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FORM AND INHERITANCE IN ARISTOTLE'S EMBRYOLOGY

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ARISTOTLE's ontology posits kinds or species of objects whose members have a common essence. As traditionally understood, the *Metaphysics* identifies an organism's essence, i.e. *what it is*, with its *form*.¹ On such a view, it is natural to suppose that members of the

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¹ Cf. *Z* 7, 1032^b1–2: 'By "form" I mean the essence of each thing' (see also *Z* 10, 1035^b32). Form is identified with the 'substance of' a thing in *Metaph. Z* 17. The 'substance of' a thing is what makes it *what it is*. What makes something a house or a human being, he says, is its *form* (1041^b7–8). In living organisms the form is the soul, and Aristotle says in *DA* 2. 4 that soul is the 'cause or source of the living body' in three ways: 'It is the source of movement, it is the end, it is the cause as substance [*οὐσία*] of living bodies' (415^b10–12). This traditional view, whereby an organism's substantial form and essence are identified, has been challenged in the last half-century. D. M. Balme, for instance, argues that form and essence are not identical ('Aristotle's Biology was Not Essentialist' ['Not Essentialist'], *Archiv für Geschichte der Philosophie*, 62 (1980), 1–12; references are to the reprinted version with appendices in A. Gotthelf and J. G. Lennox (eds.), *Philosophical Issues in Aristotle's Biology* (Cambridge, 1987), 291–312). Balme distinguishes Aristotle's use of *εἶδος* to refer to the essence, which 'picks out only those features for which a teleological explanation holds' (e.g. eyes in humans) and the 'actualized' form, which is qualitatively distinct for each individual and so includes all features of an organism (ibid. 297, 294). (Balme also distinguishes these two uses of *εἶδος* from one that refers to the species, which is the 'universal generalized over all animals that have the same essence, as they appear in nature' (ibid. 298).) Defending what I am calling a 'traditional' understanding of Aristotle's metaphysics is outside the scope of this paper; I am here arguing only for consistency between that traditional understanding and the details of the embryology that have appeared to be in tension with it.

same species will be the same in form.² Form, for living organisms, is also supposed to play a causal role in generation. This causal role for the form of a living organism is taken up in *Generation of Animals*, where Aristotle explains animal reproduction in terms of the transmission of form from one generation to the next.³ There is, however, a prima facie tension between the thesis that form can be identified with an organism's essence and the claim that form plays a causal role in generation. Many recent interpreters have claimed that if form is to play the causal role Aristotle assigns to it in generation, it must include features specific to the particular individual, and not just those common to all members of the species.⁴

² This is a natural assumption given claims such as the one at *Metaph. Z* 8, 1034^a5–8, that Socrates and Callias are the same in form (εἶδει), or the one at *DA* 2. 4, 415^b3–7, that natural organisms partake in immortality in the only way they can, namely by producing something that is the same in form (εἶδει).

³ Aristotle makes it clear at *I. I*, 715^b3–4, that this theory is meant to account for the generation of animals the same in kind (συγγένειαν) as their parents (who are the same in kind (συγγενῶν) as one other).

⁴ M. L. Gill, for instance, is persuaded that 'in his treatment of inheritance in *GA* 4. 3, Aristotle builds all material accidents (such as eye color) into the individual essence of the male parent to explain their replication' (*Aristotle on Substance: The Paradox of Unity* (Princeton, 1989), 125 n. 29). C. D. C. Reeve claims that 'species form seems far too thin to explain the inheritance of specific traits' (*Substantial Knowledge: Aristotle's Metaphysics [Knowledge]* (Indianapolis and Cambridge, 2000), 84). Note that this issue about whether an organism's form is qualitatively distinct from the form of other members of the same species is a separate issue from the notoriously controversial issue about whether form is a universal—something predicated of many instances—or whether there are numerically distinct forms for every individual. That these issues are distinct has been noted by R. Sharples, 'Species, Form, and Inheritance: Aristotle and After' ['Aristotle and After'], in A. Gotthelf (ed.), *Aristotle on Nature and Living Things: Philosophical and Historical Studies Presented to David M. Balme on his Seventieth Birthday* (Pittsburgh and Bristol, 1985), 119, and J. Cooper, 'Metaphysics in Aristotle's Embryology' ['Metaphysics'], *Proceedings of the Cambridge Philological Society*, 214 (1988), 14–41; references are to the reprinted version in D. Devereux and P. Pellegrin (eds.), *Biologie, logique et métaphysique chez Aristote* (Paris, 1990), 55–84. (Proponents of the particular-forms view might appeal to *GA* 4. 3 767^b32–5, where the particular individual (τόδε τι) is said to be the proper moving cause as well as proper end of generation, 'for what is made is some οὐσία and a particular [καθ' ἑκάστων]. I take it that in this passage he is using οὐσία in the sense he does at *Cat.* 5, 2^a11–14, for what is particular (ὁ τὸς ἄνθρωπος, ὁ τὸς ἵππος) as opposed to secondary substances that are general. That Aristotle thinks the particular (καθ' ἑκάστων) exerts a stronger influence in generation than the kind makes sense in the light of the 'particular-particular' rule from *Metaph. A* 5, 1071^a20–4: 'For it is the individual that is the originative principle of the individuals. For while man is the originative principle of man universally, there is no universal man, but Peleus is the originative principle of Achilles, and your father of you, and this particular *b* of this particular *ba*, though *b* in general is the originative principle of *ba* taken without qualification' (trans. Ross).) I am here concerned to defend the view that form in embryology is

Call this form that is qualitatively distinct for each individual organism 'subspecific form'. Socrates' subspecific form might include, for example, his snub nose. But having a snub nose is not a part of Socrates' essence—that feature is not common to all members of the species—and so subspecific form cannot be identified with essence.

Here I shall defend the view that Aristotle's account of inherited characteristics does not require subspecific forms. In the first part of the paper I argue that there is no textual evidence for the view that Aristotle is employing subspecific form in his account of family resemblance. As we shall see, his view is that familial resemblance is not an 'accidental'⁵ result. Interpreters often infer from this that inherited features are non-accidental with respect to the *form* that the offspring receives and thus conclude that form must be subspecific.⁶ However, I argue that this conclusion is unwarranted, and show that the class of accidental features and the class of features that are due to form do not constitute an exhaustive dichotomy.

Beyond there being no direct textual evidence for the thesis that subspecific, familial resemblances are due to form, this interpretation also renders Aristotle's theory of generation internally inconsistent. According to Aristotle's account of sexual reproduction in *Generation of Animals*, only males provide the form and only females provide the matter.⁷ As I discuss below, this 'reproductive

species-level form. I take this view to be compatible both with the view that form is a universal and with the view that there are particular forms.

⁵ What it means to say that these features are not accidental will be one of the issues to be discussed in what follows. In general, *accidental* causal relations are contrasted with *per se* or *intrinsic* causal relations; a doctor stands in a *per se* causal relation to the healing that he brings about by exercising his medical skill, but if that doctor also happens to be a musician, then the musician will stand in an accidental causal relation to the healing. The *locus classicus* for Aristotle's discussion of accidental causes is his discussion of luck and chance in *Physics* 2. 4–6.

⁶ For a recent example of this inference see D. Henry, 'Aristotle on the Mechanism of Inheritance' ['Mechanism'], *Journal for the History of Biology*, 39 (2006), 425–55 at 431, and id., 'Understanding Aristotle's Reproductive Hylomorphism' ['Hylomorphism'], *Apeiron*, 39 (2006), 257–87 at 276. See also Sharples, 'Aristotle and After', 120 with n. 4, and further n. 23 below.

⁷ This is repeated in a number of passages throughout *Generation of Animals*, e.g. 1. 20, 729^a9–12 (where the action of the male's semen on the female's menstrual fluid or *καταμήνια* is compared to rennet coagulating milk); 1. 21, 729^b18–21 (where the father's form is compared to what the doctor conveys to the patient); and 2. 1, 732^a3–6 (where, in giving the reason for the separation of males and females, he says that it is better for the primary cause 'to which belongs the *λόγος* and *εἶδος*' to be separate from the matter).

hylomorphism⁸ is an application of a principle of causal explanation that Aristotle establishes in the *Physics*. There he argues that explanations of change must involve an agent which imparts a form, as well as a patient which undergoes the change of taking on that form, and that these must be distinct. However, inherited traits can come from both parents, and so on the assumption that familial resemblance is due to form, maternal resemblance would also be due to form. But Aristotle cannot consistently hold that (i) the form transmitted in animal reproduction includes all the subspecific, inherited features, (ii) only the male provides form and only the female provides matter, and (iii) females also transmit subspecific features.⁹ There are two strategies for resolving this tension that defenders of the subspecific-forms interpretation tend to adopt. Some attempt to deny (ii) by offering additional textual evidence that the mother provides form,¹⁰ while others attempt to argue that the *father* is ultimately responsible for resemblance to the mother, denying (iii).¹¹ Neither of these strategies for defending

⁸ I borrow this phrase from Henry, 'Hylomorphism'. This characterization of reproductive hylomorphism leaves a number of interpretative questions open. It may or may not entail, for instance, that form and matter exhaust the parental contributions—that is, it neither says that the male contributes *only* form nor that the female contributes *only* matter.

