Sixteenth-Century Pharmacology and the Controversy between Reductionism and Emergentism

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Abstract

Although in the sixteenth century some pharmacological powers were widely ascribed to celestial influences, alternative views of the nature of such powers began to be developed: Reductionism, according to which all pharmacological powers could be understood as combinations of the powers of elementary qualities, and emergentism, according to which some pharmacological powers are irreducible to combinations of the powers of elementary but arise out of their combination and interaction. The former view can be traced in the work of Francisco Valles (1524-1592) and Thomas Erastus (1524-1583), the latter view in the work of Girolamo Mercuriale (1530-1606) and Jacob Schegk (1511-1587).

1. Introduction

Sixteenth-century pharmacology was still very much under the influence of a distinction going back to ancient medicine: the distinction between effects of medicaments that were taken to be explainable by the elementary qualities, their mutual modification in mixture and the combination of these modified (or “tempered”) elementary qualities on the one hand, and the effects of medicaments that were taken not to be explicable in this manner.[[1]](#endnote-1) Galen coined the expression that a medicament of the latter kind possesses the capacity of acting “by its whole substance,”[[2]](#endnote-2) and the question of how actions of the whole substance could be explicated gave rise to heated controversies in early modern pharmacology. Did Galen just mean that some medicaments act with respect to all of their parts? Does the relevant sense of “wholeness” involve the idea of a qualitative change arising from the interaction of all parts? Are the relevant medicaments substances in a different sense than being aggregates of different ingredients? And if so, does the relevant sense of substantiality involve the coming into being of a substantial form that did not exist before?

These questions were so intriguing for early modern natural philosophers because they were connected with even more fundamental questions concerning the relation between the observable powers of material composites and the hypothesized qualities of elements. If the wholeness involved in so-called “actions of the whole substance” boiled down to the idea of mereological composition, then these actions could be understood in the framework of ontological reduction, understood as a relation between properties: the powers of the medicaments that are said to act by their whole substance in this case would be nothing other than the collection of the powers of their constituents, perhaps modified through their interaction. This idea comes close to the idea that ontological reduction could be analyzed through the concepts of property identity and mereological composition that still plays a central role in contemporary debates about reduction (see Causey 1972; Schaffner 1993). The early moderns used the term “reductio” and its cognates to designate this relation.

By contrast, if “actions of the whole substance” involve the occurrence of new substantial forms with new causal powers, then these actions could be understood in the framework of ontological emergence. The view that some composites possess causal powers that cannot be reduced to combinations of causal powers of constituents has close parallels in a view that is now often called “strong emergence” (see Macdonald and Macdonald 2010). Also the view that new causal powers come into being through the occurrence of new substance has an analogy in recent work by Trenton Merricks (2001), although, of course, Merricks would not express this idea in terms of the Aristotelian concept of substantial form. The early moderns used the term “eductio” and its cognates to designate the relation between properties of the constituents of a composite, the newly generated substantial form of the composite, and the causal powers deriving from this substantial form.[[3]](#endnote-3)

Of course, the idea that an emergentist line of thought had some grip on early modern thought is by no means new. The influence of Alexander of Aphrodisias (fl. ca. 200 AC) in late medieval and Renaissance philosophy of mind is well understood by now (see Pluta 2007; Mitrovic 2009; Kessler 2011). Alexander formulated his ideas not only with respect to the soul but also with respect to the powers of medicaments. According to Alexander, the soul “is the power and form that supervenes upon the blend of bodies in a particular proportion, not the proportion or composition of the blend … The soul … is not a balance, but the power [that supervenes] upon the balance: it cannot be without this balance, but is not [the same] as it” (Alexander of Aphrodisias, 2008, p. 104 [*De anima* 25.2-8]. Translation from Alexander of Aphrodisias, 2012, p. 51). As Victor Caston has argued, the use of “to supervene” should here be understood as amounting to the claim that mental states cannot change without a change of bodily states, thereby exactly matching the contemporary concept of supervenience (Caston 1997, pp. 348-349; see Davidson [1970] 1980). Moreover, Caston emphasizes that, for Alexander, the soul possesses causal power that is more than an aggregate of the causal powers of the elements (Caston 1997, pp. 349-350). Likewise, Alexander points out that some medicaments possess a causal power that arises from their temperament, and since this remark stems from the context of his criticism of the harmony theory of the soul, the implication again seems to be that this power goes beyond the powers inherent in the harmony of elementary qualities (Alexander of Aphrodisias, 2008, p. 104 [*De anima* 24.24-29]). In the sense that Alexander ascribes distinct new power to souls as well as to the forms of non-animate composites such as chemical blends, Caston therefore characterizes Alexander as one of the ancient thinkers who were committed to emergentism.

As far as I can determine, neither the role of reductionism nor the role of emergentism in Renaissance pharmacology has been explored by commentators. In section 2, I will outline three diverging sixteenth-century attitudes toward reduction of pharmacological powers: the first attitude, exemplified in the work of Guilielmus Puteanus (Guillaume Dupuis), professor of medicine at the University of Grenoble, who published his main work in pharmacology in 1552, documents the persisting influence of medieval views concerning celestial causation of non-reducible powers in early modern pharmacology. The second attitude, exemplified in the work of Girolamo Mercuriale (1530-1606), a medical humanist and physician to Cardinal Alessandro Farnese,[[4]](#endnote-4) documents that emergentism about non-reducible powers was perceived as a theoretical option; the third attitude, exemplified in the work of Francisco Valles (1524-1592), a Madrid-based physician and philosopher;[[5]](#endnote-5) documents that reductionism about those pharmacological powers that most other thinkers in the field took to be non-reducible, was perceived as a theoretical alternative to emergentism and theories of celestial causation.

Due to the fragmentary nature of the source texts, section 2 will necessarily have to be somewhat fragmentary. In particular, there are clear limits to the argumentative depth in which the three attitudes toward reduction were discussed by Puteanus, Mercuriale and Valles. What can be got from their work is the insight that these three attitudes were clearly perceived as theoretical alternatives; also, in Mercuriale and Valles one gets some hints at possible argumentative strategies for defending either the emergentist or the reductionist option. For a more extensive development of these argumentative strategies, however, one has to turn to other thinkers. Section 3 will focus on Thomas Erastus (1524-1583), professor of medicine and rector of the University of Heidelberg and later professor of ethics in Basel, and Section 4 will focus on Jacob Schegk (1511-1587), professor of logic and natural philosophy at the University of Tübingen.[[6]](#endnote-6) Erastus has recently received some attention as a defender of Aristotelian natural philosophy against alchemy and Paracelsian ‘chymistry’ (see Newman, 2006, pp. 45-65). Also, his role as a public figure in the complex confessional development of the Palatinate has been studied in detail (see Gunnoe 2011). Likewise, Schegk has received some attention as one of the leading Lutheran natural philosophers after Philip Melanchthon (see Kusukawa 1999), and his sophisticated theory of biological reproduction has been studied closely (see Hirai 2007). Erastus is a prominent proponent of reductionism even about pharmacological powers that were traditionally ascribed to actions of the whole substance. By contrast, Schegk uses some ideas found in Alexander of Aphrodisias to analyze the non-elementary properties of medicaments and plants as emergent properties.

