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Material souls and imagination in Late Aristotelian embryology

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Summary

This article explores some continuities between Late Aristotelian and Cartesian embryology. In particular, it argues that there is an interesting consilience between some accounts of the role of imagination in trait acquisition in Late Aristotelian and Cartesian embryology. Evidence for this thesis is presented using the extensive biological writings of the Padua-based philosopher and physician, Fortunio Liceti (1577–1657). Like the Cartesian physiologists, Liceti believed that animal souls are material beings and that acts of imagination result in material images that can be transmitted by means of medical spirits to the embryo. Moreover, while the Cartesian embryologists accepted such a view in a quite speculative way, one finds penetrating criticism of imagination theories of trait acquisition in the Late Aristotelian tradition. Evidence for this thesis is presented using the no less extensive biological writings of Liceti's contemporary, Emilio Parisano (1567–1643). In conclusion, the Late Aristotelian tradition itself provides the theoretical tools for excising immaterial formative forces from embryology and at the same time evinces a much more acute sense for the problems inherent in imagination theories of trait acquisition than the Cartesian tradition.

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1. Introduction

In a recent article, Justin Smith examined the effort of Descartes and Cartesian mechanist physiologists to eliminate Aristotelian formative virtues from their theories of sexual generation. Smith points out that 'in seeking to explain heredity in terms of congenital acquisition alone, something very much like the Aristotelian notion of a formative virtue persists under a new guise'.¹ Aristotelian formative virtues are forces that work on the fetus in the course of its development in such a

¹ Justin E.H. Smith, 'Imagination and the Problem of Heredity in Mechanist Embryology', in *The Problem of Animal Generation in Early Modern Philosophy*, edited by Justin E.H. Smith (Cambridge, 2006), 80–99 (81).

way that the traits produced by formative virtues are not determined by features of the parental seed.² As Smith notes, the idea of forces that work on the fetus in the course of its development was reinterpreted within the framework of mechanist embryology. He writes:

In premechanist embryology ... there is an independent formative power with which the mother's imagination might interfere ... In mechanist embryology ... without any notion of an immaterial force working upon the matter contained in the uterus, or of a teleology toward which this form may conspire with the matter to move, the only formative power left to appeal to would be the imagination.³

As is well known, Descartes invoked the mother's imagination to explain cases of defective reproduction (such as the occurrence of birthmarks or elements of 'monstrosity'). In particular, he holds that the maternal imagination has an influence, by way of the umbilical arteries, on the form of the exterior parts of the fetus.⁴ What is more, Smith has brought to light the much less appreciated fact that the Cartesian mechanists invoked the workings of imagination not only to explain cases of defective reproduction but also to explain cases of undefective reproduction of animal species.⁵ Malebranche even went so far as to claim that the specific similarity between parent and offspring would be inexplicable without the workings of imagination.⁶ What makes these explanations part of a specifically mechanistic natural philosophy is that according to Cartesian mechanists, as Smith puts it, 'imagination is a bodily process like any other, capable of being explained in terms of the laws that bind all of mechanical nature ... Images, too, are entirely corporeal things'.⁷

In what follows, I will argue that the relationship between theories of imagination in mechanist embryology and theories of imagination in Late Aristotelian embryology is more complex than suggested by Smith. I will present some textual evidence indicating that imagination theories of trait acquisition became part of early modern attempts at 'mechanizing' Aristotle—attempts, that is, at reformulating certain Aristotelian concepts within a materialist framework. In particular, I will examine the views on material souls, their role in animal generation, and the role of the acts of imagination in material souls in the formation of the fetus in the thought

² For overviews of the history of this idea, see Massimo Angelini, 'Il potere plastico dell'immaginazione nelle gestanti tra XVI e XVIII secolo. La fortuna di un'idea', *Intersezioni* 14 (1994), 53–69; Massimo Angelini, 'Voglie materne e teratogenesi: la storia di un'idea', in *La cura delle malattie*, edited by A. Guerci (Genova, 1998), 114–24. On the influence of the idea on popular culture, see Claudia Pancino, *Voglie materne. Storia di una credenza* (Bologna, 1996); Claudia Pancino, 'La croyance aux envies maternelles entre culture savante et culture populaire', *Ethnologie française*, 27 (1997), 154–62; Concetta Pennuto, *Simpatia, fantasia e contagio. Il pensiero medico e il pensiero filosofico di Girolamo Fracastoro* (Rome, 2008), 368–78.

³ J.E.H. Smith (note 1), 86.

⁴ Descartes, *Primae cogitationes circa generationem animalium* (Amsterdam, 1701), 11.

⁵ J.E.H. Smith (note 1), 93–96. See See Descartes, *La dioptrique* (Paris, 1637), Sixth Discourse; *L'homme*, in Rene Descartes, *Le monde, L'homme*, ed. Annie Bitbol-Hesperies and Jean-Pierre Verdet (Paris, 1996), 152ff.; Pierre-Sylvain Regis, *Philosophia naturalis* (Amsterdam, 1654), 300; Malebranche, *De la recherche de la verite*, bk. II, pt. I, ch. 7, *Oeuvres complètes de Malebranche*, edited by Genevieve Rodis-Lewis (Paris, 1962), 1:242.

⁶ Malebranche (note 5), 243.

⁷ Smith (note 1), 91.

of the Padua-based philosopher and physician, Fortunio Liceti (1577–1657).⁸ Nowadays, Liceti is best known for his naturalized account of the formation of monsters, which regards monsters as an appropriate subject matter of medical enquiry, not of theology.⁹ His work on the formation of monsters, however, only applies theoretical principles governing sexual reproduction developed in other, much less studied, biological works of his. In fact, Liceti was a prolific writer who published books also in other areas of natural philosophy. Victor Zoubov has shown in an article published in 1936 that Liceti's theory of light exemplifies such a combination of Aristotelian and modern views.¹⁰ Zoubov does not discuss Liceti's biological views but suggests that it would be interesting to pursue further the question of how Liceti combines Aristotelian and modern views in his biological and medical writings.¹¹ Although a long time has passed since the publication of Zoubov's article, his suggestion does not seem to have been taken up by other scholars.¹² The first, and main, aim of the present paper is to investigate how Liceti's imagination theory of trait acquisition exemplifies a conciliatory strategy integrating Aristotelian views with a theory of material images of imagination.