⁹ It is arguable that we could avoid inconsistency by changing (i) to (i*): 'The form transmitted in animal reproduction prescribes inherited, subspecific features.' For (i*) leaves open the possibility that the offspring's form will include only those subspecific features it inherited from the father. In this case, the features the offspring inherits from the mother might be conveyed by and due to the matter while only those that are inherited from the father are conveyed by and due to the substantial form. The triad of claims would not be inconsistent, but merely odd for the following two reasons. First, the mother contributes the same sorts of features as the male (e.g. a particular nose shape), so Aristotle would be saying that the same sort of feature will be a feature prescribed by form *only* if it was inherited from the father, but not when it was inherited from the mother. Further, even if we accept this asymmetry, it seems that after some finite number of generations, what the father would pass on would be only species-specific features anyway. Granted that maternal resemblance occurs fairly often, each successive generation will have fewer and fewer subspecific features prescribed by or included in its form. I shall not consider this alternative here; it is not one that defenders of the subspecific-forms interpretation adopt, as far as I am aware.

¹⁰ e.g. Balme, 'Not Essentialist'; Henry, 'Hylomorphism'; A. L. Peck (trans. and comm.), *Aristotle: Generation of Animals [GA]* (Cambridge, Mass., 1942); and J. Morsink, *Aristotle on the Generation of Animals: A Philosophical Study [Study]* (Washington, 1982).

¹¹ e.g. Cooper, 'Metaphysics', and Reeve, *Knowledge*. M. Furth, on the other hand, thinks that Aristotle's theory of reproduction simply breaks down once it is 'confronted with some fairly apparent facts about heredity' (*Substance, Form and Psyche: An Aristotelian Metaphysics* (Cambridge, 1988), 132 with n. 22).

the subspecific-forms interpretation is successful, and I think it is instructive to see why this is so. I conclude by suggesting a way to understand Aristotle's account of inherited characteristics that denies that subspecific, inherited features are included in the form, and instead treats the conception of form in Aristotle's embryology as one common to members of a species and so identifiable with essence.

1. The interpretative problem

The source of the interpretative obstacle to treating forms in Aristotle's embryology as species-level forms is his discussion of resemblance to parents and ancestors in *GA* 4. 3. Earlier in *Generation of Animals* Aristotle introduces the theory of reproduction in which this account of familial resemblance is supposed to be embedded. The theory of reproduction treats the father and mother as 'principles' of generation.¹² The father, who is the agent of the change, supplies the 'principle of form'. The mother supplies the 'principle of matter', which is, according to Aristotle's theory, menstrual fluid (*katamēnia*). The father conveys the principle of form in a manner analogous to that by which a craftsman conveys the form in craft production. In both cases form is conveyed by way of certain motions or *kinēseis*.¹³ In craft production these are

¹² Cf. 1. 2, 716^a4-7: 'As we mentioned, the male and female may be safely set down as the principles of generation: the male as having the principle of movement and generation, the female as having the source of matter.'

¹³ Cf. 1. 22, 730^b10-24. There is no adequate English rendering of *κινήσεις*, and so I leave it untranslated here. This is Aristotle's general term for 'change', and it covers not just locomotive movements, but qualitative changes (such as that from cold to hot), quantitative changes (such as growth or diminution), and occasionally (e.g. in *Physics* 3. 1-3) substantial change. The *κινήσεις* in the spermatoc fluids are probably much more like the changes in a chemical reaction than locomotive movements, so in this discussion 'motion' is misleading, while 'change' is awkward. These *κινήσεις* are introduced because Aristotle needs to explain the embryo's formation in a way consistent with two principles from his natural science. First, in any change the agent must be in contact with the patient: cf. *Phys.* 3. 1-3, *GC* 1. 6-7. Second, the agent must be in actuality what the product is potentially: cf. *Phys.* 3. 1-3, *Metaph.* Θ 8, 1049^b24-7. Socrates is a human being in actuality, and so satisfies the second criterion. But Socrates does not make contact with the matter when those changes occur. His semen makes contact with the matter (the menstrual fluid in the mother), and so semen satisfies the first criterion. However, that semen is not *actually* a human, and does not *actually* have human soul. The puzzle, as Aristotle describes it there, is that the agent of the changes in the menstrual fluid that take place when the heart is being formed can be neither 'external' (since then there would be no

the motions of the craftsman's tools, while in the production of most types of animal, these are *kinēseis* carried in the semen.¹⁴

With the general theory in place, Aristotle then turns his attention at 4. 3, 767^a35–^b5 to the following phenomena, all of which are due to the 'same causes':

Some offspring take after their parents and some do not; some take after their father, some after their mother, both with respect to the whole body and with respect to each part, and they take after their parents more than their earlier ancestors, and they take after their ancestors more than after any chance persons. Males take after their father more, females after their mother. Some take after none of the ancestors, although they take after some human being at any rate; others do not take after a human being at all in their appearance, but have gone so far that they resemble a monster. (Trans. Peck, slightly modified)

The causal explanation Aristotle goes on to provide shows how some of the features that vary among members of a species can be systematically traced back, through a mechanism of inheritance, to those same features in their ancestors. Aristotle does not say exactly which features are inherited, but it is clear that at least some of them will be features below the level of the species—features that vary from one individual to the next.

As inherited features, they are importantly different from other sorts of feature that could be called 'accidental'. Inherited features are not, for instance, like the property of living in Athens, which has nothing to do with the reproductive process. Nor will an organism's subspecific inheritable features include those subspecific variations that are solely due to environmental contingencies, e.g. cold winds that affect the temperature of the parents' spermatoc fluids, or the amount of menstrual fluid that was available. An example of this sort of accidental variation is thickness of hair in humans. The reason why humans have hair at all, Aristotle tells us, is that hair protects us, and so mere possession of hair can be traced

contact with the menses) nor 'internal' (since there is nothing that is actually a living organism in that first mixture of semen and menses). Aristotle's solution involves showing how the principle of change is in a way external and in a way internal: since it is the father's nature that sets up those *κινήσεις* that carry the principle of generation, it is external, and since that principle is carried through the *κινήσεις*, it is internal.

¹⁴ Exceptions are animals that do not emit semen, and those in which males and females are not separated. Aristotle notes that in some cases the female inserts some part of herself into the male; in such cases the male transfers the *κινήσεις* directly. Cf. 1. 22, 730^b24–6.

back to human form—i.e. to what a human being is.¹⁵ However, human hair comes in degrees of thickness, and human form will not prescribe anything more determinate than an acceptable range of hair thickness.¹⁶ Rather than being due to human form, the determinate thickness of one's hair is traced back to factors such as the type of moisture and degree of heat that happened to be present while the skin was forming or when the pores were opening.¹⁷ Thick hair, for instance, is due to the loose and thick skin having larger passages and being more 'earthy' together with the oily fluid that was present, since hair grows when the fluid evaporates (*GA* 5. 3, 782^a30–^b5). Whether a human has loose and thick skin is in turn due to contingent features of both the environment and the materials available during generation. Thus, variations in hair thickness are caused by environmental contingencies and not the

¹⁵ *PA* 2. 14, 658^a18–19 with ^a21–4. For instance, humans walk upright and so need more protection for the 'nobler' front side, and walking upright is traceable to human form. The need for protection also explains why humans have eyelashes on both upper and lower eyelids.