2. Three Attitudes toward the Reduction: Puteanus, Mercuriale, and Valles

What sixteenth-century pharmacological theories have in common is the view that *some* powers of medicaments can be ascribed to the combination and interaction elementary qualities of their ingredients. This is why the distinction between primary qualities—i.e., the qualities hot, cold, wet, dry—and secondary qualities—i.e., the medical powers brought about by the mutual modification and combination of primary qualities in a mixture was widely shared. There was some disagreement as to whether or not this distinction should, within a reductionist framework, be supplemented by the concept of tertiary qualities. And most thinkers in the field agreed that, in addition to qualities that can be reduced to combinations of primary qualities, one has to admit the existence of some qualities for which this is not possible, although there was disagreement about how exactly the origin of these qualities could be understood. Puteanus takes up a widely accepted tradition concerning these issues, while Mercuriale and Valles belong to the relatively small numbers of thinkers who departed from this tradition.

*2.1. Puteanus on Reduction and Celestial Causation*

Guilielmus Puteanus surmises that, since in all effects that can be explained reductively only tempered primary qualities are causally efficacious, the concept of secondary qualities is sufficient to capture all effects of these medicaments (Puteanus 1552, pp. 22, 25-26). By contrast, in his treatment of purgative medicaments Puteanus leaves reductionist patterns of explanation and refers to a thirteenth-century pharmacological work ascribed to the Arabic physician Johannes Mesue (Yuhanna ibn Masawayh).[[7]](#endnote-7) Puteanus follows commentators on Mesue such as Mondinus de Leuciis (Mondino dei Luzzi, ca. 1275-1326) and Johannes Costaeus (Giovanni Costeo, 1528-1603) when he interprets Mesue’s view that purgative powers of medicaments derive from a celestial influence as a theory concerning the celestial origin of substantial forms (Puteanus 1552, p. 37). The relevant passage from Mesue reads as follows:

A medicament is purgative, and it acts upon the matter that has to be purged, not due to the temperament nor in the way in which two contraries act upon each other, insofar as they are contraries, nor in the way one of two similar substances attract and draw out each other, nor like a heavy body moving downwards and a light body moving upwards, but because such a power originates in the heavens. (Mesue 1552, fol. 2v)[[8]](#endnote-8)

In his commentary on this passage, Mondinus maintains that Mesue ascribes the powers “of the fourth degree” to the specific form, for instance, the power that draws out a particular body fluid (Mesue 1552, fol. 5v). Since not every compound with the same temperament possesses a specific form, Mondinus distinguishes a specific form from the “common specific form” (*forma specifica communis*) that is found in all compounds with the same temperament and regards them as an “individual specific forms” (*forma specifica propria*) (ibid., fol. 6r). As he explains, “this specific form is nothing other than something added to the complexion by means of which it exerts an operation, such that even if the complexion is not the primary principle of occult operation, it nevertheless supports the occult action of this solving medicament” (ibid.).[[9]](#endnote-9) In particular, Mondino invokes the notion of specific form to explain why the medicament not only acts upon a determinate body fluid, but also draws this fluid out on a determinate path and deposits it at a particular place (Mesue 1552, fol. 2v).

This conception of the role of specific forms is taken up in Costaeus’s commentary (ibid.). Moreover, Costaeus gives the following characterization of the relation between similarity and celestial powers in the workings of purgative medicaments: “This attraction has to be ascribed to similarity not as an efficient cause, but as a *causa sine qua non*: such that the action is primarily referred to as being received from the heavens, from whose womb both the forms and the properties of forms emanate …” (Ibid., fol. 4v ).[[10]](#endnote-10) Given the standard understanding of emanative causation as a process in which the effect instantiates the essence of the cause, albeit in a less perfect matter, without being changed itself, such a conception of the origin of the forms of medicaments and their powers implies that some pharmacological powers are celestial powers inhering in material composites. Taking up this line of thought thus leads Puteanus to an eclectic position that combines a reductionist account of a large area of pharmacological powers with a Neoplatonic account of the origin of the powers of purging medicaments.

*2.2. Mercuriale on Reduction and Emergence*

A different approach can be found in the work of Girolamo Mercuriale. On the one hand, Mercuriale pushes the reductionist program one step further by giving a differentiated account of what he calls “secondary powers” (*secundae facultates*) and “tertiary powers” (*tertiae facultates*). Examples of secondary powers are the capacities of medicaments to make parts of the organism denser and harder (or the opposite) (Mercuriale 1590, fol. 11v). Examples of tertiary powers are the capacities of medicaments to split up gall stones, to move urine, to draw menstrual blood or to purge the lung or the seed (ibid., fol. 17v). In both cases, what does the causal work, according to Mercuriale, are the tempered elementary qualities—in this sense he says that the secondary and tertiary powers “have nothing new”. However, he notes a significant difference: The secondary powers can be used for a variety of different purposes and, in this sense, they are indeterminate with respect to a particular goal. By contrast, the tertiary powers are specific to particular conditions of particular organs and, in this sense, they are determinate with respect to a particular goal (ibid., fol. 11v, 17v). Although Mercuriale does not mention the origin of this distinction, it can be found in one of Avicenna’s smaller works, *De viribus cordis*, which Mercuriale mentions in a different context (/ibid., fol. 21r). Avicenna expresses the distinction as follows: “The qualities that are attributed to medicaments with respects to the impression that they make upon the body as beneficial to it remain to be dealt with: some of them are taken to derive from absolute actions, some of them are taken to derive from actions relating to special parts of the body” (Avicenna 1608, p. 341). By implication, “absolute” actions are to be understood as actions that occur in various body parts.

Although Mercuriale in this way expands the scope of reductionist explanations, his work is also a good source for the presence of emergentist strands in Renaissance pharmacology. Mercuriale holds that the “powers of the fourth degree” (*quartae facultates*) arise from the substantial form of medicaments (ibid., fol. 20r). This is confirmed in his discussion of the problem of what could be done if medicaments, as in the case of purging drugs, have unwelcome side-effects. In this context, he uses the concept of “correcting” medicaments (*correctoria*) that designates drug that could be added to the problem-ridden drugs (ibid., fol. 62v). Mercuriale puts forth the thesis that equal quantities of medicaments should be used for this purpose since “the effects of a specific form cannot be impeded but by another specific form; and the equality of specific forms follows the equality of quantity” (ibid.).[[11]](#endnote-11) Clearly, then, he ascribes to these medicaments specific forms and, moreover, regards the strength of the powers of these specific forms as being dependent on the quantity of the underlying matter.