Any materialistic theory of the role of imagination in the formation of the fetus is clearly an important step in discarding immaterial formative forces from natural philosophy. But if my interpretation of Liceti is on the right track, such a step has been taken already within the framework of Late Aristotelian natural philosophy. Even if Descartes and his followers may have been critical of some concepts that were still in use in Late Aristotelian natural philosophy, their views concerning the role of imagination in the formation of the fetus are not so far away from those of Late Aristotelian thinkers such as Liceti. Obviously, however, even within materialist frameworks, imagination theories of trait acquisition are highly problematic. In fact, one may wonder why acute thinkers such as Descartes and Malebranche were attracted to theories as speculative as imagination theories of trait acquisition. I don't have to offer a good explanation for the Cartesian acceptance of the theory. Rather, I would like to draw attention to some Late Aristotelian criticisms of the theory. This is the second, and somewhat subordinate, aim of this paper. In particular, I will explore detailed criticisms in the work of Liceti's contemporary, Emilio Parisano (1567–1643). Considering these criticisms will make clear that already in the early seventeenth century the imagination theory of trait acquisition faced serious

⁸ For bio-bibliographical informations on Liceti, see Charles H. Lohr, 'Renaissance Latin Aristotle Commentaries: Authors L-M', *Renaissance Quarterly* 31 (1978), 532–603 (540–41). Some of Liceti's still extant manuscripts have been studied by Lucia Rossetti, 'L'ultima opera di Fortunio Liceti in un manoscritto inedito della biblioteca del Seminario Vescovile di Padova', *Studia patavina* 5 (1958), 145–51; Gian Luigi Bruzzone, 'Sei lettere di Fortunio Liceti al P. Angelico Aprosio (1646–1653)', *Quaderni per la storia dell'Università di Padova* 37 (2004), 165–73.

⁹ See Fortunio Liceti, *De monstrorum causis, natura et differentiis* (Padua, 1616). On the role of Liceti's views in the development of early modern conceptions of monsters, see Jean Ceard, *La nature et les prodiges. L'insolite au XVIIe siècle, en France* (Geneva, 1977), 443–54; Annie Bitbol-Hesperies, 'Monsters, Nature, and Generation from the Renaissance to the Early Modern Period. The Emergence of Medical Thought', in *The Problem of Animal Generation in Early Modern Philosophy*, edited by Justin E.H. Smith (Cambridge, 2006), 47–62 (56–57).

¹⁰ Victor Zoubov, 'Une théorie aristotélicienne de la lumière du XVIIe siècle', *Isis* 24 (1936), pp. 343–60.

¹¹ *Ibid.*, p. 347.

¹² However, an overview of Liceti's biological writings is given in Guiseppe Ongaro, 'La generazione e il 'moto' del sangue nel pensiero di F. Liceti', *Castalia* 20 (1964), 75–94. Ongaro writes: 'The commitment of Liceti to the Aristotelian theory of generation and development is almost unconditional and total' (p. 80). Apparently, Ongaro seems to have been unaware of Liceti's conciliatory approach to natural philosophy.

empirical problems. Descartes and his followers seem simply to have overlooked or neglected the problems identified by Parisano. Hence, not only some elements of mechanist theories of the role of imagination in animal generation were anticipated in the Late Aristotelian tradition. As far as the sense for the problems inherent in imagination theories of trait acquisition goes, the Late Aristotelian tradition was also considerably more sophisticated than Cartesian embryology.

2. Liceti on material souls and the union of soul and body

Famously, Gassendi holds that the human soul is composed of two parts, of which one is immaterial and intellectual, and the other corporeal and sensitive.¹³ Some of his commentators have claimed that Gassendi's approach was unique because it regarded sensitive souls of animals, including the sensitive part of human souls, as material while, as Saul Fisher puts it, 'for most generation theorists of Gassendi's era who also held that the parental soul gives rise to the soul of the offspring and guides its development, the new organism's soul was immaterial'. Fisher includes Liceti among these likeminded theorists and states that 'Gassendi—holding to his Epicurean tendencies—was alone among these writers in proposing a material soul'.¹⁴ I believe that Fisher has overlooked something interesting, namely, the fact that Liceti was himself committed to a dualist conception of the human soul. Liceti accepts Aristotle's view that the rational soul is divine and enters from the outside.¹⁵ Moreover, Liceti brings out an ontological implication of Aristotle's view of the origin of the rational soul: 'The intellect is not the form of the entire human nature but a part of such a form, which is the human soul, having a composite nature constituted by intellect, vegetative soul, and sensitive soul . . .'.¹⁶ Thus, the substantial form of a human being is itself a composite entity that possesses parts. These parts differ with respect to their material or immaterial nature. Liceti holds that 'the more potent, intellectual part of the human soul is not educed from matter but created out of nothing, and is immortal . . .'.¹⁷ Clearly, then, he is committed to the existence of an immaterial part of human souls. Nevertheless, he agrees with Aristotle that in the operation of the vegetative and sensitive parts of human souls—the parts that human souls share with other animals—nothing immaterial or supernatural is involved. He puts it as follows: 'For me, a human being is a natural and material body; hence, it is

¹³ Gassendi to Thomas Feyens, 6 June 1629, in Gassendi, *Opera omnia* (Lyon, 1658), vol. 6, 19. On Gassendi's dualist conception of the human soul, see Emily Michael and Fred S. Michael, 'Gassendi on Sensation and Reflection: A Non-Cartesian Dualism', *History of European Ideas* 9 (1988), 583–95; Saul Fisher, 'The Soul as Vehicle for Genetic Information. Gassendi's Account of Inheritance', in *The Problem of Animal Generation in Early Modern Philosophy*, edited by Justin E.H. Smith (Cambridge, 2006), 103–23.

¹⁴ Saul Fisher, 'Gassendi's Atomist Account of Generation and Heredity in Plants and Animals', *Perspectives on Science* 11 (2003), 484–512 (498, note 31). Similar views as to the novelty of Gassendi's conception of the soul are expressed in Jacques Roger, *Les sciences de la vie dans la pensee fancaise au XVIII siecle* (Paris, 1963), 126–31, and Peter Bowler, 'Preformation and Pre-existence in the Seventeenth Century: A Brief Analysis', *Journal of the History of Biology* 4 (1971), 221–44 (228).

¹⁵ See *De gen. an.* II, 3, 736b27–29.

¹⁶ Liceti, *De ortu animae humanae* (Genova, 1602) [henceforth: OAH], 300: 'Intellectus non est forma totius naturae humanae, sed pars talis formae, quae est anima humana, compositam naturam habens ex Intellectu, vegetali anima, & sentiente . . .'

¹⁷ OAH, 301: 'potior humanae animae pars intellectiva sit non educta de sinu materiae, sed creata ex nihilo, & immortalis . . .'

subject to natural passions arising out of matter, to generation and death; its soul, therefore, is generated out of matter, and is mortal ...¹⁸

Liceti's conception of material vegetative and sensitive souls leads to an intriguing solution to the much debated Scholastic question of how 'the entire soul is joined with the entire body'.¹⁹ Dennis Des Chene explains that this question raises two difficulties: 'The first is that the powers of an animal or human do not manifest themselves equally in all parts of the body. Moreover, injury to the body does not equally affect all the powers of the soul ... The second difficulty is that something simple, like the soul, cannot be joined with something complex'.²⁰ Liceti's theory of material vegetative and sensitive souls provides solutions for both difficulties. According to Liceti, material souls are extended beings and, therefore, have a location in space in a perfectly literal sense. Moreover, they possess parts that are extended themselves and have a location in space, as well. Hence, the relation between material souls and bodies is a relation between extended beings that possess parts that are extended, as well. In particular, Liceti claims that material souls and organic bodies stand in a relation that he calls 'co-extension'. Let us consider some passages that reveal both how he wants this claim to be understood and what reasons, in his view, support it.

