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Julius Caesar Scaliger on Plant Generation and the Question of Species Constancy

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Abstract
The sixteenth-century physician and philosopher Julius Caesar Scaliger combines the view that living beings are individuated by a single substantial form with the view that the constituents of the organic body retain their identity due to the continued existence and operation of their own substantial forms. This essay investigates the implications of Scaliger's account of subordinate and dominant substantial forms for the question of the constancy of biological species. According to Scaliger, biological mutability involves not only change on the ontological level of accidents but, in some cases, also change on the level of substantial forms. While he shares the received view that substantial forms themselves cannot undergo change, he maintains that relations of domination and subordination between substantial forms can undergo change. He uses his theory of how such changes can occur to explain cases of revertible plant degeneration. Moreover, in his view plants that belong to previously unknown biological species can emerge from changes in the relations between the many forms contained in plant seeds.

Keywords
Julius Caesar Scaliger, biological reproduction, species membership, species mutability, substantial forms, composite substances, Latin pluralism, mixture, natural teleology, plant degeneration, Theophrastus' biology, pseudo-Aristotle's *De plantis*, Aristotle's biology

1. Introduction

One of the bedrocks of the Aristotelian conception of biological reproduction is the view that "like begets like." The notion that the offspring

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of any living being belongs to the same biological species as the living being from which it originated is a straightforward consequence of two assumptions: (1) the assumption that a particular biological species is defined by a particular essence common to all individuals belonging to this species, and (2) the assumption that essences are immutable. Species constancy, hence, is part and parcel of an essentialistic metaphysics. Changes through biological reproduction, accordingly, were understood as being restricted to characteristics of living beings other than their essence.[1] The view that living beings and their offspring do not share all characteristics is commonsensical enough and was held by ancient, medieval and early modern natural philosophers alike; however, early modern thinkers began to question ancient and medieval conceptions of the constancy of biological species. In this paper, I will examine how the Padua-trained, Agen-based physician and philosopher Julius Caesar Scaliger (1484-1558) contributed to the emerging early modern conception of mutable biological species. His contribution pertains to an early stage of this story—a stage that is long before any view that *all* species are mutable. Nevertheless, it is a significant stage since it saw the old conception of the constancy of species replaced by the novel view that *some* living beings belonging to one species can develop out of *some* living beings belonging to a different species.

Scaliger's answer to the question of species constancy is not connected with new measuring techniques or with new data obtained by their application. Rather, it is connected with his metaphysical views, mainly developed in his *Exotericae exercitationes* (1557).[2] Moreover, Scaliger touches upon the question of species constancy in his extensive commentaries on ancient botanical works, such as Theophrastus' *Historia plantarum* and *De causis plantarum* and the pseudo-Aristotelian *De plantis*.[3] On first sight, with the absence of any new experiental data,

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1) See David L. Hull, "The Effect of Essentialism on Taxonomy—Two Thousand Years of Stasis. Part I," *British Journal for the Philosophy of Science*, 15 (1965), 314-326. On species constancy in the thought of Scaliger's contemporary, Andrea Cesalpino (1519-1603), see Scott Atran, *Cognitive Foundations of Natural History. Towards an Anthropology of Science* (Cambridge, 1990), 138-142.

2) Julius Caesar Scaliger, *Exotericarum exercitationum liber XV. de subtilitate, ad Hieronymum Cardanum* (Paris, 1557) [henceforth: EE].

3) Julius Caesar Scaliger, *Animadversiones in historias Theophrasti* (Paris, 1584) [henceforth: AHT]; Julius Caesar Scaliger, *Commentarii, et animadversiones, in sex libros De*

Scaliger's mode of thought may appear strangely outdated even by the standards of his own day. Nevertheless, his approach to issues of biological reproduction indicates the importance of two factors in early modern scientific thought that are quite independent of the development of new measuring techniques.