¹⁶ J. G. Lennox distinguishes between two ways of thinking about essential features or properties, and I am assuming that he is correct in attributing to Aristotle what he calls a 'non-typological' model of essentialism ('Kinds, Forms of Kinds, and the More and the Less in Aristotle's Biology', in Gotthelf and Lennox (eds.), *Philosophical Issues in Aristotle's Biology*, 339–59; repr. in Lennox, *Aristotle's Philosophy of Biology: Studies in the Origins of Life Science* (Cambridge, 2001), 160–81). According to this model, kinds are constituted by 'features with range': an essential feature is to be understood as one 'with range' in that what members of a kind share are features that all fall within some acceptable range of 'more and less'. This model is to be contrasted with that which countenances some set of qualitatively identical 'basic' or 'stock' features and treats variations of more and less (e.g. thinner or thicker hair in humans) as 'add-ons' to, rather than determinations of, the essential feature.

¹⁷ Of course, in organisms for which thick hair is either necessary or better for performing some essential function, the moving causal explanation of the production of that thick hair would also, presumably, be given in terms of the type of moisture and degree of heat that affects the size of the pores and type of skin. But in these cases thick hair would not be an accidental variation, but would be for the sake of the form of the organism, and so would be included in the form. This raises a question about what difference being useful for some function makes to what we might think of as the physical mechanism by which some part is produced. This, I take it, is part of a larger issue about how to understand Aristotle's claims (e.g. in *GA* 5. 8, 789^a8–^b2) that some phenomenon occurs *both* because it is better (i.e. for the sake of some function) and because it happens 'of necessity' (i.e. is due to factors such as thickness and thinness of the jawbone). This is not the place to address questions about the relation between formal and material natures, though any treatment of these would shed light, it is to be hoped, on the contrast between features, such as thickness of hair in humans, that are solely due to 'material' factors and features that are due to form as well.

organism's form. We can think of this type of subspecific variation as the 'by-products' of animal generation.¹⁸

By contrast, in *GA* 4. 3 Aristotle identifies *kinēseis* in the reproductive fluids from the parents as the *per se* causes of inherited features.¹⁹ These *kinēseis* are drawn from (*apo*) certain potentials (*dunameis*) that belong to the generator 'qua generator', and not accidentally:

I speak of each potential in this manner. The generator is not only a male but also such a male, e.g. Coriscus or Socrates, and he is not only Coriscus but also human. And in this sense some things that belong to the generator are closer and some further *qua* generator and not accidentally, such as being literate or someone's neighbour . . . For this reason, movements are present from the potentials in the spermatoc fluids of all such things. (4. 3, 767^b23–9, 35–6)

As Aristotle here explains, Coriscus *qua* generator is a human, a male, and a particular human male, and there are corresponding *kinēseis* in his semen for forming parts and features that look like his. As we shall see, because of the way in which both semen and menstrual blood are formed, there will also be *kinēseis* in the mother's contribution, the matter. Aristotle describes the mechanism by which the offspring comes to resemble one parent rather than the other in terms of these *kinēseis* prevailing or failing to prevail. The

¹⁸ These are the *παθήματα* that Aristotle discusses in *GA* 5 which do not 'contribute to the account of the being [*πρὸς τὸν λόγον συντείνει τὸν τῆς οὐσίας*]' of the organism (5. 1, 778^a34–^b1). These, he says, have causes that must be traced back to the 'matter and source of motion' and do *not* contribute to the *λόγος τῆς οὐσίας*. For the view that even these *παθήματα* are due to the form, see Balme, 'Not Essentialist'.

¹⁹ Aristotle prepares the ground for this account earlier in *Generation of Animals*, and so it is not merely an *ad hoc* addition to the embryological theory. In book 1 the fact that semen is a residue from the nutritive blood that is distributed to the parts of the body is said to be 'why we should expect children to resemble their parents: because there is a resemblance between that which is distributed to the various parts of the body and that which is left over' (1. 19, 726^b13–15, trans. Peck). He repeats this point at 2. 3, 737^a18–22: 'As semen is a residue, and as it is endowed with the same *kinēsis* as that in virtue of which the body grows through the distribution of the ultimate nourishment, when the semen has entered the uterus it sets the residue produced by the female and imparts to it the same *kinēsis* with which it is itself endowed' (trans. Peck). And then he reminds us of this again at *GA* 4. 1, 766^b7–10: 'To resume then: We repeat that semen has been posited to be the ultimate residue of the nourishment. (By "ultimate" I mean that which gets carried to each part of the body—and that too is why the offspring begotten takes after the parent which has begotten it, since it comes to exactly the same thing whether we speak of being drawn from every one of the parts or passing into every one of the parts, though the latter is more correct)' (trans. Peck).

kinēseis that prevail will be the causes of the new organism's body parts and organs. If the male's *kinēseis* prevail, the offspring will resemble him. If the male's *kinēseis* are too weak, the *kinēseis* from the mother will take over and the offspring will resemble her.

This is meant to explain not just morphological resemblances among particular features such as nose shapes, but sexual differentiation as well.²⁰ And the description of this mechanism explains why a son can look like his mother and a daughter can look like her father. Since there are *kinēseis* 'drawn from' the father in so far as he is not only male but also a particular male, in some cases the *kinēseis* corresponding to his gender might prevail—yielding a male offspring—while the *kinēseis* corresponding to his being a particular male do not.²¹ In such cases the mother's *kinēseis* (presumably corresponding to her being a particular female) take over, and the result will be a son who resembles his mother.

Although the details of the mechanism Aristotle describes in *GA* 4. 3 are obscure, it is clear from his discussion of inheritable traits that these features are not simply accidental by-products. These inherited features are not due to contingencies in the available matter or the environment, and they are not the accidental results of some other process or processes. Inherited features are the *per se* results of certain *kinēseis*, which are said to be drawn from potentials that the generator has non-accidentally *qua* generator, unlike being literate. Thus, inherited features are not, as some scholars say, 'material accidents'—i.e. accidents due to the matter.²² Scholars

²⁰ It is not clear that we should take sexual differences to be just differences in reproductive organs, since Aristotle says that whether the embryo is male or female depends on the degree of heat in the heart (since male and female are defined in terms of the ability and inability fully to concoct nutritive blood into semen). Cf. 1. 20, 728^a18–21, and 4. 1, 765^b8–17.

²¹ Or, conversely, the particular *κινήσεις* might prevail while those for being male do not, resulting in a daughter that looks like her father.

²² C. Witt, 'Form, Reproduction, and Inherited Characteristics in Aristotle's *Generation of Animals*', *Phronesis*, 30 (1985), 46–57 at 46, claims that 'one point of almost universal agreement is that the form or essence does not include accidental, material features of the object'. According to R. W. Sharples, 'Some Thoughts on Aristotelian Form: With Special Reference to *Metaphysics Z 8*', *Science in Context*, 18 (2005), 93–109 at 104, 'it seems that both for Aristotle and for Alexander there is in principle a distinction between what is essential to every member of a species and what is not, the latter being accidents due to the matter in each individual'. The English expression 'material accident' has no strict equivalent in Aristotle's Greek, and it is unclear what sort or sorts of effect scholars mean to pick out by that expression. It appears to be used to refer to features that are not due to form, but as we shall see below, not all features that are not due to substantial form are

tend to infer from this that those potentials that belong to Coriscus *qua* generator and non-accidentally must be part of his *form* and so part of the *form* he passes on to his offspring.²³ And since some of these non-accidental potentials are clearly not species-specific, the notion of form Aristotle uses to explain inherited characteristics seems on this view to be subspecific.

2. Subspecific form and accidental features

As we have just seen, in *GA* 4. 3 Aristotle says that the potentials for inherited traits belong to the father non-accidentally, and scholars take this to indicate that those traits are part of the father's form. I want to begin questioning this move by noting that whether or not something is accidental is relative to the subject or cause at issue.

'Accidentally' (*kata sumbebēkos*) is an adverbial expression Aristotle uses to describe two broad categories of relation—predication relations and causal ones. A predicate can *apply* to a subject either accidentally or *per se*, and something can *cause* or *be caused* by something either accidentally or *per se*. Aristotle's discussions at *Posterior Analytics* 1. 4, 1. 19, 1. 22, *Metaphysics* Δ 30, and *Physics* 1. 3 give us two general descriptions of accidental predication. First, a predicate applies accidentally to a subject if it can apply *or* not apply, as being seated might apply or not apply to Socrates. Second, that which is predicated accidentally is not part of the definition (which is an account signifying the essence) of the subject. Again, being seated does not apply to Socrates in virtue of what he is, essentially, and so is not part of the definition of his essence.²⁴

accidental, nor are they all 'due to matter'. In my view, the mistaken assumption that there is an exhaustive dichotomy between effects that are due to form and those that are accidents is the motivation for the subspecific-forms interpretation.