The intuitively strongest among Liceti's arguments concern the co-extension of the vegetative soul and the organic body of a plant. With respect to the nutrition of plants, he argues that the vegetative soul is where the operations occur, of which the soul is the primary efficient cause since according to Aristotle all physical action is by contact;²¹ moreover, according to Aristotle everything that is nourished is nourished with respect to the smallest part of its body.²² Liceti describes a cause that acts by contact as the 'primary efficient cause' (*causa effectrix primaria*)²³ and notes that, according to Aristotle, the aim of scientific research is to find out about such primary causes.²⁴ At the same time, he integrates the Aristotelian view that nutrition is not only a quantitative process but involves the persistence of an individual substance²⁵:

[N]utrition in the proper sense is the conversion of the aliment into the substance of a living and animated being, and because what is nourished, once the nourishment is added to it and prepared, communicates its own soul as a living form; therefore, if the single parts of plants are nourished, as is confirmed by Aristotle ...; then it is established that in each single part of

¹⁸ OAH, 301: 'Mihi autem homo est corpus naturale, ac materiale; naturalibus proinde ex materia passionibus, generationi, mortique obnoxius; eiusdem anima ideo ex materia genita, & mortalis ...' For Aristotle's account of the role of vegetative and sensitive souls in biological reproduction, see *De gen. an.* II, 2–5.

¹⁹ Dennis Des Chene, *Life's Form. Late Aristotelian Conceptions of the Soul* (Ithaca and London, 2002), 191. The slogan goes at least back to Augustine, *De immortalitate* 1c16.

²⁰ Des Chene (note 19), 192.

²¹ Liceti refers the reader to Aristotle, *Phys.*, 7, 10–12; 8, 33; *De an.*, 2, 3; 2, 24; 2, 47.

²² Fortunio Liceti, *De animarum coextensione corpori libri duo* (Padua, 1616) [henceforth: ACC], 12. See *De an.* II, 4.

²³ ACC, 24.

²⁴ ACC, 56. Liceti refers the reader to Aristotle, *Phys.* II, 27 and 38. The only context in which Liceti's biological writings make use of the concept of final causes is the view that the final cause of biological reproduction is the perpetuation of biological species and genera; see Fortunio Liceti, *De perfecta constitutione hominis in utero* (Padua, 1616) [henceforth: PCH], 117; Fortunio Liceti, *De monstrorum causis, natura, & differentiis* (Padua, 1616) [henceforth: MC], 33.

²⁵ See *De an.* II, 4, 416b9–20.

plants there is the soul itself as well as life, which is communicated to the aliment through nutrition ...²⁶

Hence, the relation between vegetative souls and organic bodies consists in transmitting motions through contact, and by transmitting motions, vegetative souls bring forth life. Because bringing forth life is the function of vegetative souls, Liceti says, vegetative souls can communicate their own nature onto the organic body and its parts, including the parts that are added to the body through nutrition. Since every part of the living body lives, the soul is present everywhere in the body.

Liceti develops analogous arguments with respect to the role of vegetative souls in the augmentation of living beings. In his view, due to their role in augmentation vegetative souls are co-extensive with organic bodies, for three reasons. First, Liceti argues that augmentation is an operation and natural motion that proceeds from the vegetative soul as its primary cause, and that no operation takes place without a primary agent. Moreover, he claims that there is nowhere any effect where there is no primary agent. And, once more, he borrows a view from Aristotle, namely, the view that the smallest part of the living being that grows is augmented.²⁷ Hence, the vegetative soul as primary agent has to be 'present' (in the sense explained above) in every part of the living being that grows. Second, Liceti follows Aristotle in believing that augmentation does not really differ from nutrition, according to the Aristotelian concept of augmentation as 'the conversion of the last nutriment into the substance of the living body'.²⁸ Hence, everything that follows from nutrition with respect to the co-extension of soul and body also follows from augmentation. Third, as in the case of nutrition, Liceti connects the mechanical properties of vegetative souls with their character as substantial forms: '[B]ecause Aristotle says that augmentation takes place according to the form of each particle of the ensouled being, because the pre-existing soul communicates itself into each part of the living being, once it has conjoined aliment ... as a life-giving form, as if it extended itself in all dimensions ...'²⁹

Liceti applies the view that the soul must be in contact with each part of the body also to the issue of plant generation. He maintains that the generation of a new plant happens by means of the soul. Moreover, he believes that every single particle of a plant contains the force for procreating a new plant.³⁰ His argument for the existence of a procreating power in every single particle of a plant has unmistakably atomistic overtones:

²⁶ ACC, 12–13: '[N]utricatio proprie conversio est alimenti in substantiam viventis, atque animati [*De an.* II, 4], eo quia quod aliter adiuncto sibi alimento disposito propriam animam communicat in formam vivificam; si ergo singulae plantarum partes aluntur, ut sanxit Aristoteles [*De gen. et corr.* I, 35] ...; constare cuique debet in singulis plantarum partibus animam reipsa, & vitam inesse, quae alimento per nutritionem communicatur ...'

²⁷ ACC, 13–14.

²⁸ ACC, 14: 'versio maioris alimenti in substantiam corporis animati'. See Aristotle, *De an.* II, 4; *PA* II, 4.

²⁹ Ibid.: 'Deinceps quum augmentum Aristoteli sic fieri dicatur secundum formam cuiuscumque particulae animantis, quia praeexistens anima in quantulamcumque partem corporis viventis adiuncto sibi alimento, quatenus est substantia quanta, & molis amplioris, quam hactenus effluxa e corpore, seu ab interno calore, seu ab externis caussis, consumpta, semetipsam communicat in formam vivificam, quasi se se extendens in omnem dimensionem'. See Aristotle, *De gen. et corr.* I, 35.

³⁰ ACC, 14–15.

