

CHAPTER 3

Are facts about matter primitive?

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In his biological treatises, Aristotle often appeals to some feature of an organism's body in order to explain why it has some other attribute. For example, in *Generation of Animals* II.I Aristotle appeals to variations in degrees of heat, dryness, and fluidity to explain variations in modes of reproduction – why some animals are livebearers and others are egg-producers. He says that some animals produce “complete” offspring because they are hotter (*thermotera*) and more fluid (*hugrotera*) (732b31–32), whereas other animals produce only “incomplete” eggs since they are either colder (*psychotera*) and more fluid, or hotter but drier (*xêrotera*) (733a4–6). In such contexts, Aristotle treats those bodily features as the primary *explanantia* of the relevant *explananda*.

That Aristotle treats certain bodily features – what I will call “facts about matter”¹ – as *explanantia* in particular explanatory contexts is relatively uncontroversial. Recently, however, scholars have been claiming not only that Aristotle uses such facts about matter as *explanantia* in particular explanatory contexts, but also that Aristotle considers those facts to be unexplained.² A kind's possession of a certain bodily constitution, for

¹ I have some reservations about calling these facts about *matter*, since I do not think that all of Aristotle's references to elemental forces such as heat and cold are references to the matter of a living organism, if this is understood as that “out of which” its body parts are formed (as, e.g., Ebrey understands it in this volume). I will overlook this for the purposes of this discussion, however. Following those scholars whose claims I am disputing, I will call such features as heat and cold “material” features.

² For instance, D. Charles claims that Aristotle “takes as basic” (2000: 334) and treats as “brute physical facts” (*ibid.*: 335) the differences in degrees of heat and fluidity in fish. According to J. Lennox, there are “certain material facts about certain kinds of animals that are as *explanatorily primitive* as are other facts about their living functions” (2001c: 183), and that, in particular, “the amount and kind of elementally distinct materials available in the nutritional make-up of animals is taken as a given” (*ibid.*: 186). A. Gotthelf claims that the fact that lunged organisms have a high degree of heat is, for Aristotle, “*explanatorily fundamental*” and not “explained in terms of anything more basic about these animals” (1985: 54, n. 24). In the same vein, D. Henry (2008: 59) and M. Leunissen (2010: 97) speak of an organism's material nature making contributions “independently” of the actions of its formal nature. I gather that their thought is that the material nature of a kind not only makes

instance, is said to be “explanatorily primitive” in that (1) the bodily constitution is appealed to in explaining other features of the kind and (2) there is no explanation for why the kind has that particular bodily constitution.³

Not every attribute that functions as a starting point in some particular explanatory context is an unexplained or primitive one, of course. For example, we might appeal to the nature of iron to explain why axe blades rust. But that does not entail that it is a primitive fact – one that is not itself explained – that axe blades are made of iron. So, the fact that Aristotle appeals to bodily features (such as temperature or humidity) to explain why a kind of organism has some other attribute (such as its mode of reproduction) does not alone entail that he considers the possession of those bodily features to be primitive. Yet, if Aristotle thinks there is an explanation for the presence of those bodily features, one would hope that he would indicate what that is. And in these specific cases, he does not. Given Aristotle’s silence, it is reasonable to conclude that these facts are indeed primitive.

It would be problematic, however, if this were Aristotle’s view. First, the idea that facts about matter are “as explanatorily primitive” as facts about soul would constitute a radical departure from views that Aristotle expresses elsewhere. There is some consensus, at any rate, that Aristotle considers explanatory primitiveness – that is, something’s explaining other facts but not itself being explained by anything else – to be a guide to essence.⁴ However, if an organism’s matter were part of its essence, this would be in tension with Aristotle’s claim in *de Anima* that soul, not body, is an organism’s essence.⁵

Second, the idea that facts about a kind’s matter or bodily features are “on the same level”⁶ as facts about its form or soul conflicts with the

positive contributions, but that these contributions are completely “independent” of form in the sense that the presence of the matter is not explained or caused by form. If the form explained why that matter is present, matter would not be contributing independently, but rather would be dependent on form.

³ See D. Henry (2013: esp. 238–39 and n. 25) for a clear statement of this view.