But he also has second thoughts concerning the thesis that always equal quantities are required, since the elementary qualities of the one will alter the elementary qualities of the other (ibid., fol. 63r). Here it becomes clear that he takes the strength of the powers of specific forms to change not only with the quantity of underlying matter but also with qualitative changes of the temperament of elementary qualities:

I respond what Averroes says in *Metaphysics* 8, namely, that specific forms follow their own temperament, and therefore where their own temperament is weakened, also the power of the specific form is diminished, which is why, when in mixture the heat of gummi-resina is decreased by the coldness of camphor, consequently also the purgative power and what is adverse for us is decreased … (ibid.)[[12]](#endnote-12)

Mercuriale’s reference to Averroes certainly involves some amount of interpretation since, as far as I can see, in his commentary on *Metaphysics* 8 mentions neither the concept of temperament nor the concept of specific form. But he does say something that supports Mercuriale’s reading, when he explicates the sense in which entities that are constituted by matter and form are genuine unities as follows:

The cause of the unity is that what is in potentiality is transmuted until it is made actual by an agent, that is, a being that extracts it from potency to actuality. Thus, there is an entity that possesses unity, which was at first in potentiality and subsequently is transformed from potentiality to actuality; this is so because this transformation does not confer multiplicity to this entity but rather confers perfection in being; and as a whole [this entity] is a unity in actuality … (Averroes 1552, fol. 105v [commentary 15])[[13]](#endnote-13)

Here, Averroes presents the eduction of form from the potentiality of matter as a solution for the problem of how something constituted by matter of form is not an aggregate of two distinct constituents but rather a genuine unity—a problem that for all thinkers who took substantial forms to be added to matter from the outside turned out to be almost unsolvable. Thereby, Mercuriale’s reference to Averroes gives a first hint as to a possible argumentative foundation for emergentism about substantial forms and their powers. But it seems fair to say that Mercuriale did very little to explicate this argumentative foundation in any detail.

*2.3. Valles’s Defense of Reductionism*

Does the reductionist alternative fare better in this respect? One of the Renaissance thinkers who expanded reductionism to pharmacological actions of the whole substance is Francisco Valles. On first sight, it might not be obvious that this is an adequate interpretation of his view since, in contrast to situations in which medicaments are aggregates of components that do not undergo any change of their forms, he describes medicaments that are the outcome of fermentation as follows: “When after a long time they come to undergo fermentation, the single medicaments decay with respect to form and are remitted with regard to qualities, and a single medicament arises that differs with respect to substance from both” (Valles [1564] 1606, p. 14).[[14]](#endnote-14) However, he understands this difference with respect to substance not as a difference between the substantial form of a new composite and the previous substantial forms of its ingredients. This becomes clear when he explicates in which sense complex medicaments of both kinds can be understood to “act according to their whole nature” (*secundum se totum*). In a medicament that has not undergone fermentation, the minimal particles impede each other, such that their different primary qualities cannot be sensed distinctly; by contrast, after fermentation the minimal particles do no longer possess elementary forms and the same degrees of elementary qualities as they had before (ibid.). However, what in his view does *not* take place is anything like the generation of a new quality. This becomes clear in his critical discussion of what he takes to be an emergentist strand in Avicenna’s natural philosophy. As he points out, according to Avicenna the temperament (or “complexion”) of a material composite is not a proportion of primary qualities but rather “a fifth quality resulting from them” (Ibid., p. 17; see Avicenna 1595, pp. 11-13 [liber 1, fen 1, doctrina 3, cap. 1]). As Valles notes, “his followers relate this primarily to the innate complexion, namely, the one that is inherent in the single body parts, not to the one that arises from without” (Valles [1564] 1606, p. 17).[[15]](#endnote-15) Valles also mentions an argument that was used in favor regarding the temperament as a new quality: The proportion of elementary qualities changes continuously though external influences; but natural powers often remain unchanged; hence, the temperament must be grounded in the powers of elementary qualities but differ itself from the powers of elementary qualities (ibid.).

In response, Valles unambiguously rejects the conception of temperament as emerging from primary qualities inherent in body parts. It seems unclear to him how, according to this conception, several different powers can arise from the single temperament of a body part (ibid.). Also, it seems unclear to him how one power that arises from the temperament can be impaired without an impairment of the other powers that arise from it (ibid.). This is why he holds that natural powers all immediately arise from the proportion of elementary qualities:

[A]lthough the forms of elements decay, there remain parts that correspond to them proportionally, ... and through their mutual qualitative change, some mode of substance is generated throughout the whole, according to the proportion of the substance of elements: and this proportion is the innate temperament through which the single body parts participate in their operations … This former temperament, which we said to be a ‘mode of substance’ arising from the proportion of the substance of the elements, is a natural disposition and the foundation of all powers. (Ibid., p. 18)[[16]](#endnote-16)

This then explicates the sense in which medicaments that have undergone fermentation can act according to their “whole substance”: the sense of wholeness relevant here derives from the view that the proportion of elementary qualities is a property of a whole material composite, while the sense of substantiality, somewhat less clearly, derives from the idea that even after the substantial forms of elements have been abolished in fermentation, there remain material parts that still stand in the same proportions to each other as the elements did before.

Valles also defends his reductionist stance by arguing for its explanatory potential. For instance, he criticizes a standard argument for the existence of occult powers of plant parts. According to this argument, the heating power of pepper much arise from an occult power since pepper is not hot to the sense of touch; likewise, the cooling power of opium must arise from an occult power since opium is not cold to the sense of touch (ibid., p. 37). In response, Valles concedes that the action of pepper cannot arise from inherent heat and the action of opium cannot arise from inherent coldness. However, he conjectures that the temperament of pepper is unable to resist the heat of the ambient body, similarly to what happens when rays of light are bundled in a drop of resin and set wood on fire (ibid., p. 38). Conversely, he conjectures that the temperament of opium is unable to receive the heat of the ambient body, such that, when opium reaches the heart, the vital heat of the living body is diminished (ibid.). If so, in both cases what is causally active are primary qualities such as heat and coldness.

The question, of course, is how far explanations that invoke the causal powers of primary qualities can be extended. Valles seems to get into trouble when he discusses the workings of purging medicaments, which he ascribes to a combination of two factors: (1) the similarity between the medicament and the substance that they extract from the body, and (2) the active powers of heat. As to the first factor, he explains:

This similarity of medicaments ... is not among the primary qualities … but among those accidents that follow from the mode of substance itself, which arises out of the mode of mixture; these qualities are color, thickness or thinness, friability or its contrary and other such things that seem to belong more to the side of matter. (Ibid., p. 386)[[17]](#endnote-17)

That Valles has a reductionist account of the similarity relation between medicaments and the substances that they extract from the body is confirmed by the accounts of the qualities that he mentions here: Thus, he regards color not as property of surfaces of visible bodies but rather as a structural property that is present throughout all three dimensions of a colored body, namely, the mixture between celestial and elementary heat (ibid., pp. 104; 394). He also describes the sensible species that travel through a transparent medium to make color visible as being of the same nature (ibid., p. 113). Similarly, he holds that “[t]hickness and thinness and the other accidents of the mode of substance arise without doubt from the mixture of elements” (ibid., p. 394).[[18]](#endnote-18) All of the qualities mentioned, then, can be understood as structural qualities that are wholly constituted out of the qualities of constituents.

