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Pharmacology in the Renaissance



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Abstract

In addition to practical handbooks, academic medicine in the sixteenth century offered various metaphysical accounts of the nature and causal powers of medicaments. One important strand of thought tried to reduce pharmacological powers to elementary qualities and their modifications in mixtures. In this context, the distinction between primary, secondary, and tertiary qualities was discussed. Another strand of thought ascribed so-called pharmacological powers “of the whole substance” to celestial influences. A third strand of thought discussed critically the prospects of applying emergentism – the view that from complex combinations of elementary qualities, new substantial forms with irreducible causal powers could arise – to the analysis of medicaments. While this third strand of thought faced serious ontological difficulties – such as the question of how something substantial could arise from something qualitative and the question of how unities could arise from multiplicities – some Renaissance pharmacologists adopted emergentism for particular groups of medicaments such as purgative drugs.

Introduction

Renaissance pharmacology produced a wealth of practical handbooks that listed medical properties of minerals and plants and described procedures for the preparation of medicaments (see, e.g., Lodovici 1540; Mattioli 1569; Ulmus 1597; see Palmer 1985). Paracelsus and the Paracelsians combined the practical aspects of “chymical” medicine with the stipulation of occult entities (such as heavenly spirit, demons, and “signatures”) and of powers deriving from them (such as “magnetic” sympathies and homeopathic causation) (see the entries on ► “Paracelsus and Paracelsism”). Within academic medicine, on which the present entry will focus, some pharmacological work incorporated considerations concerning the metaphysical analysis of the nature of medicaments and their modes of operation. These metaphysical views were still very much under the influence of a distinction going back to ancient medicine: the 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 were distinguished from effects of medicaments that were taken not to be explicable in this manner. Galen coined the expression that a medicament of the latter kind possesses the capacity of “altering by its whole substance” (see Copenhaver 1991). There was unanimous agreement that some pharmacological potencies could be explained in a reductive way –

a way that does not invoke any causal powers in addition to the causal powers of elements modified through their interaction – although there was some disagreement concerning the question of whether or not the potencies brought about by these “primary potencies” should be distinguished into different categories themselves. By contrast, there was fundamental disagreement concerning the question of whether or not pharmacological actions of the whole substance could be subsumed under a reductionist pattern of explanation. Most thinkers who advocated a non-reductive analysis of pharmacological potencies of the whole substance adopted various theories of celestial causation. But emergentism – the view that the temperament can bring forth novel causal properties that cannot be analyzed as combinations of the causal properties of the constituents of a composite – was clearly perceived as a possible theoretical alternative, which in some cases, in spite of critical responses, was adopted by sixteenth-century thinkers.

Medicaments and Reductionism

In Renaissance pharmacology, the view was widely shared that some potencies of medicaments could be understood as being identical with combinations of primary qualities – i.e., the qualities hot, cold, wet, and dry. According to this view, many medical powers could be understood as secondary qualities that consist in the mutual modification and combination of primary qualities in a mixture. However, there was some disagreement as to whether or not this distinction should, within a reductionist framework, be supplemented by the concept of tertiary qualities. Guilielmus Puteanus (Guillaume Dupuis), professor of medicine at the University of Grenoble, for instance, surmises that since in all effects that can be explained in a reductive way, only tempered primary qualities are causally efficacious; the concept of secondary qualities is sufficient to capture all effects of these medicaments (Puteanus 1552, 22, 25–26). By contrast, Girolamo Mercuriale (1530–1606), a medical humanist and physician to Cardinal Alessandro Farnese (see Siraisi 2003;

Arcangeli and Nutton 2008), gives a differentiated account of what he calls “secondary potencies” (*secundae facultates*) and “tertiary potencies” (*tertiaefacultates*). Examples of secondary potencies are the capacities of medicaments to make parts of the organism denser and harder (or the opposite) (Mercuriale 1590, 11v). Examples of tertiary potencies 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 (Mercuriale 1590, 17v). In both cases, what is causally efficient, according to Mercuriale, are the tempered elementary qualities – in this sense he says that the secondary and tertiary potencies “have nothing new.” However, he notes a significant difference: The secondary potencies 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 potencies are specific to particular conditions of particular organs, and, in this sense, they are determinate with respect to a particular goal (Mercuriale 1590, 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 (Mercuriale 1590, 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, 341). By implication, “absolute” actions are to be understood as actions that occur in various body parts.