The first of these factors is the role played by the metaphysics of composite substances. What is crucial, in Scaliger's view, for understanding the mutability of species is the internal structure of composite substances such as living beings. In particular, he shares the fundamental insight 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.[4] In order to get a clear grip on the metaphysical presuppositions of Scaliger's views on biological reproduction, I will explore in section 3 Scaliger's views on how a plurality of substantial forms is constitutive of the unity of a living being.

The second factor operative in Scaliger's views on biological reproduction is his metaphysical interpretation of ancient botanical works. His commentaries on ancient biological works have more than only historical and philological aims. Rather, in Theophrastus' biological writings and the pseudo-Aristotelian *De plantis*, Scaliger finds a conception that is closely analogous to his own views on a plurality of forms within living beings: the theory that "common principles" are contained in a particular plant and account for how this plant can develop into a plant belonging to a different species. Scaliger uses this theory in order to apply his theory of a plurality of forms for solving two problems: First, how can revertible biological mutability occur (as when a wild variety of a plant develops into a cultivar and vice versa)? And second, is it thinkable that biological mutability leads to species that did not exist before? I will examine Scaliger's answer to the first question in

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causis plantarum Theophrasti ([Paris], 1566) [henceforth: CA]; Julius Caesar Scaliger, *In libros duos, qui inscribuntur De plantis, Aristotele autore, libri duo* (Paris, 1556) [henceforth: DP].

4) On theories of the plurality of forms in medieval philosophers such as Jean of Jandun, John Baconthorpe and Paul of Venice, see Emily Michael, "Averroes and the Plurality of Forms," *Franciscan Studies*, 50 (1992), 155-182.

section 4 and his answer to the second question in section 5. Before addressing these issues, however, it will pay to introduce some terminological conventions that will be followed throughout the paper.

2. Concepts of Biological Mutability

There are several concepts of biological mutability that can be formulated within a broadly Aristotelian theory of living beings as endowed with substantial forms. The first concept is one that is most widely shared by thinkers in the ancient, medieval and early modern tradition. This concept is fully compatible with the assumptions mentioned above, namely, that biological species are defined by a commonly shared essence and that essences are immutable. For clarity's sake, let me use a slightly anachronistic label for this concept:

> *Accidental mutability*: Differences between a living being and its offspring are restricted to differences on the level of properties or accidents (in the philosophical sense).

As we will see, Scaliger applies the concept of accidental mutability to the kind of changes brought about by influences of time and place. Hence, in his view there are cases of biological mutability that can be exhaustively analyzed on the level of properties or accidents. However, in his view some cases of biological mutability also involve a change on the level of substantial forms. As we will see, Scaliger understands such changes as involving a change of essence and, hence, of species membership. Moreover, his analysis of such cases is closely connected with his interpretation of ancient biological works. A prominent topic in Theophrastus' *De causis plantarum* is the degeneration of plants—the process by means of which a cultivar reverts back to its corresponding wild variety. Obviously, such cases are instances of revertible change, since the cultivar in the first instance developed out of the wild variety. It is not so obvious, however, whether such cases involve a change of species membership. Evidently, what matters here is not whether modern biologists would classify wild varieties and cultivars as belonging to different species. Rather, what matters is how Scaliger describes these cases. Interestingly, in his descriptions another concept of biological

mutability plays a role (again, let me use a somewhat anachronistic label):

> *Revertible formal mutability*: Some of the relations of domination and subordination holding between various substantial forms within the same plant undergo change, in such a way, however, that the relations of domination and subordination can be reverted.

Once cases of plant degeneration are described along these lines, these cases become useful clarifying in which respect cases of (putatively) irrevertible changes that occur during plant generation differ from degeneration. Yet another concept of biological mutability is relevant here:

> *Irrevertible formal mutability*: Some of the relations of domination and subordination holding between various substantial forms within the same plant can undergo change, in such a way, however, that the relations of domination and subordination *cannot* be reverted.