[T]he thinnest powders of plants that fly through the air in the form of atoms, if they somewhere are gathered together and find some suitable material ground, we see that instantly plants are here and there generated within stones and in the cracks of houses . . .³¹

Liceti's atoms are not the indivisible, structure-less atoms of the ancient atomists. Rather, they are composites consisting of a material soul and a body. Liceti explains that, true to his Aristotelian leanings, the soul is defined as 'the first actuality of the natural instrumental body'.³² As he makes clear, this definition applies in particular to the role of the soul in nutrition, augmentation, and generation. He writes that 'an instrument cannot be operative unless it is actualised and governed by the principal agent; but it can be acted upon and be governed by it only if it is present and in contact with it . . .'³³

So far, Liceti's arguments concern the co-extension of vegetative souls and organic bodies. While this is the area where his arguments are most persuasive, he also develops arguments for the co-extension of sensitive souls and organic bodies. The most telling argument for present concerns is an argument based on the relation between the sensitive soul and the vegetative soul of an animal. Liceti starts from the observation that when the sensitive soul is occupied with something and applies all its forces of passion to it, nutrition, augmentation and the functions of sexual reproduction that are all governed by the vegetative soul are impaired or interrupted. Liceti interprets these observations as indicating that in a sensitive being the vegetative soul is dominated by the sensitive soul.³⁴ He comments: '[Y]ou can derive the fact that the dominating sensitive soul is co-extensive with the dominated vegetative soul from the fact that all physical domination takes place by means of contact and contiguity'.³⁵ Subsequently, Liceti invokes a passage from the first book of the Aristotelian *Meteorology* according to which the motions of heavenly bodies can only have causal influences on the motions of bodies on earth if the heavens and the sublunar world are contiguous. Liceti draws an analogy between a specific theory of celestial causation and his own view of the workings of material souls in organic bodies: both the domination of the vegetative soul by a sensitive soul and the domination of an organic body either by a sensitive or vegetative soul is a physical relation that works by means of the transmission of motion through contact.

³¹ ACC, 15: '[T]enuissimi stirpium pulveres sub atomorum forma per aera volitantes, si alicubi plures in unum cogantur, & subditam materiam aptam nanciscantur, nullo negocio plantas passim vel intra lapidum, domorumque rimas generare visuntur . . .'

³² ACC, 16: 'anima definiatur esse actus primus corporis naturalis instrumentalis'. See Aristotle, *De an.* II, 7.

³³ Ibid.: 'Aristoteleo monitu sunt instrumenta deservientia vegetali animae ad nutritionem, augmentum, generationem, aliasque functiones vitae obeundas [*De an.* II, 6]; at instrumentum nihil operari potest nisi actum, rectumque ab agente principali; agi autem, regique ab eo non valet nisi praesente atque attingente . . .'

³⁴ ACC, 36.

³⁵ ACC, 36: '[S]ensitricem gubernantem coextensam esse vegetali animae gubernatae inde apertissime colligas, quia gubernatio physica fit per contactum, & contiguitatem: Aristoteles enim alicubi sanxit necessarium esse mundum hunc inferiorem contiguum extare supernis latioribus, ut omnis huius mundi virtus gubernetur inde [*Meteor.* I, 2]'.
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3. Liceti on material souls and animal seed

Liceti's remarks about plant souls make it clear that, in his view, material vegetative souls play a role in plant generation. Interestingly, he also assigns a function to material sensitive souls in the generation of animals, including human beings. In his theory of animal generation, he takes up an idea that goes back to antiquity and plays a significant role in early modern biological thought, the idea that the seed derives from all parts of the organic body (an idea that is sometimes called the theory of *pangenesis*).³⁶ In his *De generatione animalium*, Aristotle launched a brilliant attack against early formulations of this idea.³⁷ In its unmodified version, this idea faces obvious difficulties. For example, it seems inexplicable how the sexual organs could receive particles from literally all parts of the body, i.e. even those that are not connected with the sexual organs through nerves and veins. This difficulty led the Renaissance philosopher and physician Girolamo Cardano (1501–1576) to suggest a modification to the theory: According to his view, it is not necessary that material particles are sent from every part of the body; all that is needed is that the *forms* of all bodily parts is communicated to the sexual organs.³⁸ Cardano himself did not specify the mechanism by means of which the form of all bodily parts could be communicated to the sexual organs. If we turn to Liceti's writings on animal generation, however, it soon becomes clear that Liceti had some determinate ideas concerning the transmission of forms to animal seeds.

An important role in Liceti's account of the formation of animal seed is played by an entity derived from Arabic medical sources: the so-called 'cambium'. As Liceti explains, the *cambium* is 'the ultimate aliment that is redundant in the nutrition of the single parts'.³⁹ He shares the widely held view that foodstuff undergoes a series of physiological changes in the body until it has the nature suitable to be integrated into the organism. But not all of it is actually integrated, and this part of the *cambium* is 'redundant'. It is this part of the *cambium* that Liceti believes is transported to the testicles. Moreover, *cambium* is understood as a transmitter of form because it already has been present to the single body parts into which it potentially could have been integrated. In Liceti's view, because portions of the *cambium* had been present in the various body parts, they have acquired 'temperaments'—certain proportions of elementary qualities—similar to the 'temperaments' of the various body parts.⁴⁰ This is how, according to Liceti, the form of a body part can be communicated to the seed without any transmission of particles from the body parts.

He describes the activity of the testicles that takes place subsequently as follows:

[T]hrough the action of the testicles all those partial temperaments of all members of similar temperament at first are converted by means of suitable mixture into a temperament that is similar to the temperament of the entire body constituted by these members, in such a way that those that were previously many things capable of mixture, which were in the preparatory veins close to the testicles among each other only confused but distinct with respect to their nature and still keeping their own forms and temperaments, . . . now are

³⁶ See Hippocrates, *Liber de foetuum formatione*, ch. 1; *De morbis*, IV; Avicenna, *Fen* 21, tract 1, ch. 8.

³⁷ See *De gen. an.* I, 15–16.

³⁸ See Girolamo Cardano, *Contradicentia Medicorum, Opera omnia* (Lyon, 1663), vol. 6, 644.

³⁹ PCH, 19: 'alimenti ultimi redundantis nutritivae singularum partium'. The theory of *cambium*, in turn, derives from Aristotle, *De gen. an.* I, 17–21.

⁴⁰ *Ibid.*

transformed through the power and action of the testicles into one perfect mixed body, once out of those previous temperaments a new temperament is produced, which is the temperament of the whole seed.⁴¹

Here, Liceti characterises the activity of the testicles as integrating the temperaments of singular body parts into a unified temperament of the entire seed. This is why seed souls are characterized as the outcome of this process: '[B]y means of the ultimate action of the testicles, the seed receives the ultimate and specific seed form, namely the vegetative and sensitive soul . . .'⁴² Moreover, Liceti shares Aristotle's view that animal seeds contain *pneuma*—a subtle, but material entity that causes the seed to be fertile.⁴³ For Liceti, the generation of animal souls is related to 'spirits' in animal seeds in the following way: 'The adequate agent is constituted out of the spirituous parts of the each seed, and so the souls of the female and male seeds are partial agents'.⁴⁴ So, vegetative and sensitive souls of seeds are to be understood as the 'spirituous' parts of seeds, and an animal soul is composed of the 'spirituous' parts of the female and male seeds. Liceti here departs from Aristotle in two respects. First, in contrast to Aristotle's one-seed theory of animal generation, he embraces a two seeds theory. Second, in contrast to Aristotle's view that only the *dynamis* but not the matter of the seed plays a role in animal generation,⁴⁵ he implies that two seed souls are material beings that, when conjoined, constitute an animal soul.