In spite of the scope of such reductive explanations of pharmacological phenomena, Puteanus and Mercuriale believe that not all effects of medicaments can be explained in this way. This is why Puteanus adopts a theory of celestial causation (see section “[Medicaments and Celestial Causation](#)”) and Mercuriale adopts emergentism to explain the occurrence of these effects (see section “[Medicaments and Emergentism](#)”). Diverging from such hybrid accounts, some Renaissance thinkers expanded reductionism also to

pharmacological actions of the whole substance. One of these thinkers is the Madrid-based physician and philosopher Francisco Valles (1524–1592, see Martin 2002), who regards this type of action as an outcome of the combination of similarity and elementary powers. He invokes similarity as an explanation for the specific actions of purgative medicaments on determinate body fluids (Valles 1582, 363). At the same time, he concedes that similitude cannot explain the direction of action since a medicament is no more similar to a determinate body fluid than this body fluid is similar to the medicament (*ibid.*). His solution is to suggest that what is causally efficient in attraction is elementary heat and that the direction of action can be explained by the presence of greater heat in one of the *relata* (*ibid.*, 364). As he argues, similarity is nevertheless causally relevant. In his view, similarity does not concern elementary qualities but rather qualities such as thickness and thinness, friability, and its contrary (*ibid.*) – generally the qualities that follow what he calls the “mode of a substance” (*ibid.*) and what we now would call its structural properties. Valles’s thought seems to be that greater heat inherent in the medicament can become operative only when the structural properties of the medicament resemble those of the body fluid upon which it acts. The concept of qualities that follow the mode of a substance brings in a sense in which only the combination of the causal powers of an elementary quality with structural properties that belong to an entire material compound produces pharmacological actions of the whole substance.

The most sustained chain of arguments in favor of a reductionist account of pharmacological actions of the whole substances can be found in the work of the Heidelberg-based physician Thomas Erastus (1524–1583). Erastus has recently received considerable attention as a defender of Aristotelian natural philosophy against alchemy and Paracelsian “chymistry” (see Newman 2006, 45–65), and also his role as a public figure in the complex confessional development of the Palatinate has been studied in detail (see Gunnoe 2011). For present purposes, his analysis of so-called “occult” qualities deserves attention. Erastus accepts two kinds of occult

qualities: (1) those that are due to substantial forms and (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 (Erastus 1574, 25). This, however, is in his view not the kind of occult potency that is observed in medicaments. The occult potencies of medicaments, as he maintains, “can be reduced to” the potencies of the temperament of elementary qualities (Erastus 1574, 31).

Erastus gives a series of arguments for his claim that “the potencies of medicaments are not properties of substantial forms” (Erastus 1574, 23). The first of these arguments could be dubbed the “Dependence on Life Argument”:

These qualities that 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. (Erastus 1574, 13)

Thus, if qualities that arise from forms depend on the persistence of life, 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; hence, their pharmacological powers cannot depend on the substantial form of the plant (Erastus 1574, 14; 18).

A second 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 (Erastus 1574, 14, 22). Hence, Erastus concludes that these medical powers cannot be essential, form-related qualities (Erastus 1574, 26). An extreme case of variation is the entire loss of powers: poison and medicaments can lose their power through long-standing 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 (Erastus 1574, 15). The implication seems to be that a power that can be lost through mere long-standing acquaintance cannot be an essential quality that derives from a substantial form.

A third argument that Erastus uses could be called the “Activity Dependence Argument.” According to this argument, potencies of substantial forms follow immediately from substantial forms; potencies 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 (Erastus 1574, 27–28). Finally, a fourth argument could be dubbed the “Body Dependence Argument.” This argument starts from the assumption that potencies of substantial forms are most active when their body is in perfect shape; by contrast, it can be observed that the potencies 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 (Erastus 1574, 28–29).

Taken together, these arguments lead Erastus to 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 dominates 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” (Erastus 1574, 46). As explains: “We 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” (Erastus 1574, 47). 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.