Both revertible and irrevertible formal mutability have to do with a change in the hierarchical ordering of substantial forms within living beings. This is why the senses in which Scaliger believes that change with respect to species membership can occur depend on his view concerning changes in the hierarchical ordering within a plurality of substantial forms. Moreover, while Scaliger seems to be committed to the applicability of all three concepts of biological mutability mentioned so far, there is a further concept that he unambiguously rejects:

> *Universal (revertible or irrevertible) formal mutability*: *All* of the relations of domination and subordination holding between the various substantial forms within the same plant can undergo change (either revertible or irrevertible).

Rejecting universal formal mutability implies rejecting the view that any biological species could develop into any other species. Let me label this view which Scaliger rejects "universal species mutability." Nevertheless, Scaliger does believe that there are singular cases in which a plant brings forth a plant belonging to a different, but previously existing species. Let me use the label "species flexibility" for such cases.[5]

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[5] I owe this terminological convention to an anonymous referee for this journal.

Moreover, he also believes in the possibility of singular cases in which a plant brings forth a plant belonging to a different species that did not exist before. Let me use the label "singular species mutability" for such cases.

3. Composite Unities and Subordinate Forms

Obviously, Scaliger's views concerning species flexibility and species mutability are closely bound to the metaphysical apparatus of dominant and subordinate substantial forms. To understand Scaliger's version of a theory of a plurality of substantial forms in living beings, it will be useful to start with some aspects of his theory of mixture. As for many other early modern thinkers, a theory of mixture (*mixtio*) provided the general framework for a theory of the generation of composite substances, including the generation of living beings. In his influential theory of mixture, Scaliger combines corpuscularian with non-corpuscularian ideas. He acknowledges cases in which corpuscles combine to make up complex bodies (such as the mixture of different grains or the mixture of water and wine) in such a way that both the substantial form of the corpuscles and their spatial boundaries remain intact. In such cases, however, he regards the resulting mixtures not as genuine unities but merely as aggregates (EE, fol. 144v). Genuine composite unities, by contrast, require a different kind of mixture. It is for these cases that Scaliger coins his famous formula "Mixture is the motion of minimal bodies towards mutual contact such that a union arises." As he explains, in cases of genuine mixture his corpuscules do not behave like Epicurean atoms that only touch; rather, they behave in such a way that a material continuum arises. The resulting composite body "becomes one by means of the continuation of boundaries" (EE, fol. 143v-144r).[6] But

[6] Confusingly, there is an earlier discussion of mixture in the same work (chapter 16), which is incompatible with the later discussion (chapter 101). In his first take on mixture, Scaliger defends the view that in mixture there is only a single substantial form of the composite. However, he seems to have been dissatisfied with his first discussion, and presents his second discussion—as the chapter heading tells us—as a "more subtle" take (*repetitio subtilior*) on mixture. For present purposes, I will focus on Scaliger's second take on mixture.

while the boundaries of corpuscles do not persist in such mixed bodies, according to Scaliger their substantial forms do persist. The resulting view is that even if the elements are no longer individuated *mathematically* (since their boundaries have fused into a continuum) they still remain individuated *physically* (since they are still informed by their substantial forms). Hence, in all mixed bodies there is a material continuum in which, nevertheless, natural minima persist due to the persistence of their substantial forms. In this way, in living beings, as in all other mixed bodies that are genuine unities, there is a plurality of substantial forms.

While this structure is common to all composite unities, the nature of substantial forms operative in living beings needs some careful consideration. Disconcertingly, Scaliger's views as to the material or immaterial nature of vegetative and sensitive souls seem to be quite ambiguous and underdeveloped.[7] However, one thing that is more important for present purposes than the materiality/immateriality issue seems to be fairly clear: Scaliger describes vegetative and sensitive souls as possessing active powers. He maintains that form "does not need any assistance in order to fulfil its goal towards which the whole composite is directed." Rather, form "changes both itself and the parts of which the body of a living being consists" (EE, 13v). In his commentary on Aristotle's *Historia animalium*, Scaliger gives a crisp argument for this view: If our soul moves the body, it does so either by means of an instrument, or immediately. If it moves the body by means of an instrument, it moves the instrument either by means of yet another instrument or immediately. Hence, we either hit upon an immediate action of the soul on a corporeal being, or we encounter an infinite regress of instruments.[8] The upshot of Scaliger's argument is that vegetative and sensitive

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7) For some relevant passages concerning this issue, see EE, fol. 16r-v; EE, fol. 151r; DP, p. 181.