Two points need some elucidation. First, Liceti believes that vegetative and sensitive souls are communicated from parents to their seeds almost in the same way as the vegetative soul is communicated from a plant to a fruit:

[A]s long as twigs are on the tree, they live by the same soul as the tree is said to live by; the soul of the tree subsequently is plurified and divided according to the division of the subject . . . Almost in this way, I believe the seed enjoys the same soul as the father; which I believe is divided and plurified according to the division of the subject when the seed is separated from the body of the father.⁴⁶

Here, Liceti develops an implication of his theory of the co-extension of souls and bodies. Plant souls are extended beings that are divided when the organic body of the plant is divided. The two parts of a divided plant live by the two parts of a divided plant soul. Likewise, animal souls are extended beings that are divided when the organic body of the animal is divided. When the body of the seed is separated from the body of the parent the seed lives by a part of the soul of the parent. The material

⁴¹ Ibid.: '[I]bi enim primum actione testium omnia illa temperamenta partialia cunctorum membrorum temperaturis similes in unam temperiem similem temperaturae totius corporis ex illis membris constituti apta mixture adeo convertuntur, ut quae prius multa miscibilia erant in vasis praeparantibus ante testes degentibus invicem solummodo confusas, sed natura distinctas adhuc proprias formas, atque temperies obtinentia, veluti grana triticea, & hordeacea in acervo, virtute, actioneque testium in unum perfectum mistum commutentur, novo ex illis prioribus simul coniunctis facto & uno totius seminis temperamento'.

⁴² Ibid.: '[U]teriori testium actione semen ita dispositum formam seminis ultimam, & specificam adipiscitur; animam nempe vegetalem, ac sensitivam . . .'

⁴³ See *De gen. an.* II, 3.

⁴⁴ PCH, 71–72: '[A]gens adaequatum est ex utriusque seminis parte spiritiosa constitutum, sic agentia partialia sunt feminei seminis anima, & masculi . . .'

⁴⁵ See *De gen. an.* I, 17–21.

⁴⁶ OAH, 329: '[F]ructus, dum arbori haerent, eiusdem animae beneficio vivunt, qua & arbor ipsa vivere dicitur, quae arboris anima postmodum plurificatur, dividiturque ad subiecti divisionem . . . Ita prorsum arbitror semen in corpore patris eadem anima potiri, quae & pater ipse fruitur; quam dividi, ac plurificari censeo ad subiecti divisionem, dum semen a patris corpore seungitur . . .'

nature of animal souls also accounts for how the souls of two seeds are conjoined. Liceti puts it as follows: ‘The two bodies of the seed conjoin aptly into one piece of matter; in the just the same way, the souls of the two seeds conjoin without further ado into one soul . . .’⁴⁷ Moreover, he compares what happens in the conjunction of female and male seeds to what happens in the case of grafting. He interprets the process of grafting as follows: ‘[I]t is certain that out of the soul of the stem and the soul of the twig, which are most often of different species, once the bodies are conjoined, there arises a third soul that has all the faculties of these two . . .’⁴⁸ Liceti’s comparison suggests that also the vegetative and sensitive souls of two animal seeds conjoin in such a way that they form a new material composite that has faculties that were previously possessed separately by the separate material souls.

Second, the ‘spirituous’ parts of seeds are more than just temperaments including the temperament of the dissimilar parts of the organism because they possess certain active properties. Consistent with his theory of material souls Liceti refrains from characterizing these active properties as something supra-natural. Rather, he writes that their active properties are ‘to segregate heterogeneous things, to congregate homogeneous things’.⁴⁹ Here, Liceti alludes to an idea prominent in the development of late medieval and early modern corpuscular chemistry, namely the idea that all that happens in the producing and dissolution of chemical compounds is the composition and separation of particles—exactly the conception that Aristotle rejects when he discusses atomism in *De generatione et corruptione* (315b7–10; 317a13–14). According to Liceti, the separating activity of the spirituous parts of seeds is analogous to what happens when a mixture of water and oil separates back into its components.⁵⁰ In the case of water and oil, Liceti thinks that what brings about the separation is the specific gravity of the components (oil being lighter than water). He also maintains that the separation of particles in embryo formation is analogous to the dissolution of chemical compounds in laboratory procedures.⁵¹ Consequently, the ‘spirituous’ parts of seeds possess active properties in the composition and separation of particles just as chemical substances used in laboratory procedures have the capacity to produce and dissolve material compounds.

4. Liceti on material souls and imagination

Liceti’s version of pangensis theory plays a major role in his account of trait acquisition, including cases of deviant reproduction. On hereditary birth defects, he writes:

Which cannot come from another fact than because the portion of matter, from which those determinate parts in the offspring are generated, had its origin from that aliment that previously was assimilated to the morbidic parts of the same kind in the paternal or maternal body, and overflowed from their aliment;

⁴⁷ PCH, 35: ‘[U]triusque seminis ut duo corpora in unam materiam apte coniungunt; ita plane duae materiales animae in unam animam nullo negotio coeunt . . .’

⁴⁸ PCH, 35–36: ‘At vero compertissimum id habemus in arborum insitione; qua constat ex anima trunci, & anima taleae plerumque diversae speciei, coniunctis corporibus, tertiam animam consurgere omnium illarum in se facultates habentem . . .’

⁴⁹ PCH, 38: ‘heterogenea disgregare, ac vicissim homogena congregare’.

⁵⁰ PCH, 39.

⁵¹ Ibid.

of whom not only the essential temperament but also the accidental one or the disposition or morbid habitus is transferred into the corresponding member of the offspring.⁵²

Thus, the *cambium* not only transmits the non-pathological temperament of the body parts of the parent to the seed but also the pathological temperament. And the temperament transmitted from the seed to the nascent living being determines the traits displayed by the offspring. In this way, transmission of temperament is connected with trait acquisition.

Clearly, then, for Liceti not all traits of the offspring are due to imagination. But imagination does play a significant role in his views on deviant biological reproduction. By now it should be fairly obvious that, for Liceti, imagination images produced by sensitive souls cannot be the result of supra-natural, immaterial potencies. To be sure, some leading seventeenth-century biological thinkers used the concept of immaterial formative forces when writing about the role of imagination in embryo formation. For example, such a non-mechanical version of the role of imagination in the formation of the fetus is found in a work by Gassendi's correspondent, Thomas Feyens (1567–1631). According to Feyens, imagination does not have a causal influence on organic parts such as the blood or vital spirits.⁵³ Rather, species in the imagination function as exemplars that guide the 'forming potency' (*potentia conformatrix*), which has causal powers.⁵⁴ Hence, the forming potency, for Feyens, is an immaterial power that has both some cognitive capacities (since it can apprehend the contents of exemplars provided by the imagination) and some physiological capacities (since it can shape the fetus according to the content of the exemplars apprehended). It is with such immaterial potencies that Liceti does away in his account of the role of imagination in the formation of the fetus.