⁴ The connection between explanatory primitiveness and essence is, for example, the subject of the investigation in Charles (2000). As Gotthelf puts the idea, unexplained features are “prime candidates for being part of the essence of the animal in question” (1985: 29). This same assumption is implicit in phrases such as “explanatorily fundamental and thus parts of the *ousia*” (*ibid.*: 53, n. 20) and “explanatorily basic and thus essential” (Gotthelf 1997 [2012]: 86). See also Lennox (2001c: 202): “If Aristotle is inclined to decide what is in the account of a thing’s being on the basis of explanatory primitiveness, and if he is willing, in natural science, to include matter in definitions, then we could expect that being blooded or being bloodless would indeed be in the substantial being of animals identified at a sufficiently general level.”

⁵ *DA* 11.1, 412b11–13; *DA* 11.4, 415b8–12.

⁶ Charles (2000: 340): “Degrees of heat are taken as explanatory givens on the same level as soul functions, pattern of movement, or being a land animal.”

programmatic remarks Aristotle makes within his biological treatises. On the basis of the introductory book of *Parts of Animals*, for example, it is natural to suppose that facts about a kind's matter are going to be explained by facts about the kind's soul:

Since every instrument is for the sake of something, and each of the parts of the body is for the sake of something, and that for whose sake they are is some activity, it is clear that the composite body, too, is constituted for the sake of some complex activity. For, sawing has not come to be for the sake of the saw, but the saw for the sake of sawing; for sawing is a certain use. So, also, the body is in a way for the sake of the soul, and the parts for the sake of the functions for which each has naturally developed. (*PA* 1.5, 645b14–20)⁷

Rather than indicating that facts about a kind's body or matter are primitive, Aristotle appears to say that facts about a kind's body depend on facts about the kind's soul: The body as a whole, as well as each of the parts of the body, naturally develop for the sake of the psychic functions they are used to perform. So, one expects that in the biological explanations that follow, facts about the form or soul – an organism's psychic capacities and functions – will have explanatory priority over facts about its body. But according to several scholars, this is not what we find.

In response to this, we might simply give up hope of finding consistency between Aristotle's theoretical commitments, as traditionally understood, and his scientific practices. We might conclude that the results of empirical research led to the demise of Aristotle's "brilliant research programme."⁸ However, I do not think we need to conclude this. Instead, I here offer three reasons to doubt that Aristotle treats facts about matter – in particular, facts about degrees of heat, dryness, fluidity, etc. – as explanatorily primitive.

First, there is evidence that those putative unexplained facts about degrees of heat, dryness, fluidity, etc. are, in fact, explained. Second, there are certain cases, such as human intelligence, where Aristotle seems to think there is a causal explanation proceeding from facts about matter, but which we have good reason to doubt are intended as proceeding from a primitive fact. Third, the idea that facts about matter are as explanatorily primitive as facts about form requires a particular conception of the causal processes that the explanations mirror. But this conception of the causal

⁷ Cf. *PA* 1.1, 642a9–13:

For, just as it is necessary that an axe be hard, since it needs to cleave, and if hard, made of bronze or iron, so also – since the body is an instrument (for, each of the parts is for the sake of something, and so likewise the whole) – it must be like *this* and made out of *these* materials, if that [for the sake of which they are] is to be.

⁸ Charles (2000: 336).

processes conflicts with the way Aristotle characterizes them. In *Generation of Animals*, for example, heat is not treated as a causal factor that works “independently” of soul, but is subservient to soul. In my view, these three considerations provide compelling reason to reject the claim that Aristotle’s biology treats facts about matter as primitive.

Hot, cold, earthy, and fluid natures

When Aristotle talks about a type of organism’s matter, he is sometimes talking about its body, in contrast to its soul. Other times, he describes the parts of which the whole body is composed as the matter. Those body parts, moreover, are discussed at three levels of generality. There are the “non-uniform” parts, such as limbs and organs, the “uniform” parts, such as flesh and bone that the limbs and organs are made out of, and the elemental potentials that make up the latter. For instance, at the beginning of *GA* Aristotle puts the point as follows:

... and the matter in animals is the parts, the non-uniform parts [are the matter] for every whole [animal], the uniform parts [are the matter] for the non-uniform, and the so-called elements of the bodies [are the matter] for these. (*GA* I.1, 715a9–11)⁹

