or occurs (1025a28–29). Consider, for example, the accidental meeting between borrower and lender described in *Ph.* ii 5. We can explain why each of the constituent

³³Incompatibilist interpreters typically claim (correctly) that Aristotle denies that material elements explain (or “account for”) teleological results, but incorrectly take mere causal sufficiency to be sufficient for the sort of explanatory relation Aristotle denies. The latter presupposition is explicit in Gotthelf's account (211) and appears to be implicit in Cooper, Lear, and Waterlow.

conditions sufficient for the meeting occurred, but beyond this, there is nothing more that can be explained. To insist on an explanation of the meeting in addition to this account of its sufficient conditions reflects mere superstition, the conviction that the meeting was not an accident. Aristotle's opponents claim that the development of animals and plants is like this accidental meeting. There is nothing there to explain beyond the activities of the material elements that collectively necessitate this development. It is mere superstition, they claim, to insist that there must be some other explanation for the development considered as such.

By claiming that the development of the parts of plants and animals is accidental and hence inexplicable, Aristotle's opponents impugn not the explanatory power of their own physical theory, but the ontological credentials of plants and animals. The opponents' thesis that plants and animals develop by accident entails that plants and animals do not come to be by nature. According to the criterion for substantiality articulated in *Ph.* ii 1, this in turn entails that animals and plants are not substances (*ousiai*). This consequence is precisely the ontological thesis defended by Aristotle's opponents in *Ph.* ii 1. This thesis is a form of eliminativism, for it proposes to eliminate from the ontological category of substance all entities other than the material elements (*Ph.* 193a21–25). To be sure, Aristotle's opponents do not deny that animals and plants exist, for they claim that they are “qualities, states, and arrangements” of the material elements (193a25–26). But they do deny that animals and plants exist in their own rights—as substances—and to deny this is to impugn seriously the ontological credentials of plants and animals. Properly understood, the objection to natural teleology introduced in *Ph.* ii 8 supports the revisionary ontological proposal of Aristotle's opponents. We may therefore conclude that the philosophical issue at stake in Aristotle's defense of natural teleology is not reductionism, but a variety of eliminativism: the ontological thesis that the material elements are “all of substance” (*tên hapasan ousian*, *Ph.* 193b24–25).

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