²³ Cf. Cooper, 'Metaphysics', 63: 'By saying that there are actually in any male animal's sperm movements belonging to it as that individual qua father Aristotle commits himself to at least the relative particularity of that animal's form.' See also n. 6 above.

²⁴ As an anonymous referee helpfully pointed out, this distinction is not as clear-cut as my treatment here might suggest. For Aristotle recognizes a difference between an attribute or property that belongs to a subject *per se* in the sense that it is part of the definition and one that belongs *per se* because it somehow follows from the definition. So, for instance, having internal angles that sum to 180 degrees is not part of the definition of triangle (and so not part of the form of triangle), but all triangles must have that property, and Aristotle will call this a *per se accident*. I am

A cause is accidental in virtue of its standing in an accidental predication relation to the *per se* or non-accidental cause.²⁵ For instance, a doctor is the non-accidental cause of healing in so far as having the potential to heal is predicated of the doctor non-accidentally.²⁶ If the doctor, say Aesclepius, should also be a builder, then the builder would also be the cause of the healing, but only accidentally. The builder can only accidentally cause the healing since having the potential to heal *applies* to the builder only accidentally.²⁷ The builder is an accidental cause of the healing in virtue of standing in an accidental predication relation to the potential to heal.

I shall not argue for a particular view about what it is to be a *per se* cause here. I am taking it for granted that it is a fact about the cause specified—the builder or the doctor—that makes him the right sort of thing to bring about the specified effect. It is the fact that the builder has the potential to build a house and the doctor has the potential to heal the sick that renders them the non-accidental causes of houses and healed patients, respectively. So what is a non-accidental result with respect to one potential may be accidental with respect to another, even if both potentials reside in the same object.

Making this last point allows us to see how the idea that inherited traits are non-accidental results *qua* generator is consistent with

overlooking this point for the purposes of this discussion, since the question I am concerned to address is whether some attribute being non-accidental entails that it is essential, and not whether being accidental leaves open (as the example just given shows) that it is in some sense essential (as having angles summing to 180 degrees is an *essential* accident of triangle).

²⁵ As has been noted, e.g. by Cynthia Freeland ('Accidental Causes and Real Explanations', in L. Judson (ed.), *Aristotle's Physics: A Collection of Essays* (Oxford, 1991), 49–72), Aristotle defines accidental predication and accidental causation in terms of one another, and so it is not obvious whether one or the other is primary. However, it is safe to assume here that, for example, the builder accidentally heals in virtue of being accidentally related to the doctor, and not the other way round. Cf. *Metaph.* Δ 7, 1017^a7–13; E 2, 1026^b37–1027^a2.

²⁶ While it may be most precise to speak of the potential that the builder or doctor has as the *per se* cause, I shall speak of the builder and doctor as *per se* causes in virtue of having that potential. Further, for the purpose of illustration, I limit the *relata* of causal relations to objects under a description, although Aristotle will also treat events (e.g. going to the marketplace) as causal *relata*.

²⁷ Sometimes Aristotle will say that it is not the cause that is accidental but rather the effect. If the baker bakes something tasty, and the tasty thing coincides with the healthy thing (that is, the healthy thing stands in an accidental predication relation to the tasty thing), then the healthy thing is an accidental effect of the baker. See e.g. *Metaph.* E 2, 1027^a3–8.

the idea that substantial form is species-level form. For in general, what results non-accidentally with respect to one specification of some substance such as Coriscus is not non-accidental relative to every other specification of him. In particular, results that are non-accidental relative to one specification need not be non-accidental relative to the specification that picks out Coriscus as a substance or specifies his substantial form. For instance, a well-tuned lyre might be a non-accidental result relative to Coriscus *qua* musician, but accidental *qua* his possessing substantial form; the potential to tune a lyre belongs non-accidentally to Coriscus *qua* musician, but accidentally *qua* substance. This should be uncontroversial whether one thinks Coriscus' form is a species form or a subspecific one; the potential to tune a lyre is surely something that can belong *or* not belong to Coriscus *qua* substance, even if we think that his substantial form is a very determinate, subspecific form. Similarly, features of his offspring might be non-accidental relative to Coriscus *qua* generator but accidental *qua* having substantial form; the potentials that belong to Coriscus *qua* generator (and from which the *kinēseis* derive that are the *per se* causes of his offspring resembling him) need not be potentials that are included in his substantial form. In this way, the assumption that it is human species form that Coriscus passes on to his offspring is consistent with the fact that potentials for subspecific, inheritable characteristics belong to him non-accidentally *qua* generator, and so form need not be subspecific.

In the claim that the well-tuned lyre is a *per se* effect of Coriscus *qua* musician, the '*qua* musician' was supposed to signal that the well-tuned lyre results from some potential Coriscus has in virtue of his capacity to engage in a certain sort of activity, viz. playing music. But what is the qualification '*qua* generator' signalling in the context of a discussion of inheritable traits? After all, we might think that *qua* generator Coriscus contributes the principle of form, and so any feature that results from Coriscus' generative activity is one that results from the form he transmits, which form is thus subspecific.²⁸ I do not, however, think that '*qua* generator' must be read this way.

²⁸ That would follow if Aristotle said that the male parent contributes *only* form. However, he does not say this (but rather that the male alone contributes form), and it is clear that there are also *κινήσεις* transmitted. It is by way of (*διὰ*) these *κινήσεις* that form is conveyed. Some interpreters speak as though these *κινήσεις* are somehow constitutive of (perhaps the physical realization of) the father's form (e.g. Balme, 'Not Essentialist', 292), but I am going to argue below that a different understanding of the relation between those *κινήσεις* and the form is suggested by

Consider the following analogy with the activity of teaching a language, e.g. French.²⁹ The goal of this teaching activity is the student's acquisition of the ability to use and understand French, which Aristotle would describe as a change from lacking to having some form, French, that the teacher possesses and that his activity aims to transmit.³⁰ The full specification of the goal of this teaching activity will include a number of the features that will belong to the student at the end of his education, and exclude others. It will include his being able to speak and read French, for instance, but will exclude the beard the student might be wearing. Even if the student's beard were in some way connected to the French teacher's activity—for example, if the student decided to grow a beard because his teacher, whom he respects and wants to emulate in every way, wears a beard—it is still not an integral part of the process of learning French, and so is accidental with respect to the French teacher's activity. The beard is not transmitted by means of the teaching process.

The full specification of the goal of the teaching activity will, however, exclude some features that *can* be transmitted by that teaching process. For instance, the relevant form (the ability to speak and read French) will not prescribe any one particular accent, but will simply specify a *range* of acceptable accents. Consequently, the teaching process does not aim at the acquisition of any particular accent within that range.³¹ Still, supposing that the student will be taught how to speak French by means of mimicry and repetition, the student may come to have the same particular accent as his teacher, for instance a Parisian accent. This feature—the Parisian accent that the teacher passes on through the teaching process—

Aristotle's analogy between those *κινήσεις* and the movements of a craftsman's tools that convey the form of the craft.

²⁹ Sean Kelsey helpfully suggested teaching as a model for making these distinctions.

³⁰ I am assuming that the change to possession of the form French is analogous to Aristotle's description in *Physics* 1. 7 of the change from unmusical to musical that the man undergoes when he acquires the form *μουσική*. Just as there are formally unimportant but causally significant aspects of learning a language (such as the acquisition of a particular accent), there are similar aspects of learning *μουσική*, such as style of performance.

³¹ A defender of the subspecific-forms interpretation might offer a competing analogy according to which it is a *Parisian French* accent that is aimed at, on the grounds that acquisition of Parisian French form is the goal, not just French form. I discuss this alternative later.

belongs to the teacher *qua* French teacher in the sense that it is something that he can pass on to the student by the process of teaching French. But since French form does not prescribe a Parisian accent in particular, that accent is not part of the French form that the teacher possesses and that his teaching aims to transmit.

It is along these lines that I propose that we think of a potential belonging to the parent *qua* generator, i.e. with respect to the parent's reproductive role. The particular Parisian accent belongs to the French teacher *qua* French teacher (and not accidentally) because that accent can be non-accidentally transmitted through the process by which French is taught. Similarly, potentials that belong *qua* generator differ from those that belong accidentally to that generator in that they *can* be non-accidentally passed on in reproduction.³² And just as the particular French accent can be non-accidental with respect to the teaching process despite being accidental with respect to French form (the transmission of which is the goal of the teaching process), these subspecific potentials can still be non-accidental with respect to the generative process despite being accidental with respect to species form (the transmission of which is the goal of the reproductive process).