Not only the body as a whole, but also the non-uniform limbs and organs, the tissues, bone, and other uniform parts those are made of, and the elemental bodies (or, more precisely, the elemental powers) are considered by Aristotle to be an organism’s matter. Here I will focus on matter at that lowest level, the bodily blend or *krasis* of elemental powers in an organism’s blood (or the analogous substance in non-blooded organisms). I will focus on matter at this level because it is the strongest candidate for being a primitive fact about matter. For, as the lowest level of composition, the elemental powers are the matter out of which the primary uniform part, blood (or the analogous substance in bloodless animals), is composed. Since blood is constituted by a particular combination of elemental powers, differences in blood are due to differences in the proportions of the elemental powers composing it, that is, by its *krasis*. For instance, blood can be more fluid

⁹ Cf. *PA* II.1, 646a12–24 (Lennox trans.):

Since there are three compositions, one might put first composition from what some people call the elements, e.g., earth, air, water, and fire. And yet, perhaps it is better to speak of composition from the potentials. . . . That is, moist, dry, hot, and cold are the matter of the composite bodies. . . . Second is the composition of the nature of the uniform parts within the animal – e.g., of bone, flesh, and the other things of this sort – out of the primary things. Third and last in the series is the composition of the nature of the non-uniform parts – e.g., of face, hand, and such parts.

or more solid, hotter or less hot, depending on its proportion of elemental powers. Blood, moreover, is the matter and nourishment for the rest of the parts,¹⁰ and thus blood (or the analogous uniform part in bloodless organisms) is said to be the cause of many other features.

The nature of the blood is the cause of many features of animals with respect to both character and perception, as is reasonable, since blood is the matter of the entire body; for nourishment is matter, and blood is the last stage of nourishment. It therefore makes a great difference whether it is hot or cold, thin or thick, turbid or pure. (*PA* II.4, 651a12–17)

In Aristotle's view, characteristics such as the "heaviness, lightness, density, rarity, roughness, and smoothness" of parts and limbs (*PA* II.1, 646a18–20) "follow from" the particular *krasis* that makes up the blood and so determines its quality. More earthy blood will give rise to parts that are, for instance, rougher rather than smooth.¹¹ In addition, *krasis* of blood is correlated with character traits (*ethê*). For example, Aristotle says that timid animals have excessively watery blood, whereas organisms with more earthy blood are more passionate (*PA* II.4, 650b27 ff). Further, there is some indication that Aristotle thinks *krasis* determines what kind of food an organism eats, or at least what it finds pleasant (*HA* VII[VIII].2, 589a8–9; 590a10–11).¹²

A kind's *krasis*, then, is identified by Aristotle as a cause of many other attributes of the kind. Characteristics such as skin texture, aspects of the kind's character, and phenomena constitutive of the kind's life (such as its mode of reproduction) all appear to be due to the particular *krasis* of blood that organisms of that kind have. Is a kind's possession of a particular *krasis* of blood a primitive, unexplained fact about the kind?

If one accepts the following principle, the answer is no:

P: If X is said to be present for the sake of Y, then X's presence is explained by Y.

Aristotle's views about explanation are complex, but I think it is safe to assume that he thinks that one explains why something is the case by citing causes. And, famously, Aristotle recognizes "that for the sake of which" as a type of cause. Given this, it follows that to cite the purpose for which

¹⁰ *PA* II.3, 650b2–3, b12–13: "It is, then, apparent from these and like considerations that blood is present in blooded animals for the sake of nourishment . . . blood is for the sake of nourishment, i.e. the nourishment of the parts."

¹¹ See *PA* II.9, 655a26–28 with IV.13, 697a7–9 on the selachian's rough skin.

¹² See also the various remarks about the connection between *krasis* and an organism's way of life in VII[VIII].2.

something is the case is, for Aristotle, to render that thing at least partially explained.¹³

Assuming that Aristotle is committed to P, then the discussion of the levels of composition in *PA* II.I is evidence that a kind's *krasis* of blood is not, for Aristotle, explanatorily primitive. For, Aristotle explicitly says there that a kind's *krasis* is for the sake of something.

Thus the matter of the elements is necessary for the sake of the uniform parts, since these are later in generation than the elements, and later than the uniform parts are the non-uniform parts. (*PA* II.I, 646b5–8 (Lennox trans.))