Liceti maintains that 'monsters' have a dual formal cause: a remote and a proximate one.⁵⁵ As in the case of all other living beings, the 'remote' form is the soul, understood as 'the first actuality of a natural organic body'.⁵⁶ By contrast, the specific and proximate form of monsters 'is nothing other than the bad constitution of the body, and the deformed organization of members, and all in all the corrupted conformation of parts'.⁵⁷ Of course, the definition of the concept of 'form', as related to monsters, sounds circular since it uses form-related concepts such as 'deformed' and 'conformation'. Nevertheless, it is informative since it tells us what kind of form

⁵² PCH, 24: '[Q]uod aliunde provenire nequit nisi quia portio materiei, ex qua illae partes determinatae in filiis generantur, ortum habuit ex eo alimento, quod prius assimilatum morboris membris eiusdem generis in corpore paterno, materno, illorum nutritivum superabundavit; quorum non solum temperaturam essentialem, sed etiam accidentalem seu dispositionem, seu habitum morbosum transtulit in filiorum membra consimilia'.

⁵³ Thomas Feyens, *De viribus imaginationis tractatus* (Louvain, 1608), 124–25.

⁵⁴ *Ibid.*, 144–45. On Feyens' biological views and their context, see L.J. Rather, 'Thomas Fienus' (1567–1631) Dialectical Investigation of the Imagination as Cause and Cure of Bodily Disease', *Bulletin of the History of Medicine* 41 (1967), 349–67; Jan Papy, 'The Attitude towards Aristotelian Biological Thought in the Louvain Medical Treatises during the Sixteenth and Early Seventeenth Century: The Case of Embryology', in *Aristotle's Animals in the Middle Ages and Renaissance*, edited by Carlos Steel et al. (Louvain, 1999), 317–37.

⁵⁵ MC, 16.

⁵⁶ *Ibid.*

⁵⁷ MC, 16: 'Caeterum specifica, & proxima monstrorum forma . . . nulla est alia quam mala corporis constitutio, deformisque membrorum organizatio, & omnino vitiata partium conformatio'.

is specific to monsters: form in the sense of organization of parts. In fact, Liceti explains:

The error of nature in the production of monsters consists, after the animation of matter, in its organization; namely, nature generating animated beings down here on earth in the matter at its disposal, constructs, in addition to the soul, which plays the role of substantial form, also some puzzling accidental form, which is comprised in the multiple structure, connection, figure, and bulk of various members.⁵⁸

Hence, in addition to offering a materialistic account of vegetative and sensitive souls, Liceti goes one step further towards what Norma Emerton has described as ‘the scientific reinterpretation of form’ in the corpuscularian philosophies of the seventeenth century.⁵⁹ Obviously, Liceti falls short of claiming that the form of living beings in general is just the organization of their parts. Nevertheless, Liceti believes that such a conception of form applies to the specific forms of the outcomes of deviant biological reproduction, that is, to the forms that make a living being a ‘monster’.

In Liceti’s view, it is quite possible that some monstrous deformities can be caused by the vehement imagination of the parents. Consistent with his conception of the specific form of monster, he maintains that a vivid image of phantasy ‘distorts the figure of some member and leads to a detrimental variation that leads away from the natural constitution, such as increasing the magnitude of some part, or doubling the number, or changing the spatial arrangement ...’⁶⁰ Liceti is also explicit about the fact that his views concerning imagination in embryo formation are in agreement with the received view in four respects:⁶¹ First, since imagination images are not involved in every case of embryo formation, the influence of the imagination on the embryo is not an essential feature of animal generation, but takes place accidentally. Second, acts of the imagination that are able to impress figures on the fetus must possess certain properties: they must be ‘vehement either due to the fixation or due to the duration, or both’. Third, imagination images are transferred to the embryo by means of medical spirits—some subtle but material substance derived from the most volatile parts of the blood and supposedly contained in nerves and veins. Fourth, phantasy impresses images of things on the body of the embryo rather than on the bodies of the parents since it is easier to impress images on soft rather than hard matter. Thus, it is the mechanical properties of the embryo’s body that explains the efficacy of images transported by medical spirits: because the embryo’s body is softer than the parents’ bodies, the images can leave traces on the embryo where they fail to leave traces on the parents’ bodies.

Liceti adds some comments of his own. He remarks that, while the imagination of the parent is an accidental cause in the formation of the fetus since the image that it impresses on the fetus does not pertain to the embryo except by accident;

⁵⁸ MC, 16–17: ‘[E]rror naturae in monstri procreatione consistit post animationem materiae in eius organizatione; siquidem natura generans animantia nostratia in subditum sibi materiam, praeter animam, quae substantialis forma nuncupatur, miram accidentalem construit formam, quae multiplicem membrorum structuram, nexu, figuram, molemque complectitur’.

⁵⁹ Norma Emerton, *The Scientific Reinterpretation of Form* (Ithaca, NY, 1984).

⁶⁰ MC, 79: ‘alicuius membri figuram distorquere, atque a naturali constitutione turpiter variare, quam partis alicuius aut magnitudinem adaugere, aut numerum geminare, aut situm permutare ...’

⁶¹ PCH, 96.

nevertheless, the imagination of the parent is by itself, and necessarily, the cause of this image since the presence or absence of such an imagination by itself confers, or does not confer, such a figure to the fetus.⁶² In this sense, he regards imagination as a not entirely accidental cause in trait acquisition. He also takes issue with the widely held view that only the maternal imagination is relevant in embryo formation. He claims that also the paternal imagination can communicate images of things imagined to the spirituous part of the seed and by means of the spirituous part of the seed to the fetus. In his view, an analogous process can take place when the maternal imagination shapes the spirituous part of the female seed. What distinguishes paternal from maternal imagination is only the fact that maternal imagination can be operative also after conception. Moreover, paternal imagination can shape the seed only while the father is awake, while maternal imagination can shape the already formed embryo by means of imagination images produced during sleep.⁶³

Most importantly for present concerns, Liceti characterizes imagination images as fully material. In fact, he likens them to Scholastic sensible species, which he, in turn, understands as fully material. According to the materialistic account of sensible species accepted by Liceti, a coloured object impresses its own colour and figure onto some medium such as the air; this medium, according to the theory accepted by him, transports such 'visible species' (*species visibiles*) from one place (e.g. the portion of air adjacent to the coloured object) to another place (e.g. the portion of air adjacent to the eye), without changing the qualities of the species.⁶⁴ Liceti also accepts the materialistic view that sensation can be explained in an analogous way: as sensible species are transported by a material medium outside the human body, they are transported by medical spirits inside the human body. In his view, something analogous holds for the propagation of imagination images:

[T]he instruments of imagination are transferred by the vehicle of the spirits in the same way as the external sense by means of the impressed image of the object recognized; by it it creates a similar image in that part of the spirits which is contiguous to it, and this successively in another part up to the organ of the internal sense ...⁶⁵

As Liceti makes clear, consistent with the assumption he shares with the received view, these images extend themselves in all directions: they are created 'in the whole substance the spirits, which permeate their whole body in each of its parts ...'⁶⁶ But even if they are not directed towards one particular region of the body, at least they also reach the seed or the embryo, respectively. In particular, the notable effect in the offspring is explained by the fact that the transmission of images in the spirits is continued 'until the spirituous substance of the seed and the embryo is reached'.⁶⁷

⁶² MC, 97.