3. Subspecific form and reproductive hylomorphism

So far I have argued that the fact that subspecific, inherited traits are the results of the *kinēseis* that are drawn from potentials that the father has non-accidentally does not entail that those traits are due to the substantial form that the father provides. Potentials that belong *qua* generator need not be ones that belong *qua* substance, i.e. as part of substantial form. Rather, I have suggested that '*qua* generator' signals that the potential is one that can be transmitted by the generative process.

The discussion of inherited traits in *GA* 4. 3 does not, therefore, definitively commit Aristotle to a notion of subspecific form. But neither does that discussion explicitly rule out subspecific form. In fact, the word for form (*eidos*) does not even occur in that chapter.

³² This, I take it, is the point of the contrast with accidental features that can be common to children and parents, but which Aristotle says belong accidentally *qua* generator. If Coriscus is someone's neighbour, then his offspring who live with him will have the same neighbour. And Coriscus, being literate himself, is likely to have a literate child. But these are not biologically inherited resemblances.

It is open to the defender of the subspecific-forms interpretation to point out that for all Aristotle says in that chapter, it is possible that all of the potentials that belong *qua* generator are included in the form passed on in reproduction. Some of those potentials would be accidental with respect to species form, but *all* of them would be included in the organism's form. That is, *form* would include all those potentials for which there are corresponding *kinēseis* in the spermatic fluids. My opponent might think that in my example I should have said that the form that the student receives from the teacher is *Parisian French* form—that the form acquired in learning the language is subspecific—even though a Parisian accent is accidental with respect to French.

However, the offspring will resemble the mother when the male's *kinēseis* fail to prevail, and so the *kinēseis* that she provides are used during the formation of the embryo. And as Aristotle says again and again, what the mother provides in animal reproduction is matter and not form. But if the subspecific, inherited features that these *kinēseis* produce are part of form, then either she also contributes form (and so despite what Aristotle initially says, the mother must end up making the same sort of contribution as the male does)³³ or she does not really contribute *kinēseis* for subspecific features.³⁴ A common reaction among scholars is to take this apparent inconsistency as an indication of the need to qualify or amend our understanding of Aristotle's reproductive hylomorphism.³⁵ A

³³ In addition to his many scattered remarks distinguishing the male and female roles in generation, Aristotle's lengthy discussion in *GA* 1. 17–18 of the pangenesis view that assigned the same sort of contribution to both parents is incontrovertible evidence that his considered view is that the male and female must make *distinct* kinds of contributions in reproduction. Right from the beginning of *Generation of Animals* Aristotle identifies the female and male as the principles of generation: the male is the active principle in that he has the source of change and generation, and the female is the passive principle who supplies the matter (1. 2, 716^a4–7). In doing so, Aristotle is self-consciously satisfying constraints on adequate causal explanation that he set out in his discussions of natural science in *Physics* 1 (1. 7, 190^a13–16) and *Metaphysics Z* (Z 7, 1032^a12–14; Z 8, 1033^a24–8). In those passages he makes it clear that any analysis of change must identify not only an agent of the change but also a thing changed—the patient.

³⁴ See n. 9 above for a brief discussion of a third option that I am not considering here.

³⁵ Morsink, *Study*, 141–3, for example, takes this 'admission' of a contribution from the mother to be a qualification of reproductive hylomorphism. Balme, 'Not Essentialist', 293–4 n. 14, tries to downplay this tension by claiming that Aristotle's statement that the male provides form and the female provides matter is 'only true when carefully qualified'. Henry, 'Hylomorphism', defends a view according

less common yet still influential strategy involves explaining how maternal resemblance can be attributed to the form that the father provides.³⁶ Let us consider these two strategies in turn.

4. Does the female also contribute form?

Is there any evidence that Aristotle thought that females contribute form? There are at least some respects in which the female's contribution might be thought of as involving form. The matter that she provides—the menstrual blood—is far from inert or featureless. In the preface to his edition and translation of *Generation of Animals* Peck points out that the matter in the context of biological reproduction has a quite complex form.³⁷ As Aristotle explains, the menstrual fluid or *katamēnia*, like the father's semen, is a residue 'cooked up' from the blood that nourishes and constructs the organism's body. Because it is a residue from this blood, the *katamēnia* has, in potential, all the parts of the living body that come to be formed out of it (2. 3, 737^a22–4). In fact, even though that residue will not be potent enough to allow her to reproduce on her own (since females are less hot than males and so the female's *katamēnia* is not as well concocted as the male's semen), Aristotle does seem to think that in some cases females can generate up to a point (1. 21, 730^a30–1). Some female animals, Aristotle claims, can make 'wind eggs', which are a sort of unfertilized egg (1. 21, 730^a4–7) that is nevertheless alive in some way (2. 5, 741^a19–21).

The discussion of wind eggs arises prominently in *GA* 2. At the end of *GA* 2. 4 Aristotle concludes that for reproduction 'among the animals in which [the males and females are separate], the female needs the male' (741^a4–5). He then begins *GA* 2. 5 by asking why that should be the case:

to which reproductive hylomorphism is really the thesis that the male provides *sensory* soul. Like Henry, Peck argues that the mother's role is more extensive than Aristotle's more general comments might lead us to think; in fact, the mother provides not just matter but also nutritive soul. Since a living organism's soul is its form, this means that the mother provides at least part of the offspring's form. Peck thinks this is evident in Aristotle's discussion of a phenomenon he calls 'wind eggs'. In sect. 4 I assess the evidence Peck offers for interpreting reproductive hylomorphism in this way.

³⁶ This strategy, discussed below, is employed in Cooper, 'Metaphysics', and Reeve, *Knowledge*.

³⁷ Peck, *GA*, xiii.

And yet someone might be puzzled about what the cause of this is. If indeed the female has the same soul and the matter is the female's residue, why does she need the male and not generate all on her own? (741^a6–9)

In living organisms the form is the soul. Among animals, adult females have the same sort of soul as the male. Since the female provides the matter, she seems to have both the form and the matter *herself*. So, Aristotle asks, why does she need the male at all in order to reproduce? His answer is given at 741^a9–15:

The reason is that an animal differs from a plant with respect to sensation. It is impossible for a face or hand or flesh or any other part to exist if it does not have sentient soul either in actuality or in potentiality or in some way or just simply. For it will be like a corpse or part of a corpse. If, then, the male is the agent of this sort of soul, wherever the female and male are separate it is impossible for the female to generate an animal all by herself.

Aristotle here suggests that the reason a female cannot generate a new animal all by herself is that she cannot provide *sentient* soul, the possession of which differentiates animals from plants.³⁸ For Aristotle, even plants have soul, but there is a hierarchy of types of soul and plants have only the lowest kind—nutritive soul. Nutritive soul is the set of capacities an organism has for performing basic vital activities such as nutrition and maintenance. In addition to nutritive soul, animals have sentient soul. And humans will have not only nutritive soul and sentient but also rational soul. In the passage above, Aristotle says that males are necessary for animal generation because males provide sentient soul; being able to provide sentient soul is 'what it is to be' the male (741^a13–16).

Still, Aristotle acknowledges that there is reason to be puzzled, particularly since females of some bird species produce what he calls 'wind eggs'. Although these wind eggs are not alive in the same way that fertilized eggs are, they do perish, which seems to indicate that they were alive in some sense. Wind eggs are not completely devoid of life like wooden or stone eggs (741^a18–23).

Peck takes this to show that the female must also contribute form:

Hence, the meaning of the statement that 'the male supplies the Form' can only be that the male supplies that part of the Form known as sentient Soul: everything else, including nutritive Soul, can be, and is, supplied by the female. (Peck, *GA*, xiii)

³⁸ Cf. *DA* 2. 2, 413^b1–4.

Yet Peck's suggestion that the female provides everything except that part of soul in virtue of which an organism is an animal—sentient or perceptive soul—is questionable. It is doubtful that the mother supplies the nutritive soul in an unqualified way. While Aristotle does say that wind eggs have soul, he adds that it is clear that they have soul only potentially (741^a23).³⁹ Wind eggs do not *actually* have nutritive soul.