Let me state very briefly what I take Aristotle to be saying in the surrounding context. The highest of the three levels of material composition of living bodies – the instrumental, non-uniform parts such as eyes and hands – have functions. And it is for the sake of performing those functions that they are present in an organism. For instance, birds have wings because they are flyers, since wings are the instruments required for flying (*PA* IV.I2, 693b11–13). And sensory organs are present because they are required for performing perceptual activities. Flesh, for instance, is the organ of the primary sense – touch – that animals must have since they are by definition *perceptive* living things (*PA* II.8, 653b22–24).¹⁴

Most variations,¹⁵ such as variations in size or quality of the instrumental parts and sensory organs, are explained by the functional needs of the particular kind of organism.¹⁶ For instance, some birds (such as the carnivores

¹³ I say “at least partially” because Aristotle says at *APo.* II.II, 942a0–27 that one should give demonstrations “through” each of the four causes to fully explain something. I cannot address here the complicated issues about Aristotle’s conception of explanation. It is sufficient for my purposes to note that there is a difference between cases in which there is a demonstration through some cause or other, and cases in which there simply is no cause to cite and so no demonstration to give, for example, in the case of indemonstrable statements of essence. There will be material and efficient causal explanations of *how* organisms perform the activities constitutive of their essence, of course, but that does not render the fact *that* the organisms have those essential activities explained. That is, there is no explanation of why they have the essential activities and functions that they do.

¹⁴ It is uncertain how, exactly, Aristotle is thinking of the role that flesh plays in tactile sensation. See Lennox (2001a: 213) for a discussion of this. At any rate, it is clear that Aristotle thinks that flesh is necessary for touch, so this complication does not matter for my purposes here.

¹⁵ Two exceptions come to mind: Aristotle says that a certain octopus has a slender body and that the elephant has a large size, but does not give any explanation for these facts. The slenderness of the octopus explains its having only a single row of suckers (*PA* IV.9, 685b12–16), and the elephant’s large size explains its having a trunk (*PA* II.16, 658b33 ff). It is not clear how Aristotle is conceiving of size or other “dimensional” features, though there is some reason to be cautious about calling these features “material” ones. In *de Anima* II.4, 416a16–18 Aristotle claims that the “limit and *logos* of size and growth” is “of soul” and more “of account” than “of matter.”

¹⁶ In other cases, differences are explained by the kind’s *krasis*. The number of gills that a kind of fish has, for instance, is due to its degree of heat (since gills are the instruments for cooling in

with crooked talons) have larger wings with plentiful feathers (*PA* IV.12, 693b27–694a4) because they need to be good flyers (presumably because of the way they catch their food, by chasing down rodents and grabbing them). In order to perform their functions, the instrumental parts must have certain powers or capabilities. The human hand, for instance, “needs one power (*dunamis*) for the action of compressing and another for that of grasping” (*PA* II.1, 646b23–25). In order to have such powers, the hand must be made of appropriate uniform matter, for example, matter that has what I will call “dispositional properties” such as hardness, softness, elasticity, and flexibility.¹⁷ Uniform parts, considered as parts with certain dispositional properties, are the parts that meet the functional requirements of the non-uniform parts they compose.¹⁸ This is why the uniform parts are said to be for the sake of the non-uniform.

Finally, the dispositional properties of uniform parts are brought about by particular kinds of elemental blends. As we learn in *Meteorology* IV, dispositional properties (called *pathêmata* in *Meteorology*) are the results of the interactions of the active powers – the hot and the cold – and the passive powers – the moist and the dry. Particular proportions of those elemental powers give rise to those dispositional properties by which uniform substances such as flesh, bone, and wood are distinguished from one another, such as solubility, solidity, and flexibility. When a particular elemental blend is the right one to bring about the uniform parts (considered

water-dwellers, and so hotter ones need more gills to cool them) (*PA* IV.13, 696b12–23). But, again, the fact that *krasis* explains other features does not entail that the presence of that particular *krasis* is a basic, unexplained feature.

¹⁷ *PA* II.1, 646b10–27:

Now animals are composed out of both of these two sorts of parts, uniform and non-uniform; the former, however, are for the sake of the latter, as it is to the latter that actions and operations belong (e.g. eye, nose, the face as a whole, finger, hand, the arm as a whole). And inasmuch as the actions and movements both of an animal as a whole and of its parts are complex, the substances out of which these are composed must of necessity possess distinct *dunamis*. Softness is useful for some purposes, hardness for others; some parts must be able to stretch, some to bend. In the uniform parts, then, such *dunamis* are found apportioned out separately: one of the parts, for instance, will be soft, another hard, while one is fluid, another solid; one viscous, another brittle. In the non-uniform parts, on the other hand, these *dunamis* are found in combination, not singly. For example, the hand needs one *dunamis* for the action of compressing and another for that of grasping. Hence it is that the instrumental parts of the body are composed of bones, sinews, flesh, and the rest of them, and not the other way around.