8) *Aristotelis historia de animalibus. Iulio Caesare Scaligero interprete, cum eiusdem commentariis* (Toulouse, 1619), 595-596. On Scaliger's view of vegetative souls as self-moving beings, see Guido Giglioni, "Girolamo Cardano e Giulio Cesare Scaligero: Il dibattito sul ruolo dell'anima vegetativa," in *Girolamo Cardano: Le opere, le fonti, la vita*, ed. Marialuisa Baldi and Guido Canziani (Milan, 1999), 313-339, 318. On Scaliger's commentary on the *Historia animalium*, see Kristian Jensen, "The Ms-tradition of J.C. Scaliger's Historia de animalibus," *Acta Scaligeriana* (Agen, 1986), 257-283; Stefano

souls are active beings in the sense that they can induce bodily motion without being dependent on any entity external to them.

How do such active beings relate to the substantial forms of the parts of organic bodies? The relation does not appear to be one of formal causation. In a different context, Scaliger rejects the view that forms can inform other forms (see EE, fol. 11r). Presumably, he would accordingly reject the idea that the dominant form of a living being informs the subordinate forms of the parts of its body. Rather, Scaliger's account of the plurality of forms in a living being invokes the teleological nature of forms—their being directed towards certain ends. The teleological nature of subordinate forms becomes evident when he discusses the view expressed in Jean Fernel's *De abditis rerum causis*, according to which bones in a carcass are nevertheless true bones.[9] Scaliger objects that the bones of a living being live, as becomes evident by the fact that they grow and are nourished; moreover, he argues that bones of a living being live by means of the dominant form of the living being. As he argues, a bone in the carcass is not the same because it does not fulfil any of its previous tasks (EE, fol. 16v). Hence, identity conditions of bodily parts are not only connected with the mere presence of their substantial forms but also with the specific teleological function of these substantial forms. The substantial forms of the bone parts in the living body fulfil a teleological function that differs from that of bone parts in a dead body.

Teleology also gives a clue as to the sense in which Scaliger believes that forms "can be mixed and form one being" (EE, fol. 144v). He writes:

> [T]he less noble bodies are made for the sake of the more noble bodies. In the same way, also forms are made for the sake of forms. For example, it is certain that the forms of a horse and an ass mix. Since this is so, all arguments [to the contrary] dissolve. Hence, not only the forms of elements, but also of wine, and of

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Perfetti, *Aristotle's Zoology and its Renaissance Commentators (1521-1601)* (Leuven, 2000), 155-181.

9) See *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 John M. Forrester. Introduction and annotations by John Henry and John M. Forrester (Leiden, 2005), 195.

> some animals can be mixed in such a way that out of two or more there arises an actual *per se* unity.[10]

This passage indicates that the subordination relation is to be understood as a relation of final causation. Some material objects and some forms are less "noble" than others because they are made for the sake of other material objects and other forms. With respect to the structure of living beings the picture that is suggested by this passage would be the view that bodily organs such as a nose or an eye, as well as their respective forms, are less "noble" than the entire body of the living being and its soul because they are made for the sake of the entire body of the living being and its soul. In this sense, subordinate forms that are all teleologically directed towards the dominant forms can be said to be "mixed" and to form a unity. Such an interpretation is fully consistent with Scaliger's claim that the forms of the most perfect living beings do not mix because they are the only ones that are not directed towards any further goal (EE, fol. 145r).