Medicaments and Celestial Causation

One of the alternatives to such reductionist accounts of pharmacological actions of the whole substance invoked celestial influences on medicaments. For instance, in his treatment of purgative medicaments, Puteanus refers to the authority of a thirteenth-century pharmacological work ascribed to the Arabic physician Johannes Mesue (Yuhanna ibn Masawayh; on the authorship of this text and its influence, see De Vos 2013). 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 the nature of celestial influence that Mesue has in mind as theory concerning the celestial origin of forms (Puteanus 1552, 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)

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). As Mondinus 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., fol. 6r). 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 (*ibid.*). This conception of the role of specific forms is taken up in Costaeus's commentary (*ibid.*, fol. 2v). 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). Given the standard understanding of emanative causation as a process in which the effect instantiates in less perfect for the essence of the cause, such a conception of the origin of the forms of medicaments and their potencies implies that such pharmacological potencies are themselves celestial potencies inhering in material composites.

Perhaps the most spirited defense of the idea of celestial causation in the origin of the forms of medicaments and of living beings can be found in the work of Jean Fernel (ca. 1497–1558). Fernel maintains that "the single Form of the Heaven comprehends in potency all forms, be they already existent or simply possible, of living beings, plants, stones, and metals, and as if pregnant with innumerable forms, begets and spawns from Herself everything..." (Fernel [1548] 2005, 111). Thus, mixed bodies such as metals, stones, plants, and animals "draw their essence of their form from heaven" (Fernel [1548] 2005, 315). He is explicit about the view that subcelestial bodies derive their form from the heavens because the motions of subcelestial bodies are influenced by the movements of celestial bodies (Fernel [1548] 2005, 307). Fernel holds that the multiplicity of movements of subcelestial bodies derives from the fact that the inner heavenly spheres rotate in a direction opposite to the rotation of the extreme sphere (Fernel [1548] 2005, 309). His view of celestial causation is combinatorial: the complex motions of composite bodies on earth are the result of the combination of motions of heavenly bodies. Moreover, to explain how the motion of distant heavenly bodies is communicated to composite bodies on earth and how the transmission of motion confers

substantiality upon composite Fernel's invokes an entity called "*spiritus*" that he regards not only as a force that pervades the universe but also as a subtle, material medium (see Clericuzio 1988, 36–39; Bono 1990, 356–364; Dessi 1995; Hirai 2005, 88–96). The *spiritus* not only transmits celestial motions in a way such that composite bodies on earth would be purely passive but also transmits something of the powers of heavenly bodies to bodies on earth, such that the simple forms of composite bodies become principles of activity of their own (Fernel [1548] 2005, 359). Fernel maintains that the divine spirit "distributes itself" into the whole of a composite body and "despatches and instals the simple form into the prepared matter" (Fernel [1548] 2005, 319).

This can be seen as the relevant background for Fernel's analysis of pharmacological actions of the whole substance. Fernel's pharmacological conceptions are developed most fully in his *Therapeutics*, where he applies a variety of explanatory principles. For instance, he maintains that purgative medicament work sometimes by means of attraction by means of heat, sometimes by means of vacuity, and sometimes by means of similitude of the whole substance (Fernel 1585, 371). Thus, secondary potencies such as relaxation and attenuation, attraction, repulsion, and dissolution are given a reductionist account that points to the effect of the tempering of the elementary qualities on body part (Fernel 1585, 388–389). Hence, in all such secondary potencies, what is causally efficient are still the tempered primary qualities. By contrast, action by means of similitude, in Fernel's view, cannot be explained in such a reductionist way: "This similitude does not belong to temperaments but to substances" (Fernel 1585, 371). Fernel compares such potencies of the whole substance with the forces of the magnet, which has "the power to actually attract iron through a celestial potency, which is beyond the elements" (Fernel 1585, 393). He claims that of this kind is also the "tertiary potency" of medicaments, which "does not arise primarily and by itself from the temperament nor from matter but from the total substance of a thing and its form" (Fernel 1585, 393).

Medicaments and Emergentism

While the reduction of some (or all) pharmacological potencies to primary qualities and the alternative explanation of some pharmacological potencies through celestial causation were clearly the dominant explanatory patterns in the Renaissance, emergentism was clearly perceived as a possible third theoretical option. One context in which this becomes clear is Fernel's detailed criticism of Alexander of Aphrodisias' emergentism about medicaments and the soul (on the reception of Alexander in Renaissance philosophy of mind, see Kessler 2011). Fernel's literary figure Brutus articulates the emergentist position of Alexander of Aphrodisias as follows:

[T]he form of a composite is a power, derived from the tempering and mingling of the bodies substrate to it; the preparation actually comes from the mingling of the substrate, and the potentiality itself, when it has attained completeness, becomes an entelechy, that is, a perfection, so as to be the form of the thing. Thus, I consider that a form develops from the potentiality of the matter, because the potentiality itself passes over into the form in an unbroken sequence, and becomes action. (Fernel [1548] 2005, 167–169)