¹⁸ Lips and nostrils, for instance, are “fleshy” (*sarkina*) because the dispositional features of flesh are required by the functions that lips and nostrils perform in living organisms that have them (see *PA* II.16, 660a8–11). The function of lips in all animals that have them is to protect the teeth. In humans, in addition to this function, lips also help enable speech (*PA* II.16, 659b30–34). The function of nostrils in organisms that have lungs is to enable breathing (*PA* II.16, 659a30–31).

as parts with certain dispositional features), that blend is required by, and so present for the sake of, the presence of the uniform parts.

Each level of bodily composition is said to be for the sake of the one above. The matter for the instrumental parts – the uniform parts – must have specific dispositional features appropriate to their functions. And the uniform parts, considered as parts with distinctive dispositional features, must be composed of specific elemental blends that give rise to those dispositional features. For this reason, the particular elemental composition of the blood is for the sake of the parts that come to be formed out of it. Thus, if we accept principle P, Aristotle's discussion in *PA* II.1 gives us grounds for thinking that a kind's *krasis* is not primitive.

In sum, a kind's particular *krasis* can give rise to various features (such as hard eyelids) because of the nature of that elemental blend, and thus *krasis* can explain (in a given explanatory context) other features. And certain features, such as the dispositional properties that the uniform parts need to have, may come to be formed "of necessity" (as described in *Meteorology* IV), because the material at the lowest level of composition naturally has certain effects. But this does not make it a "brute" or "primitive" fact that an organismal kind has that particular composition or blend. It might be a brute or primitive fact that the elements have the causal powers that they do, but asking why the elements have the causal powers they do is different than asking why some particular elemental blends are present in a kind of organism's blood.¹⁹ As I understand it, Aristotle's view is that the presence of a particular *krasis* in an organism's blood is explained teleologically, by reference to the dispositional properties that the kind's uniform parts must have. Uniform parts must have certain dispositional properties, given the functions that the non-uniform parts they constitute must perform. If this is correct, then a kind's *krasis* is not a primitive, unexplained fact.

Heat and human intelligence

The argument offered in the last section relied on the claim that *krasis* is said to be for the sake of something in *PA* II. According to what I called principle P, this renders the presence of the *krasis* explained, and not primitive. But one might deny that Aristotle is really saying that *krasis* is for the sake of something in the strong sense that makes P sound like a

¹⁹ On this point, see Cooper (1987: 261): "if an animal of a certain kind is to be constituted these certain amounts of certain elements must be present for use: in effect, for *this* creature *those* elements are hypothetically necessitated. But plainly that presupposes, and does nothing to explain, the natural powers of the elements concerned."

plausible principle. In this section I offer a second reason for rejecting the idea that the possession of a particular *krasis* is primitive, which reason does not rely on the claim that *krasis* is for the sake of the parts formed out of it.

Suppose that Aristotle thinks that a kind's *krasis* explains why the kind has the mode of reproduction that it does, and that there is no further explanation for the kind having that particular *krasis*. Suppose the possession of a particular *krasis*, that is, is explanatorily primitive. Now explanatory primitiveness in the sense at issue here is not relative to an explanatory context. So, if the particular *krasis* an organism has is being treated as a primitive fact about the kind in the explanation of its mode of reproduction, then it must also be primitive in any other explanation. Yet, some of the causal connections that Aristotle cites between a kind's *krasis* and other features are such that it would be surprising if *krasis* – as opposed to the feature that the particular *krasis* is causally connected to – were being treated as explanatorily primitive. Consider, for example, the connection between *krasis* and human rational activity:

. . . in man the brain is more fluid and greater in volume than in any other animal, and the reason of this, in its turn, is that the heat in the heart is purest in man. The fineness of the blend (*eukrasian*) in man is shown by his possession of intellect: there is no other animal which is so intelligent. (*GA* II.6, 744a26–31 (Peck trans.))

Humans, Aristotle says, have the highest degree of heat of any living organism. That we have the most heat explains, among other things, why humans alone have an upright posture.

For heat promotes growth, and a profusion of blood is a sign of heat. And further, the bodies of those that are hotter are more erect, which is why mankind is the most erect of the animals. (*PA* III.6, 669b3–6 (Lennox trans.))