In Valles’s view, relations of structural similarity explain why the medicament acts upon one substance contained in the body rather than upon another substance (ibid., p. 385). At the same time, he is clear that the similarity relation is symmetrical and cannot explain the direction of action (ibid.). This is why he invokes the active powers of the heat inherent in the medicament to account for why the medicament acts upon the body substance (ibid., p. 386). However, here one of the limitations of Valles’s approach becomes visible since, here and elsewhere, he leaves it completely open how attraction can arise from heat.

3. Erastus’s Critique of Emergentism

Thus, while the writings of Mercuriale and Valles clearly document that emergentism about some pharmacological powers and reductionism about all pharmacological powers were perceived as possible alternatives to the dominant view that combined reductionist accounts of some pharmacological powers with theories of the celestial origin of other powers. In both Mercuriale and Valles one finds some hints at possible arguments for the emergentist option, and Valles emphasizes some aspects that seem to remain unclear in the emergentist option. At the same time, no attempt at developing further arguments for the existence of now causal powers can be found in Erastus, and Valles’s arguments for the explanatory potential of reductionism has its clear limits. This is why it is interesting to see that the controversy over reductionism and emergentism has been developed in considerably greater argumentative depth in the writings of Thomas Erastus and Jacob Schegk.

Erastus’s *De occultis pharmacorum potestatibus* (1574) integrates pharmacological phenomena that were traditionally regarded as “actions of the whole substance” within the scope of phenomena that can be explained by the causal powers of the temperament of elementary qualities. To be sure, the work does not go reductionist regarding substantial forms. As Erastus surmises, the powers of substantial forms cannot be reduced to the powers of mixtures, they cannot emerge from the powers of mixtures, nor do they arise from celestial causation; rather, they are created at the beginning of the world and possess the capacity of propagating themselves through multiplication (Erastus 1574, p. 8). However, Erastus gives a reductionist account of all powers of medicaments, even of those that are said to act by their whole substance, and does not ascribe substantial forms to any medicament. Consequently, Erastus accepts two kinds of occult qualities: (1) those that are due to substantial forms, (2) those that are due to the temperament alone. An example that he mentions for the first kind of occult quality is the capacity of the torpedo fish to numb the hand that touches it (ibid., p. 25). This, however, is in his view not the kind of occult power that is observed in medicaments. The occult powers of medicaments, as he maintains, “can be reduced to” the powers of the temperament of elementary qualities (ibid., p. 31).

Erastus offers a reductionist account of the notion of pharmacological actions of the whole substance: “we say that the whole substance acts because it acts not only through one or two qualities that dominate over the other qualities in mixtures but rather by the forces of the whole matter composed and mixed of so-and-so many parts of such-and-such a nature” (ibid., p. 46).[[19]](#endnote-19) As he explains: “[W]e understand by ‘whole substance’ and ‘whole temperament’ not only the temperature brought about by the mutual action and passion of primary qualities considered, as it is called, abstractly, but rather together with the subject matter; that is, we denominate in this way the temperament that inheres in so many parts of matter of such-and-such quality, or that is aggregated out of so many temperaments of such-and-such quality of parts” (ibid., p. 47).[[20]](#endnote-20) Thus, in Erastus’s view, the only sense of wholeness required to explicate the notion of pharmacological actions of the whole substance is captured by the view that these actions involve the causal powers of the entirety of elementary qualities entering a temperament, plus the view that these powers never occur outside a material substrate. Clearly, this conception excludes the view that through the temperament some novel, emergent causal powers arise in medicaments.

Erastus gives a series of arguments for his claim that the powers of medicaments do not derive from substantial forms (ibid., p. 22). In what follows, I will focus on those arguments that seem to be most relevant for the prospects of pharmacological emergentism in the sixteenth-century context, since they exclude the view that medicaments possess substantial forms that emerge from the powers of matter. The first of these arguments could be dubbed the “Dependence on Life Argument”:

These qualities, which depend in this way on form and are in the composite through the form, are present when the form is present; but when the form disappears, they must simultaneously disappear. For if they could inhere in a subject that is not informed by this form, they would not at all depend on this form. (Ibid., p. 13)[[21]](#endnote-21)

What Erastus here has in mind is the role of substantial forms as principles of life in living beings—plant souls as principles of the life of plants and animal souls as principles of life of animals. Accordingly, if qualities depend on forms that guarantee the persistence of the life of a living being, qualities that persist after the death of a living being cannot be thought of as qualities that arise from forms. But this is exactly what can be observed in plant-based medicaments, since it is possible to separate by chemical procedures medically efficient plant parts after the death of a plant. Hence, Erastus concludes, the pharmacological powers of plant parts cannot depend on the substantial form of the plant from which they derive (ibid., pp. 14, 18).

A second argument could be dubbed the “Body Dependence Argument”. This argument starts from the assumption that powers of substantial forms are most active when their body is in perfect shape; by contrast, it can be observed that the powers of medicaments often presuppose the dissolution of natural bodies, for instance in the preparation of pharmacological powders, and that many medicaments operate more strongly once they are ground to powder (ibid., pp. 28-29). Hence, the relevant pharmacological powers cannot be understood as being brought forth by the substantial form of the plant.

A third argument that Erastus uses could be called the “Variation of Powers Argument.” According to this argument, qualities that arise from substantial forms should be found in all individuals with substantial forms of the same species. But with respect to the medical powers of plant parts, there is variation from individual to individual (ibid., pp. 14, 22). Hence, Erastus concludes that these medical powers cannot be essential, form-related qualities (ibid., p. 26). An extreme case of variation is the entire loss of powers: poison and medicaments can lose their power through longstanding acquaintance of the body with them; however, according to the conception of forms as essences, the powers of the substantial forms cannot diminish over time in this way (ibid., p. 15). The implication seems to be that a power that can be lost through mere longstanding acquaintance cannot be an essential quality that derives from a substantial form.

A fourth, closely connected, argument that Erastus develops could be called the “Activity Dependence Argument”. According to this argument, powers of substantial forms follow immediately from substantial forms; powers of medicaments, by contrast, need an external principle to become active. This follows from the fact that medicaments need to come into contact with the heat of a living body to become active. But, as Erastus argues, this is something that they have in common with all faculties that follow from the properties of matter and the temperament alone (ibid., pp. 27-28). Hence, the inability to initiate changes independently of external influences is what, in Erastus’s view, speaks against ascribing pharmacological powers to substantial forms.

4. Schegk’s Defense of Emergentism

Erastus’s arguments thus make clear that emergentism about pharmacological powers faces serious theoretical difficulties. This is why it is interesting to see that Schegk not only adopts an emergentist analysis of some powers of medicaments but also offers a series of arguments that purport to show why this is the adequate analysis. Schegk also mentions Erastus (Schegk 1585, p. 9) and, hence, probably was aware of the theoretical challenges just outlined, but he never explicitly addresses Erastus’s objections. Still, it can be shown that Schegk’s natural philosophy provides theoretical resources for countering Erastus’s arguments. This will be the task of the present section. For reasons that will be become clear presently, it will be useful to group together the first two and the last two arguments of Erastus.