There are living organisms that have nutritive soul in actuality but lack sentient soul, namely plants. But Aristotle does not think that the mother makes a plant that can then become an animal once sentient soul is added.⁴⁰ Although it is *like* a plant in that it has nutritive soul, the wind egg is not, strictly speaking, a plant. Wind eggs are not generated in the way that plants are, and will not develop further (as a plant would).⁴¹

Moreover, Aristotle says that nothing *actually* living—nothing ensouled (*empsychon*)—is made by the mother (2. 3, 737^a32). Thus, even if wind eggs are plant-like, an organism has nutritive soul *in actuality* only when it has the parts or organs that are needed to perform nutritive soul functions, which parts and organs a wind egg does not have.⁴²

There may still be room to argue that this discussion of wind eggs shows that the female can sometimes contribute nutritive soul on her own. This nutritive soul would presumably not be the same sort of nutritive soul that a plant has, and might even include the potential presence of sentient soul. However, even if it were the case that sometimes females can contribute an animal's nutritive soul, this still would not show that Aristotle thinks

³⁹ In the subsequent lines Aristotle makes it explicit that he means they have *nutritive* soul in potential.

⁴⁰ He does liken the embryo's life to that of a plant at 2. 3, 736^b12–13. However, in this passage Aristotle's point is that the newly forming animal is at this stage in possession of nutritive soul only potentially, and not actually, since it does not digest its own nourishment. It is thus like a plant in so far as the plant's 'digestion' takes place in the soil in which it is living. It is only in this respect that Aristotle thinks embryos are like plants. The embryo at this stage is certainly unlike a plant that has nutritive soul in actuality.

⁴¹ 3. 7, 757^b26–7: 'For neither has [the wind egg] come to be as a plant simply [*ἀπλῶς*], nor as an animal by copulation.'

⁴² Cf. 2. 1, 734^b24 ff. This is also why the *σπέρμα* and *κῆμα* have nutritive soul only *potentially* at 2. 3, 736^b8–12: 'Well then, it is clear that the *σπέρματα* and *κῆματα* which are not yet separate on the one hand have nutritive soul potentially, but on the other hand do not have it in actuality until, just like the separated *κῆματα*, they draw in nourishment and do the work of this sort of soul.'

this is what *usually* happens or that it happens among animals other than birds; more argument is needed for the claim that her role always extends as far as contributing something that actually has nutritive soul. Moreover, even if it could be shown that the mother's contribution—the *katamēnia*—is something that has form, there is a more general worry about inferring from this that she provides part of the offspring's form. This inference makes use of too crude a picture of what it is to be the matter for some change.

As Aristotle conceives of matter, it is not just physical stuff of the sort studied in materials science departments today. Matter is one of the four causal factors Aristotle introduced in the *Physics*, where it is called the cause as 'that out of which something comes to be as a constituent' (2. 3, 194^b23–4). Bronze, for example, is the matter of the statue that comes to be formed out of it.

What counts as the matter for any given change depends upon what that change is a change *into*. Aristotle calls that which the change is a change into in this sense the 'form' for the change. As Aristotle tells us explicitly in the *Physics*, 'matter is relative; for there is different matter for a different form' (2. 2, 194^b8–9). For instance, clay might be the matter for the bricks, while bricks are the matter for the house, but clay is not, strictly speaking, the matter for the house. The clay takes on brick form and the bricks take on house form, but the change into a house is not a change of which the clay is the matter. So whether something is the matter for some change or not depends upon what the form of the change is.⁴³

That which plays the role of the matter for a change will itself be something *of some sort*, a hylomorphic composite of form and matter. Thus, the matter for a change will have some formal cause of its own, as well as features and properties that belong to

⁴³ Cf. *Metaph.* Θ 7, 1048^b37–1049^a18. The point that clay is not, properly speaking, the matter for the house might alternatively be put by saying that bricks are potential houses to a greater degree than is the clay that the brickmaker uses to make the bricks. The matter for a change must have the form potentially, and it is common Aristotelian doctrine that there are grades of actuality and potentiality. Cf. also *DA* 2. 5, 417^a21–^b2. This Aristotelian doctrine is discussed in A. Code, 'Soul as Efficient Cause in Aristotle's Embryology', *Philosophical Topics*, 15 (1987), 51–9 at 56–7. As Code points out, both the form and the matter for the developing embryo can exist at varying levels of passive and active potentiality, respectively. What I want to emphasize here is that the matter the mother provides can be at a high level of passive potentiality without thereby playing an active, rather than passive, role.

it non-accidentally.⁴⁴ But that does not imply that it cannot play the role of matter in a particular change. Bricks, for instance, have form, and they have features or properties that can be manifest in the completed house (e.g. their colour or texture) without thereby making a ‘formal’ contribution to the house in the sense of contributing the form of the house. Aristotle may have thought that the brickmaker provides form—brick form—to the clay the bricks are made from. But he does not think that for this reason the brickmaker provides part of the house form; this is what the housebuilder provides. Similarly, the mother’s role is to provide the matter for animal generation, and this matter is quite complex—perhaps even to the point of having nutritive soul in a qualified way.⁴⁵ But this does not change the fact that the mother is contributing the matter for the substantial change, and not form. When Aristotle says that the mother is the passive element that provides the matter and the father is the active element that provides the form, he is distinguishing their *roles* in the substantial change. To say that ‘matter *qua* matter is passive’ (*GC* I. 7, 324^b18) is to say something about *how* matter contributes to some change, and not *what* matter contributes.⁴⁶

Aristotle’s discussion of wind eggs does not provide the textual evidence needed for rejecting or amending his repeated claim that the female does not contribute form. First, the textual evidence adduced is questionable, since it is not clear that Aristotle thinks that wind eggs are actually ensouled. Second, even if they were, his views about the relation between matter and form would not preclude the mother from providing solely the matter for animal generation, even if that matter were ‘informed’ to a high degree. If those *kinēseis* in the female’s *katamēnia* are the *per se* causes of those inherited features by which the offspring resembles its mother, then those features cannot be due to the form.

⁴⁴ If Aristotle believed in ‘prime matter’, it would only be in most cases that the matter is a hylomorphic composite.

⁴⁵ Even if it were the case that wind eggs had nutritive soul unqualifiedly—and I do not think they do—that would not blur the distinction between the female’s contribution and the male’s. In this case, what would be potentially an animal, in need only of contact with the appropriate active potential, would be not her menstrual fluid but that wind egg that she makes. She would still provide only the matter for the substantial change.

⁴⁶ Cf. *GA* I. 21, 729^b12–13: ‘Of course the female *qua* female is passive, the male *qua* male is active.’

5. Is the male responsible for maternal resemblance?

An alternative strategy for resolving the tension between maternal inheritance and subspecific forms is to deny that the *kinēseis* responsible for maternal resemblance come from the mother. Rather, we might suppose that on Aristotle's view, reproductive hylomorphism is supposed to go all the way down to those inherited characteristics: the father is responsible for all the features of its offspring, including those features by which the offspring resembles its mother and maternal ancestors. Consequently, since all those features that are passed on to the offspring are due to the male, there is no tension between reproductive hylomorphism and the interpretation of forms as subspecific.

If we are to adopt this view we must explain *how* the father is responsible for all those features, in particular for those that seem to be traced back to *kinēseis* in the mother's menstrual fluid. One influential strategy, which John Cooper has employed, is to appeal to *GA* 4. 3, 768^a11–14, where Aristotle says that the mother's *kinēseis*, as well as those of the ancestors, are present *in potential*:

Some of the movements are present [*eneisi*]⁴⁷ in actuality, and some in potential; in actuality are those of the generator and of the universal, such as human and animal, in potential those of the female and of the ancestors.

Cooper reads this passage as claiming that the *kinēseis* responsible for maternal resemblance are potentially present *in the male semen*. This is a controversial reading, and the text leaves open two more plausible options. These *kinēseis* could be potentially present in the menstrual fluid or in the embryo, rather than the male's semen. It is not likely that Aristotle thought that there was a 'physically realized representation of the movements of the females he can copulate successfully with (and their ancestors)' in the male's semen.⁴⁸ Cooper suggests, more plausibly, that what Aristotle means when he says the maternal *kinēseis* are in the male's semen potentially is that the male's *kinēseis* can 'elevate' to the level of actuality the female's *kinēseis*, which are present only potentially beforehand.⁴⁹ Although there are physical *kinēseis* in the mother's *katamēnia*, these are,

⁴⁷ Cooper, 'Metaphysics', 70 n. 14, claims that this *ἐνεῖσι* refers back to *σπέρμασι* at 4. 3, 767^b36, and that there Aristotle must be referring to the male's spermatic fluid.

⁴⁸ Ibid. 72.