Being able to stand upright, moreover, allows humans to engage in rational activities:

Mankind, however, instead of forelimbs and forefeet has arms and what are called hands. For it alone of the animals is upright, on account of the fact that its nature and substantial being are divine; and it is a function of that which is most divine to reason (*noein*) and to think (*phronein*). But this is not easy when much of the body is pressing down from above, since the weight makes thought and common sense sluggish. (*PA* IV.10, 686a25–32 (Lennox trans.))

And engaging in rational activities is what distinguishes humans from other animals. Being able to do so is part of human nature, and actually doing so is our natural end or purpose (*telos*):

Reason (*logos*) and intellect (*nous*) are for us the goal of nature. (*Pol* VII.15, 1334b15)²⁰

It is reasonable to suppose that a kind's *telos*, for example that the human *telos* is rational activity, is a primitive fact. For, what something is, essentially, and what it is for the sake of, Aristotle says, are the same.²¹ And what something is, essentially, has no further explanation.²² If possessing a high degree of heat were simply a primitive fact about humans, rather than something that is conditionally necessary for rational activity, then part of the essence of human beings (rational activity) and a fact about the human body's material composition (high degree of heat) would be two independent facts. That the two facts are coordinated so well – that is, that the material composition is conducive to some part of the essence – would then turn out to be due to chance. But this fortuitous coordination occurs regularly, and Aristotle denies that regularly occurring, beneficial outcomes could be merely due to chance.²³

Further, it is not solely human rationality that Aristotle correlates with the *krasis* of a kind's blood (or the analogous substance in bloodless organism). First, differences in *krasis* are also linked to the intelligence and perceptive capacities of non-human organisms, such as bees:

Thicker (*pachuteron*) and hotter blood is more productive of strength, while thinner (*leptoteron*) and cooler blood is more perceptive and intelligent (*noerôteron*).²⁴ And the same difference obtains among the attributes analogous to blood. This is why both bees and other such animals are wiser (*phronimôtera*) in their nature than many blooded animals, and why among blooded animals those having cold and thin blood are wiser than their opposites. But those with hot, thin, and pure (*katharon*) blood are best; for such animals are at once in a good state relative to both courage and wisdom (*phronêsîn*). (*PA* II.2, 648a2–11 (Lennox trans., modified))

²⁰ Cf. *NE* x.8, 1178b21–23: “So, then, the activity of a god, superior as it is in blessedness, will be theoretical activity; and so, too, the human activity that has the greatest affinity to this one will be more productive of *eudaimonia*.”

²¹ *Phys.* II.7, 198a24–27. Cf. *GA* I.1, 715a8–9: “the *logos* and that for the sake of which as end are the same (*tauton*).”

²² Of course, *how* a kind achieves its *telos* will have a material and efficient causal explanation. But *what* it is does not.

²³ Aristotle argues in *Phys.* II.8 against an opponent of natural teleology by arguing that regularly occurring, beneficial natural phenomena cannot be due to chance, and that consequently they are finally caused.

²⁴ I am taking references to “thick” and “thin” blood as references to blood that is drier and more fluid, respectively. In *GC* II.2, 329b17–330a0, Aristotle says that thick (*pachu*) and thin (*lepton*) are ‘of’ dry and fluid, respectively. What exactly this amounts to is not important for my purposes. I am solely interested in the connections drawn there between thickness and dryness, and thinness and fluidity.

And heat seems to be correlated with other ways that Aristotle ranks animals:

The reason why some creatures have this part, and why those having it need respiration, is that the more honorable animals have a greater proportion of heat. (*de Resp.* 477a14–16 (Ross trans.))

In my view, Aristotle is not ordering animals on the scale of honor or value on the basis of how much heat their bodies happen to have, as a primitive fact. If this is so, we have good reason to doubt that Aristotle considers a kind's *krasis* to be primitive.

Tools

In this section, I offer a third reason for doubting that Aristotle considers facts about matter to be primitive. In short, this reason is that in Aristotle's biological account of animal generation, the elemental powers such as heat and cold do not operate independently of, but rather are subordinate to, an organism's soul. Given that elemental powers play this subordinate causal role, I will argue, facts about matter cannot be primitive in Aristotle's biological explanations.