*4.1. Schegk, the Dependence on Life Argument and the Body Dependence Argument*

Obviously, Erastus’s first two arguments rest on the assumption that there is only a single substantial form in a living being. Erastus explicitly subscribes to this assumption without, however, giving any argument for it (Erastus 1574, p. 12). This is unfortunate because he overlooks the existence of a tradition within late medieval Aristotelianism that is sometimes called “Latin Pluralism.” According to this tradition, within each living being there exists a plurality of substantial forms, in such a way that subordinate forms are dominated by the substantial form of the entire living being (see Michael 1992).

Schegk is one of the adherents of this tradition and combines the theory of a plurality of forms in living beings with emergentism. What is more, he uses this combination of theoretical assumptions to explicate the origin of the pharmacological powers of plant parts and to explain why the pharmacological powers that plant parts retain even after the death of the plant can be ascribed to substantial forms. The relevant forms, however, are not the plant forms but rather the forms of plant parts, which are seen as emerging from the potentiality of the matter constituting the plant parts.

To begin with, Schegk maintains that both inanimate forms and animate forms depend on the mixture of elements:

Some forms are merely natural, and without them animate forms cannot exist. However, the natural forms can exist without the animate forms, as when the form of the animate flesh decays. Both kinds of form have their mixture, and when the mixture is destroyed, also its substantial form is destroyed. (Schegk 1585, p. 122)[[22]](#endnote-22)

This conception of the origin of animate forms has the consequence that “an animate form also is a physical form” (ibid., p. 122).[[23]](#endnote-23) This is why Schegk takes natural forms to be inseparable from matter (ibid., p. 54). The only exception that Schegk allows concerns human souls, which he takes to be the result of separate acts of divine creation (Schegk 1580, sig. G5r). But he is clear that this sets human souls apart from all other substantial forms of living beings which are “educed” from the potentiality of matter (ibid.). Consequently, all natural forms are understood as being not only inseparable but also causally dependent on matter: “In nature, there is no essential power, either manifest or hidden, without a natural power or impotency that arises in natural things due to the mixture of the four elements—mixtures that are coming to be and ceasing to be as the instrumental causes of natural powers” (Schegk 1585, p. 66).[[24]](#endnote-24) More specifically, the relation between the instrumental causes and the essential form generated by them is characterized as a supervenience relation: As Schegk maintains, what cannot be the case is the situation in which different substantial forms are joined with the same temperament (ibid., p. 123). Or, as he expresses it: “As many differences as there are of substantial forms, so many differences are there between temperaments of mixtures of elements, through which such substances are generated …” (Ibid., p. 152).[[25]](#endnote-25)

To the natural forms that depend in this way on matter belong not only the substantial forms of living beings but also the “plastic power” (*plastica facultas*) inherent in seeds (see Hirai 2007, reprinted in Hirai 2011, ch. 3). This becomes clear when Schegk uses the phenomenon of plant degeneration—the process by means of which a cultivar reverts back to its corresponding wild variety—to illustrate the way in which the plastic power depends on matter. Schegk interprets this phenomenon as an instance of species change: A change in natural powers modifies the essential powers of the seed and, hence, the “essential form” of the seed (Schegk 1585, p. 85). The analogy between plant degeneration and the origin of the plastic power suggests that, as the substantial forms of the wild varieties of plants emerge from the change in the natural powers of matter, so does the plastic power emerge from the instrumental causes contained in the seed. In this way, the origin of plastic powers is understood as a special case of material upward causation—a kind of causation that leads from complex properties of mixtures to substantial forms with novel causal properties.

Yet, this is not the only direction of causation that Schegk takes into account.[[26]](#endnote-26) Both self-motion and self-reproduction involve the capability of living beings of acting upon themselves. This is why the role of emergent substantial forms in downward causation, for Schegk, is crucial for characterizing the new causal powers that the emergent substantial forms. Schegk maintains that the temperament of the mixture determines the substantial form, which in turn determines the further accidents that belong to the natural thing (ibid., p. 26). In particular, downward causation is described as being relevant for the generation of plant-based medicaments. In the first instance, downward causation changes the temperament of elementary qualities: “[T]he soul of rhubarb is the cause of proper and ordinary proportions of elementary qualities without which rhubarb could not have its forces and powers” (ibid., p. 89).[[27]](#endnote-27)

What is more, in Schegk’s view the process through which the plant soul causes qualitative changes in mixtures involves both downward causation and a subsequent new instance of upward causation—a causal relation that does not terminate in the plant soul itself but rather gives rise to new forms of plant parts. This becomes clear when he writes about both rhubarb and rhubarb juice:

[B]oth of these bodies, which are mixed at the same time, are effects of the soul, which generated and produced rhubarb, insofar as it not so much an animate body but rather a natural body, in such a way that it obtains even without the soul its medical powers and qualities, due to the nature, that is form, that it received from the soul, and which can subsist itself without the soul. (Ibid., p. 90)[[28]](#endnote-28)

As Schegk explains, when the soul produces posterior and perfect forms in similar parts, the forms previously inhering in these parts are thereby not abolished. Rather, the posterior form existentially depends on the previous forms such that, if the previous forms were abolished, the more perfect form would perish as well. This is what Schegk has in mind when he says that the previous forms stand in the relation of mediate matter to the perfect forms (ibid., p. 42). Diachronic downward causation therefore is described as a process of perfection of previously existing forms:

In this way, the posterior does not arise out of the prior but arises and is generated after that which is prior, such that its coming into being is nothing but that the prior is perfected by the posterior, as when we say that out of a boy there arises a man, not as if the subsequent perfection of the man would destroy the nature of the boy but that he perfects it with the degree of age. (Ibid., p. 43)[[29]](#endnote-29)

Here, Schegk focuses on physiological changes brought about by emergent vegetative and sensitive forms and the role of these physiological changes in the material causation of non-mental emergent forms that occur at a later point in time. Moreover, he analyses these non-mental emergent forms as resulting from forms that emerged even before the emergence of vegetative and sensitive powers.

Schegk’s ontology of a plurality of forms, connected with his view of a causal circle, is put to various explanatory functions, all of which are relevant for his pharmacological views. First, it is used to explain why the prior forms persist when the posterior forms are destroyed: even if the posterior forms are required for the changes in the physiology from which the modifications of the prior forms emerge, these modifications persist as long as their physiological basis persists (ibid., p. 44). This applies in particular to medical powers of plants: even when the vegetative soul perishes, the substantial forms of the parts of the plant can persist (ibid., p. 45). Second, the plurality of forms of plant parts explains why different plant parts have different medical powers—the different substantial forms of plant parts emerging from downward causation and the potentiality of matter gives rise to different causal powers (ibid., p. 77). Third, the theory of emergent substantial forms of plant parts offers an explanation for why the medical powers of plant parts are independent from the persistence of the entire body of the plant, as documented by the fact that grinding a medicament to powder does not diminish its medical powers. The only condition that has to be fulfilled is that matter is not divided beyond the size of a natural minimum understood as the minimal portion of suitably organized matter capable of sustaining a substantial form of a particular kind (ibid., p. 79). Specifically, this is the idea that Schegk applies to the medically efficient parts of plants such as rhubarb (Schegk 1580, sig. M3v). These considerations offer the theoretical resources for answering the first two anti-emergentist arguments developed by Erastus—the Dependence on Life Argument and the Body Dependence Argument: A plurality of emergent forms within the plant organism allows the persistence of plant parts with substantial forms of their own independently of the persistence of the substantial form of the living plant, and also independently of the persistence of the entire organic body of the living plant; all that is required is the persistence of a material composite from which the substantial form causally responsible for the pharmacological power emerges.