⁶³ Ibid.

⁶⁴ On Renaissance of theories of sensible and intelligible species, see Leen Spruit, *Species intelligibilis. From Perception to Knowledge. Vol. 2: Renaissance Controversies, Later Scholasticism, and the Elimination of the Intelligible Species in Modern Philosophy* (Leiden, 1995).

⁶⁵ PCH, 97–98: '[P]hantasiae instrumenta vehiculo spirituum ea ratione transferuntur, ut sensus exterior mediante imagine obiecti a se cogniti sibi impressa consimilem procreet in ea spirituum parte, quam contingit, & haec in aliam successive usque ad organum sensus interioris ...'

⁶⁶ PCH, 99: 'Sic penitus a parentum phantasia vehementem rei alicuius imaginem obtinente in tota spirituum substantia, quae universum illorum corpus omniquaeque permeat, consimilis procreatur imago ...'

⁶⁷ PCH, 98: 'quousque perventum sit ad spirituosam seminis substantiam, atque ad embryonem'.

The analogies that Liceti draws between the propagation of sound, colour, and imagination images are telling. He understands sounds as motions in sounding bodies that subsequently cause similar motions in material media. Accordingly, the motions constituting sound are in the sounding body, in the portions of air transmitting the sound to the sensory organs, and in the portions of medical spirits transporting the sound from the sensory organs to other bodily organs. In this sense, there remains something identical in the object represented and the images doing the work of representation. Moreover, since Liceti compares representations of sound to representation of colours, it seems plausible to apply his analysis of how sounds are represented to how colours are represented by sensible species. In this case, Liceti would be committed to the view that images representing objects of certain colour and figure themselves have certain colour and figure that are sufficiently similar to the properties of the represented object. What is more, by comparing the transmission of sensible species to the transmission of imagination images, he transfers a theory that was originally intended to answer the question of how sensory impressions represent objects to the question of how imagination images represent objects. Plausibly, Liceti is also committed to the view that imagination images have some of the properties of the objects that they are meant to represent. If this is what he had in mind, as is supported by the fact that he characterizes the activity of imagination as ‘picturing’, it is easy to understand how he came to the belief that imagination images can transmit the properties that they represent to the embryo: Imagination images are material images that possess some of the represented properties. Because they possess these properties, they can transmit them from one part of a material medium to an adjacent part of the medium, and finally to the surface of the body of the embryo.

5. Parisano’s criticism

Even if Liceti’s account of material animal souls and material imagination images does not invoke any immaterial formative powers, it makes assumptions that are problematic in other respects. The view that imagination images share some properties with the objects that they represent was one of the ideas that were targeted in the work of Liceti’s contemporary, Emilio Parisano. Strangely enough, Liceti never seems to have made any reference to Parisano’s extensive biological writings, nor Parisano to Liceti’s no less extensive work in natural philosophy. Clearly, however, Parisano was very much aware of recent developments in theories of animal generation, and many of the objections that he raises against the relevance of imagination in embryology can be applied to Liceti’s views.

Parisano opens his criticism of imagination theories in embryology with the following problem: Consider a case in which a dog gives birth to puppies that differ from each other with respect to colour. He questions the assumption that during conception different imagination images of dogs of different colour were simultaneously in the dog’s soul. Parisano comments jokingly that he couldn’t even imagine such an act of imagination. But he also gives a concise argument for his bewilderment:

[W]e believe that a human being can hardly imagine during the sexual act two different persons in the required fixed way, so that it seems even less plausible

to assume that animals, having a less developed imagination and being more dedicated to the sexual act, are capable of such acts of imagination.⁶⁸

Here, Parisano takes up a criterion for acts of imagination with the required causal powers (a criterion also accepted by Liceti), namely that these acts are stable enough. Parisano questions the reality of psychological states simultaneously representing two living beings with different properties in the required stable way. If such states cannot be found in the experience we have of the activities of the human soul, it is implausible that animals have such psychological states. But Parisano goes on to make the following suggestion: Imagine that, contrary to what is actually the case, during the sexual act a dog is imagining two or more dogs of different colour in the required fixed way. Then, Parisano argues, the following problem arises: During coitus, the sperm is ejected, but it is not instantly present in the uterus; rather, it is drawn there only after the end of coitus. By contrast, the act of imagination ends when the pleasure of coitus vanishes. So, the act of imagination is no longer present in the soul of the animal when the actual process of conception—the interaction of male and female seed—takes place.⁶⁹ Hence, there is a temporal gap between the occurrence of the act of imagination and the occurrence of the conjunction of female and male seeds. For this reason, it remains inexplicable how the imagination could act on anything that could be identified as an embryo.

A further objection concerns the transitive nature of the supposed activity of the imagination, i.e. its supposed capacity of acting not only on the maternal body but also on the body of the seed. Again, this is a capacity that Parisano feels he cannot imagine. He offers the following argument: '[I]mpressions take place in already formed parts that are well organized and truly existing as such'.⁷⁰ Thus, supposing that imagination could work on the seed, as Liceti supposes both with respect to maternal and paternal imagination, would amount to the assumption that imagination is at work already at an implausibly early point in the development of a living being.

Parisano also develops an objection against the idea that the imagination 'paints' anything in the sense that the imagination image has the same colours and shapes as the object depicted: 'Does this pictorial imagination have the colours ready there in a bag or a pitch?'⁷¹ The implication of Parisano's rhetorical question obviously is that there are no colours in bodily parts—not the colours, that is, that are represented by the imagination images. He takes up this line of argument later in the text, where he argues that acts of imagination belong to the category of concepts. Because they are concepts they are capable of representing non-existing things. In the latter case, these concepts also represent non-existing colours, figure, forms and properties. Evidently, the contents of such concepts cannot have been caused by these properties since, by hypothesis, these properties do not exist. If the

⁶⁸ Emilio Parisano, *Nobilium exercitationum de subtilitate pars altera* (Venice, 1635) [henceforth: NES], 68: 'Etenim vix hominem tam brevi illo temporis spatio in quo bestiae illa voluptas a se amotam ad se se allicit ac rapit consulto & omni dedita opera duos viros fixe . . . imaginari posse credimus, nedum bestias imminutae imaginationis & brutino illo furori prorsus deditas'.

⁶⁹ NES, 69.

⁷⁰ Ibid.: '[I]mpressiones fiunt in partibus efformatis, bene dispositis, atque actu talibus bene existentibus . . .'