Before arguing for this, I should emphasize that the idea that Aristotle thinks facts about matter are primitive is by no means unmotivated. For example, Aristotle claims in *Physics* II.2 and *PA* I.1 that it is incumbent on the natural scientist to understand the matter as well as form, since both the matter and form are said to be a thing's nature. A natural scientist, Aristotle thinks, must understand the material basis for the exercise of the various vital capacities (with the exception of *nous*) that make up an organism's soul and essence. One cannot make sense of life and living things without understanding the nature "as matter." Aristotle also claims that natural beings are analogous to "the snub" in that they cannot be defined without reference to the matter, just as snubness cannot be defined without reference to the nose. And there are indications that Aristotle considers some bodily features to be in the being (*ousia*) or included in the definition (*logos tês ousias*) of the kind.²⁵ When we add to all of this Aristotle's appeals to the necessary interactions of heat and cold, for instance, in explaining various features of living organisms, it is not unreasonable to think that Aristotle is treating facts about matter as explanatorily primitive.

²⁵ Gotthelf (1985) discusses in detail the passages where some bodily feature seems to be treated as included in the essence or definition. See, however, note 15, above.

The idea that matter is explanatorily primitive, however, requires a certain picture of the causal processes that the scientific explanations mirror. On the interpretation of material facts as primitive, there are, as it were, two independent sets of explanations; some explanations proceed from form or soul, and some proceed from matter. Corresponding to those explanations that proceed from the form or formal nature there is one causal process, and corresponding to those explanations that proceed from matter is another. Proponents of the interpretation of material facts as primitive think that in addition to the goal-directed causal processes, there is also “a necessity rooted in the material nature of an animal, which constrains, and perhaps acts independently of, the actions of its formal nature.”²⁶

There is an alternative picture, however, that more accurately portrays matter’s role. This alternative can accommodate the fact that the matter of a living organism is in a sense its nature, insofar as it is a source of change and rest that belongs to it non-accidentally. And this picture also allows for certain features of living organisms to be formed “of necessity” because of the interactions of the material elements. Nevertheless, this alternative does not construe matter as operating independently of form or soul, or treat the presence of matter as primitive. This is the picture that emerges in *Generation of Animals*.

In *GA*, Aristotle is explaining how the efficient cause of generation (the father or the father’s nature or soul) conveys the form (which he has in actuality) to the matter provided by the mother, and how the embryo is then formed. To do so, Aristotle must explain the material basis by which form is conveyed, and then how the embryo’s tissues, bones, limbs, and organs are constructed. That material basis, as it turns out, is what we might think of as metabolic processes – heating and cooling – in the spermatic residues and nutritive (and growth promoting) blood.²⁷

When Aristotle describes this process, he sometimes refers to heat and cold as the *tools* of soul. Elsewhere, Aristotle also describes the body as a tool of soul.²⁸ Insofar as Aristotle is conceiving of soul as a living substance’s capacities for engaging in vital activities, it is natural to understand such descriptions as indicating that the body parts are the means or instruments by which vital activities are performed, much like an artisan’s tools are the means by which the artisan’s *technê* is carried out. And for parts that have functions, the description seems apt. Eyes, for instance, are the tools by

²⁶ Lennox (2001c: 187).

²⁷ See, for example, *GA* II.6, 743a36–b5 and *GA* II.1, 734b28–735a4, both quoted below.

²⁸ For example, *PA* I.1, 642a9–13; *PA* II.7, 652b7–15; and *DA* 2.4, 415b18–20: “all natural bodies are tools of soul, as those of animals, so too, those of plants, as being for the sake of soul.”

which an organism engages in seeing; hands are tools by which we grasp and press things. But heat and cold are less obviously analogous to the craftsman's tools than are functional organs and limbs. And Aristotle is aware of this, which is why he modifies the analogy with craft production when explaining how nutritive soul uses heat and cold as tools:

... as the products of art are made by means of the tools of the artisan, or to put it more truly by means of their movement, and this is the activity (*energeia*) of the art, and the art is the form of what is made in something else, so is it with the power of nutritive soul. As later on in the case of mature animals and plants this soul causes growth from the nutriment, using heat and cold as its tools (for the movement of the soul is in these), and each thing comes into being in accordance with a certain formula, so also from the beginning does it form the product of nature. (*GA* II.4, 740b25–34 (Platt trans., modified))

Here Aristotle compares heat and cold not to an artisan's tools but to their *movements*, that is, the tools as they are being used. These movements of the artisan's tools, Aristotle says, are the *energeia* or activity of the artisan's *technê*. This suggests that the important point of the analogy between the movements of the artisan's tools and the heating and cooling in blood is that each is the activity or *energeia* of some *dunamis*. In living organisms, the heating and cooling are the activities of soul capacities; these are how those vital activities are carried out.