⁴⁹ 'On this conception, the semen would be said to have these movements poten-

on Cooper's proposed reading, in the semen potentially in that the semen has the power to make those *kinēseis* actually present in the offspring's blood. The *kinēseis* of the female and ancestors are only potentially present until they become *actual* movements by the father's agency, and so in this way the father is responsible for those maternal-resembling features in the offspring. Consequently, maternal resemblance creates no problem for maintaining both that forms passed on in animal reproduction are subspecific and that Aristotle endorsed reproductive hylomorphism.⁵⁰

The intuition behind Cooper's interpretation seems to be that since the father is the primary agent of the whole process of generation, all of the results of the process must be due ultimately to him. Cooper is certainly right that the father, and only the father, is the agent who contributes form. However, as I shall go on to show, this does not entail that all the results of the generative process are due to the form that the father provides.

In the next section I provide an alternative interpretation of Aristotle's account of inherited characteristics that is consistent with reproductive hylomorphism and allows those *kinēseis* that the mother provides to be the *per se* causes of those features by which the offspring resembles her. The interpretation I offer, moreover, does not require that the form passed on by the father be subspecific.

6. Agents, patients, and tools

'Matter' and 'form' often refer to the passive and active causal factors, respectively, that Aristotle thinks are involved in any

tially, just in virtue of the fact that it is capable of making the embryo have them as movements of its form—despite the fact that the semen does not impose them, in the sense of transferring from itself movements already actually or virtually existing in it, so much as simply work to strengthen movements provided by the mother in the catamenia' (ibid.).

⁵⁰ Reeve offers a slightly different strategy for attributing those *kinēseis* to the father that makes use of Aristotle's claim that females are deformed males. According to Reeve, the *kinēseis* in the female's menses alter and so deform the male's movements, which are transmitted to the offspring: 'Generalizing, we can say that whenever a movement deriving from a male form is altered or deformed by the natural tendencies in the female menses, the resulting fetus will itself be deformed (*GA* 4. 3, 767^a36–^b15). But it will be deformed, as opposed to having an undeformed form contributed by its mother, precisely because it is always the father who contributes the actual movements that concoct the menses' (Reeve, *Knowledge*, 53–4).

change. In Aristotle's embryology, when he says that the mother is the passive element that provides the matter and the father is the active element that provides the form, he is distinguishing their *roles* in the substantial change. This is evident in his association of father and mother with agent (that which acts) and patient (that which is acted upon), respectively, throughout *Generation of Animals*.⁵¹ The importance of their having these separate roles underpins arguments Aristotle gives both for and against particularities of his own and his predecessors' views. An example of this is his argument that the female does not emit *sperma* like the male, and so the offspring is not a mixture from both parents' *spermata*. At the end of a lengthy discussion (spanning *GA* 1. 19–20) about the nature of the residue emitted by the female, he concludes that she does not emit *sperma* as the male does. The 'universal' (*katholou*) reason Aristotle gives for this is as follows:

For it is necessary that there be a generator and that out of which, and even if these should be one,⁵² at least they must differ in *eidos* and the *logos* of these must be different. But in those [organisms] having separate *dunamis* both the body and the nature of what is acting [*poiountos*] and what is being acted upon [*paschontos*] must be different. If then the male exists as mover and agent, and the female exists as patient, the female would contribute to the semen of the male not semen but matter. Which very thing also apparently happens. (*GA* 1. 20, 729^a24–32)

The reason females cannot contribute the same sort of spermatogenic fluid as the male does, Aristotle here explains, is that they have different roles in the production of the new organism; the male is the agent and the female is the patient. This is primarily how Aristotle is thinking of the respective contributions of the male and the female in animal generation.

According to Cooper, since the father is the active factor, any feature that is produced by the reproductive process must be due to him. Cooper asks us to imagine a sculptor trying to shape some stone that is too soft and thus too difficult for that sculptor to manipulate precisely. Consequently, some features of the finished statue

⁵¹ Aristotle uses the same vocabulary of agent and patient (*ποιῶν* and *πάσχων*) as he does in *GC* 1. 7–9 to describe the roles of mother and father throughout *Generation of Animals*, e.g. 1. 20, 729^a24–30; 1. 21, 729^b9–21.

⁵² Aristotle thinks that the 'male' and 'female' *δυνάμεις* are 'mixed together' in plants and hard-shelled organisms (*δοσπρακόδερμα*); that is, there are not male and female organisms, but each individual has both sorts of principle. Cf. *GA* 1. 23, 731^a1–2, 731^b8–13; 2. 1, 732^a11–12.

will not be what the sculptor intended. Cooper thinks that those unintended features should still be attributed to the sculptor's art:

Then whatever features of shape, surface texture, etc., the resulting statue has will have been the product of *his* art: his art will have been the originating source, and the only originating source, of these outcomes (assuming nothing pushes his hand or falls on the statue while he is working on it that affects these features). The stone itself contributes only as matter, not as a source of any of the changes it undergoes while these outcomes are being achieved. (Cooper, 'Metaphysics', 77–8)

We might concede to Cooper that there is some sense in which the sculptor's art is the ultimate source of all the features in the statue. But the sense in which this is so does not entail that all those features are part of the sculptor's art. Seeing why this is will provide us with the materials for an interpretation of Aristotle's account of inherited characteristics that employs species form.

The sculptor's art is, in the language of *GC* 1. 7, a 'first agent' (which acts without itself being affected). However, the art, when exercised, must be exercised in a particular way, and with particular tools and techniques. These tools and techniques are 'last agents' (which make contact with what they act upon, and are therefore also affected).⁵³ In general, 'last agents' can have *per se* effects that are distinct from the effects of form, the first agent. For example, the doctor will use food or drugs as tools or instruments by which the form of health is conveyed to the patient. Those instruments might consist of a special diet (e.g. of raw foods and cold liquids) that aims at reducing the temperature of the patient's blood. The determinate reduction of temperature will be the *per se* result of the diet. But that medical expertise, the knowledge that the doctor

⁵³ 'The same account must hold for acting and suffering as for being moved and moving. For 'mover' is said in two ways: that in which the principle of motion exists is held to be a mover (for the principle is the first of the causes); and again, the last [mover] towards the thing being moved and the generation is held to be a mover. Similarly with 'agent'; for we say that both the physician and the wine heal. So, nothing prevents the first mover in a change from being unmoved (and in some cases this is even necessary), while the last [mover] always moves by being itself moved. Further, in action the first [agent] is unaffected, but the last itself suffers. For as many things as do not have the same matter, these act while being unaffected (e.g. the medical skill, for this is affected in no way by the thing being made healthy while producing health), whereas the food is also affected in a way while producing [health]—for it is heated or cooled or affected in some other way at the same time as it is producing [health]. The medical skill is the principle, and the food is the last [agent] and thing in contact [with what is acted upon]' (324^a24–^b4).

has in virtue of which he is said to have that *technē*, can still be and aim at something general, namely health.⁵⁴ Similarly, we can concede that the sculptor's art is the first agent of the results of the sculpting process without inferring that the sculpting art aims, *per se*, at all the results of the process; in particular, the art need not prescribe those results of which the particular tools and techniques used in bringing about the statue are the *per se* causes. Tools can have *per se* effects that are far more determinate than the proper aim or goal of the first agent that uses them.

If this is right, the *kinēseis* from the female (as well as those from the male) can be the *per se* causes of features in the offspring, even though only the male provides form. For what Aristotle says about the *kinēseis* is that they are 'tools':

. . . as the products of art are made by means of the tools of the artist, or to put it more truly by means of their movement, and this is the activity 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 in these is the movement of the soul), 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* 2. 4, 740^b25–34, trans. Platt)⁵⁵

Aristotle tells us in this passage that the *kinēseis* ('in' heat and cold) are used by nutritive soul in a manner analogous to the way that tools are used in craft production. Nutritive soul is the capacity an animal has to engage in various vital activities such as digestion, growth, and reproduction. These activities are, on Aristotle's view, primarily achieved by means of concoction: food is concocted into blood, blood is concocted into parts and organs,

⁵⁴ Cf. *NE* 10. 9, 1180^b13–22: 'But individuals can be best cared for by a doctor or gymnastic instructor or anyone else knowing universally [*καθόλου*] what is good for everyone or for people of a certain kind (for the sciences both are said to be, and are, concerned with what is common [*τῶν κοινῶν*]); not but what some particular detail may perhaps be well looked after by an unscientific person, if he has studied accurately in the light of experience what happens in each case, just as some people seem to be their own best doctors, though they could give no help to anyone else. None the less, it will perhaps be agreed that if a man does wish to become master of an art or science he must go to the universal, and come to know it as well as possible; for, as we have said, it is with this that the sciences are concerned.' See also *Rhet.* 1. 2, 1356^b30–3: 'No art [*τέχνη*] considers the individual. The medical art [*ἰατρική*], for instance, [does not consider] what is healthy for Socrates or Callias, but [what is healthy] for this sort or these sorts (for this is in the province of art [*ἐν τέχνῳ*], but the individual is indefinite and not knowable).'