*4.2. Schegk, the Variation of Powers Argument and the Activity Dependence Argument*

Erastus’s last two arguments require us to consider a difference that Schegk draws between the structure of living beings and their seeds, on the one hand, and the plant parts with pharmacological powers and other mixtures. Schegk ascribes to both inanimate mixtures and living beings “connate heat” (*calidum nativum*, *thermos symphytos*), while among the instrumental causes specific for living beings and their seeds, he identifies an entity called “innate heat” (*calidum insitum*, *thermos emphytos*).[[30]](#endnote-30)

As to the nature of connate heat, it is instructive to see that in *De causa continente* Schegk adopts much of Alexander of Aphrodisias’s theory of mixture (in fact, the work is accompanied by Schegk’s Latin translation of Alexander’s *De mixtione*). The core idea of Alexander’s *De mixtione* is expressed in the following account that Schegk gives of the role of the tempering of elemental qualities in mixture:

Those entities that constitute a temperament are first divided and split up amongst each other into minute parts, then their activity is gradually diminished through the composition of minimal parts …, and third, as it were through some agreement, they jointly bring about a single form of the entire mixed body. (Schegk 1540, fol. 65r)[[31]](#endnote-31)

According to this account substantial form of the mixture arises through the tempering of elementary qualities. And it is the elementary heat tempered through the other elementary qualities that Schegk calls “connate heat”. In his later writings, Schegk emphasizes that connate heat does not possess a celestial essence but is grounded in the coming-together (*synkrisis*) of elements (Schegk 1580, sig. K2v). In particular, he takes the connate heat of living beings to be grounded in the temperament of seeds (ibid.). In living beings, the connate heat is the cause of concoction, of which in Schegk’s view there are two kinds: One kind is restricted to the qualitative and quantitative change of material particles without any change of species. The other kind involves the occurrence of “some species and form through which a new substance comes into being and the prior substance ends, as when out of nutriment blood is produced through concoction” (Schegk 1550, p. 402).[[32]](#endnote-32) Due to the role in the generation of a new substance, connate heat has a special relation to substantiality: “In so far as it is considered as a quality of some kind, due to the mixture of elements that evidently can be more or less perfect it inheres in this co-substantial entity” (Schegk 1580, [sig. K6r]).[[33]](#endnote-33)

As to the nature of innate heat, Schegk maintains that it should regarded as one of the causes of the generation of living beings (Schegk 1540, fol. 15r). Likewise, in *De plastica seminis facultate* he describes it as the “instrument” of the plastic power (Schegk 1580, sig. C2r-v; see Hirai 2007, 14-20). With a view to this instrument, Schegk there quotes approvingly the passage from Aristotle’s *De generatione animalium* II.3 according to which a seed contains an entity, variously called “vital heat”, “ether” or “pneuma”, which does not arise from the mixture of elements but rather stands in a relation of analogy to celestial bodies (Schegk 1580, sig. B3r; see Aristotle, *De gen. an.*, 736b29-727a7). In *De caloris vi et efficacia in rebus naturalibus*, he returns to the question of the nature of this entity and maintains that innate heat does not emerge from elementary qualities but rather derives from the heat of celestial bodies (Schegk 1585, p. 294). What is more, in *De calido et humido nativis et insitis in corpore animatorum* he unambiguously characterizes this kind of heat as a quality:

Because innate heat is a quality, it must necessarily inhere in its proper subject, which is that which, being of the same genus due to mixture, finally underlies the substantial form as the ultimate or proper matter. Before this heat is perfect, in ultimate matter, form will not be in it … Hence, simultaneously with ultimate matter the form arises and, simultaneously with it, it perishes, in such a way, however, that innate heat is a proper quality of the ultimate matter which is the proper subject of the nascent form. (Schegk 1580, [sig. I8r])[[34]](#endnote-34)

Thus, innate heat for Schegk is not a kind of subtle matter but rather a quality that is one of the causal factors that play a role in the emergence of the substantial forms of living beings. Characterizing the ultimate preparation of matter and the emergence of the substantial form of living being as simultaneous indicates that Schegk thought of material upward causation as synchronic. This distinguishes upward causation from downward causation, which involves changes of elementary qualities—a process that requires time and hence can be characterized as diachronic. At the same time, due to its role in the emergence of the substantial form of a living being, Schegk holds that innate heat has a special relation to substantiality:

[Innate heat] is not a quality or an accident, in so far as it constitutes with primary matter the proper or ultimate substrate, and for this reason we call it co-substantial. For because of it, the substantial potentiality of primary matter is transformed into substantial actuality, that is, into a form that constitutes the essence of a thing. (Schegk 1580, [sig. K6r])[[35]](#endnote-35)

Schegk’s treatment of innate heat leaves us with the question of why it should be necessary to stipulate the existence of a non-elementary causal factor. Schegk offers an answer that derives from a traditional assumption concerning the nature of a temperament, namely, the assumption that, once a temperament has reached its completion, the tempered elementary qualities have reached an equilibrium or “balance”, understood as the stable end-point of processes of interaction between elementary qualities (see Kaye, 2014, p. 4). Schegk maintains that a mixture of this kind can bring forth a new substantial form that has new causal powers to act upon other bodies; but he argues that, due to the stability of the equilibrium of elementary qualities the mixture and its substantial form do not acquire the powers of changing itself (Schegk 1585, pp. 273, 277-278). This distinction between active powers working on other bodies and active powers working within a body produced by mixture motivates Schegk’s usage of the distinction between elementary heat and its role in temperaments, on the one hand, and innate heat on the other hand. He introduces the notion of innate heat as a non-elementary causal factor that continuously disturbs the state of equilibrium of elementary qualities. Only a continuous disturbance of equilibrium is what, as he argues, can explain the emergence of the ability of a composite to change itself because the composite will perpetually strive towards restoring the equilibrium (ibid., pp. 275-276). The ability of self-change is exactly what is needed in living beings.