If we grant that Aristotle is thinking of heat and cold in this way – that is, as tools by which soul capacities are exercised – two points follow. First, it follows from the idea that heat and cold are tools or instruments that their causal role is thereby a subsidiary one. They are *sunaitia*, not *aitia*.²⁹ And subsidiary causes never operate independently of the first or primary cause to which they are subordinate. Consequently, as subsidiary causes, the elemental powers in living organisms' bodies do not operate independently of, but are rather subordinate to form or soul.³⁰

Second, auxiliary causes can have their own *per se* effects. The drugs that the doctor prescribes, for instance, have powers “of necessity” to alter the patient's body. Those powers the drugs have are not working independently of the doctor's art, however; the drugs are present in the patient's body (they have been ingested, that is) only because the doctor prescribed them. Nevertheless, the powers in the drugs cause changes in the patient.

²⁹ Cf. *DA* II.4, 416a13–14.

³⁰ Balme (1987: 276) also makes the point that as *sunaitia*, the matter's “natural action and movement” will not produce its effects unless “nature causes it to do so.”

Similarly, heat and cold in living organisms have powers, grounded in necessity, of producing features (softness, hardness, etc.) of the body, just as they do in craft production.

Heat and cold (which is deprivation of heat) are both employed by Nature. Each has the power, grounded in necessity, of making one thing into this and another thing into that; but in the case of the forming of the embryo it is for a purpose that their power of heating and cooling make it such, partly owing to necessity, partly for a purpose – sinew solid and elastic, bone solid and brittle. (*GA* II.6, 743a36–b5 (Peck trans.))

As tools of soul, and so subsidiary causes, heat and cold can cause changes in the embryo's body. But still, just as in the case of craft production, heat and cold do not operate on their own.

And as in speaking of an axe or any other instrument, we should not say that it was made solely by fire, so we should not say this about a foot or a hand, nor, similarly, of flesh either, because there is a function of this also. As for hardness, softness, toughness, brittleness and the rest of such qualities which belong to the parts that have soul in them, heat and cold may very well produce these, but they certainly do not produce the *logos* in virtue of which the one is now flesh and the other bone. Rather, the movement derived from the generator who is in actuality that which the material out of which the offspring is formed is in potential. The very same thing applies to things formed in accordance with art. For, heat and cold may soften and harden the iron, but they do not produce the sword. This is done by the movement of the tools, which has the *logos* of the art. For the art is the principle and form of the thing being made, but in another. But nature's movement is in [the product being formed], derived from another natural being having the form in actuality. (*GA* II.1, 734b28–735a4)

Viewed from this perspective, the idea that matter operates independently of soul does not really get a foothold. Rather, matter is always operating as a tool of soul, and so subordinate to it. Accordingly, facts about matter in the scientific demonstrations that display the causes will also be subordinate to facts about form or soul, and not “as explanatorily primitive” as them.

Conclusion

I began by noting a recent trend to interpret Aristotle's biological explanations as treating facts about matter as explanatorily primitive. This interpretation, however, is in tension with what we would have expected, given what Aristotle says outside the biological works. And, I argued, it is far

from obvious that the biological explanations treat facts about matter as primitive. I offered the following three considerations.

First, from Aristotle's discussions in *PA* II.I, it would seem that matter at the lowest level of composition – an organism's bodily blend or *krasis* – is not primitive, at least not if one accepts that citing what something is for the sake of entails that it is explained. Second, there is reason to think that certain appeals to *krasis* are not intended as references to primitive facts. For Aristotle correlates facts about a kind's *krasis* with facts about human rationality. If human rational capacities are part of human essence, this would render the coordination between essence and matter a coincidence. But I do not think that this can be Aristotle's view. Third and finally, I have tried to indicate the way in which Aristotle's conception of the metabolic processes – the heating and cooling involved in reproduction, development, and maintenance – imbeds the actions of the elemental powers into the activity of the soul or form of the organism. Heat and cold are tools by which soul activities are carried out. This bars them from being "independently" operative in the way that has been suggested in the recent literature.