⁷¹ NES, 68: 'An pictrix ista imaginatio istos colores in promptu illico in pera, in pixide habet?'

contents are not caused by the properties that they represent, it does not make sense to assume that the concepts *have* the properties that they represent. But if they do not have the properties that they represent, they also cannot transmit these properties to the seed.⁷² Moreover, while Parisano develops this line of argument only with respect to properties of the seed, it could easily be applied to the properties of the already formed fetus: If imagination images do not possess the properties that they represent, they are also not capable of transmitting their properties to the already formed fetus.

Finally, Parisano also argues that physiological considerations speak against imagination theories in embryology. One consideration concerns the path that imagination images could take in medical spirits or ‘vapours’. He notes that vapour

moves through the optical nerve to the brain, and from there through the nerve of the sixth conjugation to the liver. But the nerve of the sixth conjugation reaches not to the internal parts of the liver but only to the membrane that surrounds it and ceases there. Hence, how does the vapour that got there continue to the skin of the fetus? Maybe you say that the vapour moves from the eyes through the arteries and veins . . . But if the vapour moves either from the sense of smell or the sense of sight and the liver by means of the spirits and the blood, why to the liver and not to the heart and the brain?⁷³

The objection seems to be that if we consider the physiological details of the nervous system, we don’t get any plausible pathway that imagination images could take from the brain to the fetus; but if we assume that imagination images are transported through arteries and veins such images would get everywhere in the organism. Liceti could counter this objection by affirming the second horn of the alternative posited by Parisano. Liceti could argue that, according to the elements of the received view accepted by him, imagination images indeed are transmitted into any region of the body reached by medical spirits and that the fact that visible traces are left on the body of the embryo but not on the body of the parent is an outcome of the softer nature of the embryo’s body. Nevertheless, Parisano has one more physiological consideration to add. In Parisano’s view, vapours or spirits are generally not the right kind of entity to transmit imagination images, such as from the brain to the fetus. This is the reason why: ‘Even if they could receive them, because they are altered on their itinerary . . . most of these species would perish. Add to this that these vapors, preserving themselves, retain only their forms, qualities, and properties, not foreign ones’.⁷⁴ Parisano’s objection seems to be that it is misleading to think about medical spirits and vapors as media in the same way as the air functions as a medium. According to Scholastic theories of sensible species shared by Liceti, the air is capable

⁷² NES, 281: ‘Quod ipsi in capite, rerum non existentium conceptus, earumque colores tunc non existentes, figuram, formam, proprietates accipient, in uterum, in semenque deferant, nec mente assequor, nec capiam unquam’.

⁷³ NES, 285: ‘[P]er opticum ad cerebrum tendet, illinc per nervum sextae coniugationis ad iecur. At nervus sextae coniugationis non ad internam partem iecoris, sed ad membranam ipsum ambientis tendit & ibi desinit. Quo modo ergo vapor illuc perventus ad cutim faetus tendet? . . . Dices tendet vapor ab oculis per arterias & venas . . . Sed vapor sive ab olfactu, sive a visu ad iecur tendat mediante spiritu & sanguine, cur ad iecur, non ad cor & cerebrum?’

⁷⁴ Ibid.: ‘[E]tiamsi suscipere possunt, quia in itinere alterentur absumeruntur . . . species illae pluries perirent. Praeterquam quod vapores se se conservantes sua, formam, qualitates, proprietatesque suas retinerent non alienas . . .’

of taking on properties of objects represented without undergoing any other change. Parisano is attentive to the fact that medical spirits, like any other part of an organic body, are subject to perpetual change caused by the organic functions (such as nutrition, growth, and sensation). Even if some imagination images might be impressed on medical spirits, medical spirits are not the right kind of entity to *preserve* such images. While we might appreciate materialistic accounts of the transmission of imagination images as a significant step in naturalizing embryology, Parisano believed that his arguments demonstrate that imagination theories should be simply eliminated from embryology. As he puts it, 'it is pure nonsense to suppose that the maternal imagination has any influence in the empty spaces of uterus'.⁷⁵

6. Conclusion

Obviously, Descartes's and Malebranche's views on the role of imagination in embryo formation do not coincide with Liceti's. To begin with, the Cartesian mechanists do not accept some Aristotelian concepts that Liceti believed he could reformulate within a theory of material souls. For example, none of the Cartesian mechanists would think of the body as an 'instrument' of the soul. Likewise, none of the Cartesian mechanists would believe that in nutrition the soul expands its own 'substance' into a larger portion of matter. In fact, it goes against the central tenets of Cartesianism to assume that the soul is capable of defining the substance of an organic body at all. Moreover, Smith is certainly right in pointing out that the Cartesian mechanists extended the range of cases where imagination was thought to play an explanatory role from cases of deviant reproduction to cases of non-deviant reproduction. Since Liceti believed that imagination is only an accidental, non-substantial factor in biological reproduction, he restricted the applicability of such an explanation to cases which involve, according to his view, a disturbance of accidental, not of substantial form, i.e. to cases of deviant reproduction. Thus, the Cartesian mechanists went beyond Late Aristotelian natural philosophy in two respects: (1) they achieved much greater independence from Aristotelian notions; and (2) they assigned to imagination a greater explanatory role in embryo formation. Nevertheless, it should be clear by now that the rupture between Cartesian and Late Aristotelian imagination theories of trait acquisition was less radical than suggested by Smith. In particular, the work of Liceti demonstrates that imagination was regarded as something that could be included in a version of mechanized Aristotelianism. His imagination theory of trait acquisition provides a vivid example of how the Late Aristotelian tradition proved to be surprisingly innovative.⁷⁶ Somewhat paradoxically, Liceti's imagination theory of trait acquisition is an instance in which the Late Aristotelian tradition itself provided the theoretical tools for excising immaterial formative forces. Moreover, the work of Parisano also indicates another aspect of Late Aristotelian thinking about imagination and

⁷⁵ NES, 280: 'Purae nugae sunt, quod matris imaginatrix in uteri vacuum descendat . . .'

⁷⁶ On the innovative nature of early modern Aristotelianism, see Charles B. Schmitt, 'Towards a Reassessment of Renaissance Aristotelianism', *History of Science* 2 (1973), 159–93; Christia Mercer, 'The Vitality and Importance of Early Modern Aristotelianism', in *The Rise of Modern Philosophy: The Tension between the New and Traditional Philosophies from Machiavelli to Leibniz*, edited by Tom Sorell (Oxford, 1993), 33–67.

embryology: While Descartes and his followers quite speculatively seized upon mechanical imagination images as a hypothetical explanatory tool, Late Aristotelian thinkers developed an acute sense for the problems involved in invoking imagination in embryology. The Cartesian mechanists seem to have been unaware of the existence of the set of objections developed by Parisano. However, taking Parisano's objections seriously could have contributed to the strength of Cartesian embryology.