The difference between connate and innate heat matters a lot in his eyes: Without innate heat, mixtures lack the capacity of acting upon themselves, once the balance between elementary qualities has been reached (ibid., p. 273). This is why mixtures of this kind, even if they possess causal powers that go beyond the causal powers of mere aggregates of elements, cannot spontaneously initiate activities by changing themselves but rather depend on the presence of suitable other substances upon which they could act. For this reason, Schegk could easily concede to Erastus that plant-based medicaments, in contrast to living beings and their seeds, display activity dependence. But this corresponds exactly to Schegk’s distinction between substantial forms that emerge from mixtures without the influence of vital heat and substantial forms that emerge from mixtures together with the influence of vital heat—the latter constitute composite substances that possess the power of altering both themselves and other bodies, while the former constitute composite substances that alter other bodies without having the capacity of altering themselves. Thus, if medicaments are thought of as belonging to the category of mixtures that generate substantial forms but do not have the power of acting upon themselves, the causal inertness of medicaments outside the organic body is exactly what is to be expected. This, then, provides the theoretical resources for answering Erastus’s Activity Dependence Argument.

Yet, if the idea that some pharmacological powers derive from substantial forms can be defended, why do these powers differ with changes in the material constitution of the medicament or with increasing familiarity of the patient with the medicament? Schegk holds that emergent forms can persist even when some changes in the temperament occur: “Because natural substances are generated together with matter, their function and actions can be hindered, in such a way however that the substance does not decay or perish …” (ibid., p. 28).[[36]](#endnote-36) This is why differences in the temperament can lead to different actions, although the substantial forms remain the same (ibid., p. 132). Moreover, Schegk argues that the fact that a medicament needs the presence of a suitably tempered organism does not speak against the view that the medicament acts by means of a substantial form since it is a widely-accepted assumption in Aristotelian natural philosophy that the temperament is an instrumental cause by means of which substantial forms exert their action (ibid., p. 82; see Bos 2003). Schegk’s view that substantial forms and their powers supervene upon the temperament of the material composite from which they emerge is thus combined with the view that the relevant supervenience relation is asymmetrical, since a change in the temperament (and hence a change in the way in which the form can act by means of the temperament) can take place without a change in the substantial form and its powers. Analogously, because their agency depends on the temperament of the organic body, changes in the strength of their activity should be expected depending on changes in the temperament of the body, including those changes partly brought about by the medicament itself. This is why changes in the activity of the medicament can be brought about by changes in the temperament of the organic body, and still these activities can be regarded as effects of unchanged essential powers emerging from the temperament of the medicament. And this provides the theoretical resources for answering Erastus’s Variation of Powers Argument.

5. Conclusion

Attitudes towards reductionism is sixteenth-century pharmacology thus diverged significantly. While Valles and Erastus held that all pharmacological powers could be reduced to the powers of the elements and their temperament, Puteanus, Mercuriale and Schegk held that some pharmacological powers should be ascribed to substantial forms. With respect to powers of this kind, Puteanus adopted Mesue’s theory of the celestial origin of substantial forms that could explain pharmacological actions of the whole substance. Mercuriale, by contrast, was aware that this way of supplementing reductionist pattern of explanation was not the only available theoretical option and therefore pointed the reader’s attention to what he regarded as emergentist strands in Averroes. This, by itself, of course, would not be a very consequential insight if there had been no attempt to develop this line of thought in more detail. However, as I have argued, such an attempt can be found in Schegk’s pharmacological writings.

To bring out the argumentative strengths of Schegk’s position, a comparison with Erastus’s defense of a thoroughgoing version of reductionism about the powers of all medicaments turned out to be useful. Contrasting Erastus’s arguments with what Schegk says about synchronic upward causation and diachronic downward causation makes it clear that sixteenth-century emergentism provides theoretical resources that Erastus had not reckoned with. By combining the theory of a plurality of substantial forms in a living being with the idea that these forms are educed from the potentialities of matter makes it clear that the independence of plant-based medicaments from the plant soul and the entire organic body of the plant cannot provide a valid argument against the agency of substantial forms. Likewise, the dependence of the agency of medicaments on a suitably tempered matter in the medicament and on a suitably tempered human body is exactly what is to be expected given Schegk’s conception of the dependence of substantial forms and their agency on the temperament of the mixtures from which they emerge and of his conception of the inability of mixtures that lack innate heat to initiate action spontaneously.