Alexander's application of this line of thought to medicaments is made explicit when Brutus remarks about form:

[I]t appears to emerge from the temperament of the body, like a simple force originating from the temperament and concordant harmony of substrate bodies . . . [I]n this way we understand that the power of mixed theriac or of a medicated drink develops from the mingled and tempered powers of simples, and this accords with Galen's attitude too. (Fernel [1548] 2005, 175)

Fernel's literary figure here accurately represents Alexander's position. According to Alexander, the soul "is the power and form that supervenes on 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]; Alexander of Aphrodisias 2012, 51). As Victor Caston has argued, talk about

supervenience 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, 348–349). Moreover, Caston emphasizes that, for Alexander, the soul possesses causal powers that are more than the aggregates of the causal powers of the elements (*ibid.*, 349–350). Likewise, Alexander points out that some medicaments possess powers that arise 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 these are powers that go beyond the powers inherent in the harmony of elementary qualities (Alexander of Aphrodisias 2008, p. 104 [*De anima* 24.24–29]).

Fernel rejects emergentism due to two problems. The first problem could be called the "substantiality problem." Fernel is aware that Alexander regards forms of composites as substances while at the same time regarding the forms of elements as belonging to the category of qualities (Fernel [1548] 2005, 147; see Alexander of Aphrodisias 2008, 70–72). However, Fernel's spokesperson Eudoxus argues that Alexander faces a problem: "No accident can really accomplish the essence of a substance; in the same way, what some call the essential difference between things cannot be supplied from an accident, because an accident could not alter the essence of a natural thing" (Fernel [1548] 2005, 153). Thus, neither saying that the emerging form is a quality nor saying that a substantial form can emerge from qualities will be satisfactory. The second problem – call it the "Simplicity Problem" – is developed by juxtaposing quotations from Alexander's treatment of elements and from his treatment of composites. On the one hand, Alexander writes: "Simple bodies which have a simple substrate, have taken on a simple form and nature. But those in which the substrate is not simple, but is already some body, or a composite: in them the form is more perfect, with more prominent and complex embellishment. And deservedly so, for the form which is in the matter and the substrate contributes something to the form of things that are composite"

(Fernel [1548] 2005, 163, Alexander of Aphrodisias 2008, 74–76). On the other hand, Alexander adds a little later: “The multitude of forms, and their diverse mingling, can contribute a reasonable cause of change in substrate bodies” (Fernel [1548] 2005, 163; Alexander of Aphrodisias 2008, 76). Brutus comments on the latter passage: “Does not this say clearly that the forms of mixed bodies are themselves mixed too, and from them springs a form of the whole, to be itself composite?” (Fernel [1548] 2005, 163). Eudoxus is not satisfied: “[T]he simple form of a whole composite has to be single, and being different from the forms of the simple items and the parts, can constrain these forms, unspoilt and intact, into a whole, though they would otherwise perish” (Fernel [1548] 2005, 165). As Eudoxus argues, a mere composite of substantial forms could not possess simplicity (Fernel [1548] 2005, 181) and therefore also could not possess new causal powers (Fernel [1548] 2005, 187).

Mercuriale adopts a different version of emergentism. He holds that the “potencies of the fourth degree” (*quartae facultates*) arise from the substantial form of medicaments (Mercuriale 1590, 20r). He ascribes to Averroes the view 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 . . .” (Mercuriale 1590, 63r). The relevant sense of “following from” that Mercuriale has in mind is plausibly an emergentist one that involves the assumption of new causal powers since otherwise the contrast that he draws between potencies of the second and third degree that do not possess new causal powers (see above, section “[Medicaments and Reductionism](#)”) and potencies of the fourth degree would be pointless.

Perhaps the most fully articulated version of pharmacological emergentism can be found in the work of the Tübingen-based physician and natural philosopher Jacob Schegk (1511–1587). As in Avicenna’s version of emergentism, not all causal factors operative in the generation of substantial

forms and their potencies in Schegk’s natural philosophy are potencies of matter. Most notably, Schegk uses the term “innate heat” (*calidum nativum, thermos emphytos*) to denote a kind of non-elementary heat operative in the generation of animate beings (on Schegk’s account of the generation of living beings, see Hirai 2011, chapter 3). In Schegk’s view, innate heat does not emerge from elementary qualities but rather derives from the (non-elementary) celestial bodies (Schegk 1585, 294). At the same time, he maintains that innate heat should not be regarded as the primary cause of generation but rather as one cause among others (Schegk 1540, 15r). Moreover, he does not characterize this kind of heat as something corporeal but rather 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. 15iiiiv)

Thus, innate heat for Schegk is a quality that is one of the causal factors that play a role in the emergence of forms from a suitably prepared portion of matter.