⁵⁵ See also, for example, 1. 22, 730^b19–24; 2. 6, 743^a36–^b5.

and excess nutritive blood is concocted into semen and *katamēnia*. Concoction endows the blood with *kinēseis*—a series of heatings and coolings, similar to a chemical process, perhaps—which are used in the growth and maintenance of the parents' bodies. Since the generative fluids are residues from the concoction of blood, the same *kinēseis* that were present in that blood will be present in their generative fluids and passed on to the offspring, where they will be used in the formation of its body.⁵⁶ In this way, the *kinēseis* function as tools not only in reproduction but also in the performance of other nutritive soul activities.

Concoction, like any vital activity, requires the presence of an organ by which the organism can engage in it. This is why, Aristotle says, the heart must be formed first: the heart is the organ by which nutritive soul activities are primarily exercised, and nutritive soul must be present first since there must be a source or principle (*archē*) of the subsequent arrangement of the animal's body.⁵⁷ Once the rudimentary heart is formed by the initial action of the semen upon the *katamēnia*, the *kinēseis* from both parents are available for use as tools in the generation of the new organism. And, as we saw in the discussion of the passage at 4. 3, 767^b23 ff., there are *kinēseis* not only for more general traits (e.g. animal or human traits), but also for the very determinate, subspecific features by which offspring resemble their families more than other members of the species. And this is as it should be, since Aristotle thinks the development of the embryo proceeds in stages from most general (first it is only an animal) to most particular (the particular shape of nose, perhaps).⁵⁸ Since the *kinēseis* are used as tools to construct the body at each stage, there are *kinēseis* for features at all levels of generality. Thus the *kinēseis* the female provides can be the *per se* causes that 'fashion and shape' the embryo; although only the father is the agent of generation, all of the *kinēseis*, both those from the father and those from the mother, can be tools.⁵⁹

⁵⁶ Aristotle tells us long before the discussion in *GA* 4. 3 that this fact about *σπέρμα*—that it is formed from nutritive blood and so has those same motions in it—is what explains family resemblance. See 1. 18, 725^a21–7; 1. 19, 726^b1–24.

⁵⁷ See *GA* 2. 4, 739^b33–740^a24.

⁵⁸ See 2. 3, 736^b2–5. Clearly there is a question about what it means to be 'only an animal' and so also about what those *κινήσεις* for more general traits would be for. One option might be that an organism is an animal only when it has a heart (or the analogous organ in bloodless organisms), and so a *κίνησις* for a more general trait might be one that is the *per se* cause of the heart.

⁵⁹ I am taking Aristotle's language quite literally in treating the *κινήσεις* as tools

Now what goes for tools generally should also go for these *kinēseis* used by nutritive soul. And what I have been suggesting goes for tools generally is that they normally have *per se* effects that are much more specific than the effects at which the 'first agent' that uses them aims.⁶⁰ Like a *technē*, the father's nature or soul is a first agent; like other tools, those *kinēseis* are last agents. The *per se* effects or aims of a first agent (the soul or the *technē*) responsible for some change usually do not include all of the effects of the last agents. In so far as the aim of the first agent can be characterized generally as the imparting of form (whether the soul of the living organism or the form of health), it does not follow that every effect of the last agents is due to the form.

Consequently, Cooper's inference from the fact that the male is the agent to the claim that the male contributes maternal features need not be made. If we were forced to accept the subspecific-forms interpretation, we might be inclined to make some such move to accommodate maternal resemblance, rather than deny reproductive hylomorphism in the way that Peck does. However, as I argued in Section 2, we are not so forced. Moreover, in this section I have sketched an alternative way to accommodate Aristotle's account of inherited characteristics within the hylomorphic framework in which the theory of generation is given.⁶¹

distinguishable from the form or soul that uses them. Alternatively, it might be thought that these *κινήσεις* are, for Aristotle, just what having soul amounts to. (In this spirit Balme speaks of the *κινήσεις* in the seminal fluids being potentially the offspring's soul: see n. 28 above.) A virtue of that alternative picture is that it sidesteps any need to explain how soul and those physical *κινήσεις* are related, which is a challenge for anyone who takes literally talk about soul as an agent using *κινήσεις*. On the alternative view, soul just is reducible to those *κινήσεις*. It is not obvious that this reductive picture is Aristotle's, however. Soul or nature is a *δύναμις*, and is a principle or source from which *κινήσεις* arise (*Metaph. Θ* 8, 1040^b8–10). The soul is not a *κίνησις*. Of course, there is no distinct physical entity that is the soul. But this should not threaten the conceptual distinction between soul and body.

⁶⁰ The idea that *κινήσεις*, which are 'in' or dependent on heating and cooling, have their own *per se* effects is implied by 2. 1, 734^b28–735^a4, where Aristotle is making the point that heating and cooling alone are not sufficient to make any of an organism's functional body parts, despite their being sufficient to produce certain *πάθη* such as hardness or brittleness.

⁶¹ This rough picture requires much smoothing out. In particular, it must be supplemented by a story about what it means for the soul or nature to 'use' those *κινήσεις* as tools. Aristotle does not describe anything in animal reproduction analogous to the craftsman who is holding the hammer or the doctor prescribing diets. This, I take it, is part of a general question about what Aristotle means when he speaks of the soul 'using' the body, or how it can be the source of movement in the

7. Conclusion

I began by noting that there is a putative inconsistency between the idea that form is essence and the idea that form is the moving cause of animal generation. The form identified with essence in Aristotle's *Metaphysics* seems to be one shared by members of a species, but many scholars have held that Aristotle's account of inherited characteristics shows that he is using subspecific forms in embryology. I have argued that nothing Aristotle says in *Generation of Animals* constitutes definitive evidence that forms in embryology are subspecific. Moreover, we saw that the subspecific-forms interpretation creates problems for the internal consistency of *Generation of Animals* that are not easily resolved. If the form that the father transmits in sexual reproduction is subspecific, there is a tension between Aristotle's reproductive hylomorphism and the idea that the mother contributes subspecific features. I have considered two ways that interpreters have attempted to resolve this tension and argued that both involve assumptions that are questionable, given Aristotle's other commitments. In the last section I outlined an interpretation of the account of inherited traits that avoids the tension between reproductive hylomorphism and maternal resemblance. The male provides form, and the female provides matter, but they both contribute *kinēseis*. The *kinēseis*, and not form, are the *per se* causes of inherited traits. Since they are tools used in the process of generation, *kinēseis* can have *per se* effects distinct from the effects of the first agent who imparts form. This

body without itself being moved, which is a subject that needs separate treatment. While this does need to be answered somewhere, I do not think that answer is to be found in *Generation of Animals*. There he speaks of the soul using the body (or the *κινήσεις*, which are in the body), but does not try to explain what that means. J. G. Lennox discusses Aristotle's ascriptions of agency to soul, an organism's formal nature, in 'Material and Formal Natures in Aristotle's *De partibus animalium*', in id., *Aristotle's Philosophy of Biology: Studies in the Origins of Life Science* (Cambridge, 2001), 182–204, where he notes, correctly, that this should not be taken as merely metaphorical. The relation between such ascriptions of agency to nature and Aristotle's teleology is discussed in A. Preus, *Science and Philosophy in Aristotle's Biological Works* (Hildesheim and New York, 1975), ch. IV, pt. B, 221–44. I shall simply state here without defence that this is a worry that arises not only for the soul's relation to the living body that it uses as its tool, but also for any τέχνη; it is the medical art in the mind of the doctor, not the doctor, that is in the strictest sense the moving cause of the healing. Cf. *Phys.* 2. 3, 195^b21–5. For a discussion of this point see S. Menn, 'Aristotle's Definition of Soul and the Programme of the *De anima*', *Oxford Studies in Ancient Philosophy*, 22 (2002), 83–139.

interpretation does not require subspecific forms, and so would allow one both to hold on to the doctrine that form is essence, and to assign to species-form a primary causal role in animal generation.

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