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1. On the medieval background, see McVaugh 1974a; Gibbs 2013. [↑](#endnote-ref-1)
2. For a comprehensive list of the occurrences of the concept of action of the whole substance in Galen, see Copenhaver 1991, note 25. [↑](#endnote-ref-2)
3. On early modern treatments of the eduction of forms, see Blank 2014; Blank 2016; Blank 2017. [↑](#endnote-ref-3)
4. On Mercuriale’s natural philosophy, see Siraisi 2003; Arcangeli and Nutton 2008. [↑](#endnote-ref-4)
5. On Valles’s natural philosophy, see Martin 2002. [↑](#endnote-ref-5)
6. On the intellectual situation in sixteenth-century Tübingen, see Methuen 1998. [↑](#endnote-ref-6)
7. On the authorship of this text and its influence, see De Vos 2013. [↑](#endnote-ref-7)
8. “Medicamentum est purgatorium, non a temperamento, neque ut contrarium agens in contrarium, quatenus contrarium, neque ut simile trahens & evellens alterum, aut ut contrarium, neque ut leve sursum, grave deorsum, agitans purgandam materiam, sed quia talem coelitus est sortitum facultatem.” This translation and the following ones are my own. [↑](#endnote-ref-8)
9. “ipsa forma specifica non est aliud formaliter quam quoddam additum supra complexionem per quod facit talem operationem. Aut etiam licet complexio non sit primum principium operationis occultae, tamen multum adiuvat ad occultam operationem illius medicinae solutivae.” On the concept of occult powers, see Hutchinson 1982; Millen 1985; Henry 1986; Blum 1992. [↑](#endnote-ref-9)
10. “Sed ascribenda attractio haec similitudini, non veluti effectrici causae est, verum ut causae quae sine qua non, solet nuncupari: ita ut ipsa quidem actio primum caelo accepta referatur, e cuius sinu et formae & formarum proprietates emanant …” [↑](#endnote-ref-10)
11. “Ubi miscenda sunt alterantia purgantibus propter nocumenta evidanda qualitatis medicamentorum nobis adversae, debet alterantium quantitas esse aequalis quantitate purgantium; ratio est, quia effectus formae specificae non possunt impediri, nisi ab aequali forma specifia, aequalitas formae specificae sequitur etiam aequalem quantiatem.” [↑](#endnote-ref-11)
12. “Respondeo id quod dicit Averroes 8. *Metaphysicorum*, formas specificas consequi proprias temperaturas, & propterea ubi retunduntur temperaturae propriae, diminuitur etiam facultas formae specificae, & propterea in mixtione cum a frigiditate camphorae sit retusa caliditas scammonii, consequenter etiam est retusa facultas purgatoria, & adversa nobis …” [↑](#endnote-ref-12)
13. “[C]ausa istius unitatis est ut transmutetur quod est in potentia, donec fiat in actu ab agente, scilicet ab extrahente ipsum a potentia in actum. Est igitur hic aliquid unum, quod primo est in potentia, & post transfertur de potentia in actum, translatio enim eius non largitur ei multitudinem, sed perfectionem in esse, et in toto hoc est unum in actu …” [↑](#endnote-ref-13)
14. “Cum … diurnitate ad fermentationem veniumt, corrumpuntur singula secundum formas, remittuntur secundum qualitates; fitque unum medicamentum, diversum substantia ab utrisque.” [↑](#endnote-ref-14)
15. “Hic illius asseclae primum de innata complexione, ea (inquam) quae in singulis membris sita est, non de ea quae aliunde provenit, agi affirmant …” On early modern emergentist readings of Avicenna’s conception of temperament, see Blank forthcoming. [↑](#endnote-ref-15)
16. “[Q]uamquam elementorum formae corrumpuntur, manent partes illis proportione respondentes; … atque ex horum attemperatione, quendam substantiae modum per totum generari pro ratione proportionis substantiarum elementarium: atque hanc proportionem esse nativam temperiem, ex quam singula membra suas operationes participant … Atqui hoc temperamentum qualitatum, est dispositio quaedam corporum temperatorum. Prius illud temperamentum, quod modum susbtantiae esse dicimus, ex substantiarum elementarium proportione factum, est habitus naturalis, & fundamentum omnium facultatum.” [↑](#endnote-ref-16)
17. “Haec similitudo medicamentorum … non est in primis qualitatibus …; sed in illis accidentibus, quae consequuntur ipsum substantiae modum, qui nascitur ex modo mixtionis. Hae qualitates sunt: color, crassities aut tenuitas, friabilitas aut contrarium & tales aliae, quae videntur esse magis ex parte materiae.” [↑](#endnote-ref-17)
18. “Crassitiem & tenuitatem, & reliqua accidentia modi substantiae, non dubium est ex mistione elementorum provenire.” [↑](#endnote-ref-18)
19. “Tota igitur substantia dicimus agere, quod non una duntaxat duabusve qualitatibus in mistione caeteras superantibus agit, sed totius materiae ex tot ac talibus partibus concretae & mistae viribus nos afficit.” [↑](#endnote-ref-19)
20. “[N]os per totam substantiam totumque temperamentum non tantum temperiem ex mutua primarum qualitatum actione & perpessione ortam, & in abstracto, ut vocant, consideratam intelligere, sed una cum hac subiectam quoque materiam comprehendere: hoc est temperiem in tot & talibus materiae partibus insidentem, sive ex tot ac talibus partium temperamentis conflatam sic nominare.” [↑](#endnote-ref-20)
21. “[C]ertum omnino est, quae hoc modo a forma pendent, perque eam in composito insunt, ea praesente forma adesse, eademque abeunte, necessario simul cum ea abire. Quia si in subiecto aliquo ea forma non informato inhaerere possent, ab illa forma omnino non dependererent.” [↑](#endnote-ref-21)
22. “Quaedam sunt naturales duntaxat formae, & sine quibus animatae non esse possunt. Naturales autem possunt esse sine animatis, ut quando desinit forma carnis animati. Utraque forma suam crasin habet, qua perempta perimitur etiam ipsius forma substantialis …” [↑](#endnote-ref-22)
23. “Ex quo par est intelligi animatam formam etiam esse physicam formam …” [↑](#endnote-ref-23)
24. “In natura nullam esse potentiam essentialem, sive sit manifesta, sive sit occulta, sine potentia naturali, aut impotentia, quae provenit in rebus naturalibus propter mixtionem quatuor elementorum, qua mixtione generantur etiam & corrumpuntur, ut instrumentali causa potentiae naturales.” [↑](#endnote-ref-24)
25. “quotquot formarum substantialium differentiae sunt, totidem etiam sunt temperamentorum ex elementis mixtorum quibus tales substantiae generantur differentiae …” [↑](#endnote-ref-25)
26. On ancient views concerning downward causation, see Sorabji 2010; Ganeri 2011. [↑](#endnote-ref-26)
27. “[A]nima rhabarbari causa est craseos propriae & vernaculae, sine qua rhabarbarum vires suas & facultates habere nequit.” [↑](#endnote-ref-27)
28. “[A]mbo simul mixta effectus sunt animae, quae procreavit & produxit rhabarbarum, quatenus est non tam animatum quam naturale quoddam corpus, ut quod etiam sine anima vires suas & proprietates medicas obtineat, propter naturam, idest forma, quam accipit ab anima, & qua etiam sine anima seipsa subsistere potest.” [↑](#endnote-ref-28)
29. “Et hoc modo posterius non ex priore, sed post illud, quod prius fuit, fieri & generari dicitur, ut nihil aliud sit illud fieri, quam prius a posteriore perfici: ut si dicamus e puero fieri virum, non quod viri perfectio succedens, corrumpat naturam priorem pueri, sed quod cum gradu aetatis perficiat.” [↑](#endnote-ref-29)
30. On ancient and medieval accounts of innate heat and its relation to innate humidity, see Hall 1971, Niebyl 1971; McVaugh 1974b. [↑](#endnote-ref-30)
31. “Constat etiam ea quae contemperantur inter se primum minutatim dividi atque confringi, mox minimorum compositione actionem paulatim debilitari, atque habescere, nam integra viribus plus valent, & confestim ad agendum incumbunt, tertio, quasi consensione quadam in mixti totius corporis formam unam aliquam conspirare, cum agendo patiendoque prope paria, unum in alterius potestatem redigi nequeat.” See Todd 1976, p. 158 [*De mixtione* 233.2-5]. [↑](#endnote-ref-31)
32. “Una est, qua pervenitur ad speciem aliquam & formam, qua nova substantia incipit, & prior desinit, ut cum ex alimento conconctione generatur sanguis.” [↑](#endnote-ref-32)
33. “[Q]uoad consideratur, ut qualitas quaedam, consubstantiali huic inest propter crasin elementorum, quae quod perfectior aut imperfectior dicatur, ipsum per se est manifestum.” [↑](#endnote-ref-33)
34. “*Emphytos* autem calor qualitas cum sit, in suo proprio subiecto ipsum necesse est inesse, quod ipsum nimirum est, *ton homophylon* causa concrementi quoad ut *eschate* seu *oikeia hyle* formae substantiali subijcitur. Antequam illud calidum sit perfectum, in materia ultima, non inerit ei forma … Simul ergo cum materia ultima forma nascitur, & simul cum ea interit, sic tamen, ut calor *emphytos* sit propria qualitas ultimae materiae, quae *oikeios* subijicitur nascenenti formae.” [↑](#endnote-ref-34)
35. “Qualitas vel accidens non est, quandoquidem cum materia prima *oikeian hylen*, seu *eschatio* constituat, & ob id consubstantialem eam appellamus. Nam propter eam, substantialis potentia materiae primae actu substantiali, id est, forma constituente essentiam rei permutatur.” [↑](#endnote-ref-35)
36. “Quum enim substantiae naturales sint concreatae cum materia, & facultates & actiones earundem impediri possunt, ut tamen substantia earum non corrumpatur aut pereat …” [↑](#endnote-ref-36)