In line with such a conception, Schegk maintains that both inanimate forms and animate forms depend on the mixture of elements: “In nature, there is no essential potency, either manifest or hidden, without a natural potency 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 potencies” (Schegk 1585, 66). As he explains, “[w]e call an instrumental cause a cause due to which substances and their properties are generated and without which neither substances nor their properties can be saved from corruption” (ibid., 88). To illustrate the way in which the emergent potencies depends on matter, Schegk uses the phenomenon of plant degeneration – the process by means of which a cultivar reverts back to its corresponding wild

variety. He interprets this phenomenon as an instance of species change: A change in natural potencies modifies the essential potencies of the seed and, hence, the “essential form” of the seed (ibid., 85). The relation between the instrumental causes and the essential form generated by them is characterized as a supervenience relation: the properties of forms vary with the variation of the natural potencies of the composites on which they depend.

Moreover, he characterizes the relation between instrumental causes and forms as a relation in which something substantial is generated out of something non-substantial. This becomes clear when he notes that the faculty by means of which out of a non-substance a substance is generated as a faculty that differs from faculties that are always in the process of becoming (Schegk 1550, 144). As he expresses it, it is a faculty “that can all at once actually change and that is as a whole capable of exercising its whole activity without motion” (ibid., 143). This implies that something genuinely new is generated. Moreover, in contrast to ordinary changes that take place successively, the generation of substantial forms here is described as a momentary event. The emergence relation thereby is characterized as an instance of synchronic material causation.

Schegk also considers the role of the emergent forms and their potencies in downward causation. He maintains that the temperament of the mixture determines the substantial form, which in turn determines the further accidents that belong to the natural thing (Schegk 1585, 26). In particular, diachronic downward causation is described as being relevant for the generation of plant-based medicaments that act by their whole substance. In the first instance, downward causation affects the temperament of elementary qualities: “The soul of rhubarb is the cause of proper and ordinary proportions of elementary qualities without which rhubarb could not have its forces and potencies” (ibid., 89). But given the potency of the temperament of generating substantial forms, this change of temperament also can bring with it the generation of the substantial form of a plant part. Thus, the juice of rhubarb “receives its form from the soul and can subsist without the soul” (ibid., 90).

This is why such medicaments act by their whole substance: “Forms are the causes and instruments of the preparation of elementary qualities, such that faculties arise in them when they change our body with respect to entelechy . . .” (ibid., 29). For example, water-hemp and absinth do not make our body dry and hot not because they are dry and hot but because they have a potency that derives from their substantial form that constitutes their essence (ibid., 30). Moreover, as he explains, when the soul produces posterior and perfect forms in similar parts, the previous forms of 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., 42). Diachronic downward causation therefore is described as a process of perfection of previously existing forms (ibid., 43).

Finally, this conception of a circle of causation 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., 44). In particular, this applies to the pharmacological powers of plant parts: even when the vegetative soul perishes, the substantial forms of the parts of the plant can persist (ibid., 45). Emergent plant souls thus are understood as one of the causal factors that, through downward causation upon their material substrate, lead to the emergence of the substantial forms of plant parts that can survive the death of the plant and that explain the powers of medicaments that act by their whole substance.

References

- Alexander of Aphrodisias. 2008. *De l'âme*. Ed. and trans. M. Bergeron and R. Dufour. Paris: Vrin.
- Alexander of Aphrodisias. 2012. *On the soul. Part I: Soul as the form of body, parts of the soul, nourishment and perception*. Trans. C. Victor. London: Bloomsbury.

- Arcangeli, Alessandro, and Vivian Nutton. 2008. *Girolamo Mercuriale: medicina e cultura nell'Europa del Cinquecento*. Florence: Olschki.
- Avicenna. 1608. *De viribus cordis*. Trans. A. V. Arnaldus. In Avicenna, [Canon.] *Tomus secundus*, 334–352. Venice: Giunta.
- Bono, James J. 1990. Reform and the languages of renaissance theoretical medicine: Harvey versus Fernel. *Journal of the History of Biology* 23: 341–387.
- Caston, Victor. 1997. Epiphenomenalisms, ancient and modern. *Philosophical Review* 106: 309–363.
- Clericuzio, Antonio. 1988. Spiritus vitalis: Studio sulle teorie fisiologiche da Fernel a Boyle. *Nouvelles de la République des lettres* 8: 33–84.
- Copenhaver, Brian. 1991. A tale of two fishes: Magical objects in natural history from antiquity through the scientific revolution. *Journal of the History of Ideas* 52: 373–392.
- Dessi, Cristina. 1995. Marsilio Ficino, Jean Fernel e lo spiritus. In *Filosofia, scienza, storia*, ed. Antonio Cadeddu, 203–219. FrancoAngeli: Milan.
- De Vos, Paula. 2013. The 'prince of medicine'. Yuhanna ibn Masawayh and the foundations of the western pharmaceutical tradition. *Isis* 104: 667–712.
- Erastus, Thomas. 1574. *De occultis pharmacorum potestatibus*. Basel: Perna.
- Fernel, Jean. 1585. *Universa medicina*. Lyon: Giunta.
- Fernel, Jean. 2005. *Jean Fernel's on the hidden causes of things. Forms, souls and occult diseases in renaissance medicine*. With an edition and translation of Fernel's *De abditis rerum causis* by J. M. Forrester; introduction and annotations by J. Henry and J. M. Forrester. Leiden/Boston: Brill.
- Gunnoe, Charles D. 2011. *Thomas Erastus and the palatine. A renaissance physician in the second reformation*. Leiden: Brill.
- Hirai, Hiro. 2005. *Le concept de semence dans les théories de la matière à la Renaissance*. Turnhout: Brepols.
- Hirai, Hiro. 2011. *Medical humanism and natural philosophy: Renaissance debates on matter, life and the soul*. Leiden: Brill.
- Kessler, Eckhard. 2011. Alexander of Aphrodisias and his doctrine of the soul. 1400 years of lasting significance. *Early Science and Medicine* 16: 1–93.
- Lodovici, Antonio. 1540. *De occultis proprietatibus*, Olyssipone [no publisher].
- Mattioli, Pietro Andrea. 1569. *De simplicium medicamentorum facultatibus*. Venice: Valgrisius.
- Mercuriale, Girolamo. 1590. *Tractatus. De Compositione Medicamentorum. De Morbis Oculorum & Aurium*. Venice: Giunta.
- Martin, Craig. 2002. Francisco Valles and the renaissance reinterpretation of Aristotle's *Meteorologica IV* as a medical text. *Early Science and Medicine* 7: 1–31.
- Mesue, Johannes. 1552. *Opera, a Ioannes Costa medico Laudensi nunc recognita, & aucta adnotationibus*. Venice: Giunta.
- Newman, William R. 2006. *Atoms and alchemy*. Chicago: University of Chicago Press.
- Palmer, Richard. 1985. Pharmacy in the Republic of Venice in the sixteenth century. In *The medical renaissance in the sixteenth century*, ed. A. Wear, R.K. French, and I.M. Lonie. Cambridge: Cambridge University Press.
- Puteanus, Guilielmus. 1552. *De medicamentorum quomodocunque purgantium facultatibus*. Lyon: Bonhomme.
- Schegk, Jacob. 1540. *De causa continente. Eodem interprete Alexandri Aphrodisaei De mixtione libellus*. Tübingen: Morhard.
- Schegk, Jacob. 1550. *In reliquos naturalium Aristotelis libros commentaria plane philosophica*. Basel: Hervag.
- Schegk, Jacob. 1580. *De plastica seminis facultate. De calido & humido nativis. De primo sanguificationis instrumento*. Augsburg: Iobinus.
- Schegk, Jacob. 1585. *Tractationum physicarum et medicarum tomus unus*. Frankfurt: Wechel.
- Siraisi, Nancy G. 2003. History, antiquarianism, and medicine: The case of Girolamo Mercuriale. *Journal of the History of Ideas* 64: 231–251.
- Ulmus, Johannes Franciscus. 1597. *De occultis in re medica proprietatibus*. Brixiae: Praesenius.
- Valles, Francisco. 1582. *Controversiarum medicarum et philosophicarum libri decem*. Frankfurt: Wechel.