4. Subordinate Forms and Species Flexibility

Now we have in hand two crucial metaphysical presuppositions of Scaliger's account of species mutation: the view that dominant substantial forms are active beings that are capable of producing bodily movements independently of any entity external to them, and the view that subordinate substantial forms constitute a unity because they are all teleologically directed towards a dominant form. In the remainder of this paper, I will try to show how these presuppositions are connected with Scaliger's answer to the question of species constancy.

To begin, it is important to note that not all kinds of biological mutation, in Scaliger's view, relate to the level of substantial forms. Scaliger points out that trees mutate not only with respect to color but

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10) EE, fol. 144v: "… Formarum … illarum naturam esse dixerimus: ut & misceri, & seiungi queant. Idque propter imperfectionem. Etenim haec ignobiliora propter nobiliora corpora facta sunt. Sic & formas propter formas. Quemadmodum equi, & asini formas misceri certum est. Quod si ita sit, solvuntur argumenta omnia. Ut non solum elementorum formae, sed & vini, & quorundam animalium ita commisceri possint: ut ex duabus, aut pluribus unum fiat actu, & per se."

also with respect to leaves, fruit, and "almost the whole nature of the tree." Moreover, he notes that mutation can come about in different ways: "By means of nature, as when they become sterile or bear fruit due to the changes of the sun and the heavens, as when olive changes into wild olive. By means of art: as in grafting, pruning, dunging, loosening the soil, and finally preparing the ground."[11] Not all of these changes relate to the level of substance: Scaliger notes that mutation can take place either with respect to substance, or quantity, or quality (CA, p. 288). Hence, for Scaliger there are cases of accidental mutability. At the same time, he maintains that while mutations with respect to quantitiy and quality do not constitute differences in species, a change in substance does (ibid.). Such a mutation of the whole species (*mutatio totius speciei*), in his view, takes place when water-mint changes into mint. Moreover, he emphasizes that such changes cannot be induced by art but take place "by nature only" (*a natura sola*) (ibid.).

In particular, Scaliger's concept of species is bound to the metaphysical concept of substantial form. This becomes obvious when he considers the question of whether there are new species in the potency of nature besides those that exist now. He notes that Cardano holds that either the forms of living beings are constituted by the forces of some stars, or that they are varied according to different regions and the flow of time. Scaliger comments that the first horn of Cardano's answer is evasive, since the question is just whether a particular number of stars is able to constitute more forms of living beings than it did previously (EE, fol. 319v). The other horn of Cardano's answer, in Scaliger's view, relates to a variation not of substance but of accidents: "For if a substance, that was one individual, became different through place, place would be the giver of forms … The same has to be said to you with respect to time."[12] While Scaliger concedes that place and time can change accidental features of living beings, his objection seems to

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11) EE, fol. 232r: "Natura: veluti cum sterilescunt, aut foecundantur, soli, Caelive mutationibus: ut Olea, Oleastrum. Arte: insitione, amputatione, stercoratione, ablaqueatione, cultu denique."

12) EE, fol. 319v: "Si enim substantia, quae una erat, alia fieret, per locum: locus esset formarum dator … Idem quoque de tempore tibi dicendum est."

be that place and time cannot change species because they cannot change substantial forms.

By implication, then, the notion of species is connected with the notion of substantial form. In fact, Scaliger writes about a substantial form that shapes matter for its own purpose that "this is essence and what we call species."[13] Moreover, due to the connection between the notions of essence and species, he writes that "a species is an essential whole."[14] While Scaliger does not explicate the notion of an essential whole, we do find such an explication in Rudolph Goclenius' *Lexicon philosophicum* (1613)—a resource that still provides invaluable insight into sixteenth-century philosophical usage. Goclenius writes that such a whole is something "that consists of parts or principles that constitute essence."[15] When Scaliger regards biological species as such wholes, he seems to suggest that substantial forms are the principles that constitute essence and, therefore, determine species membership. Moreover, due to the connection between the notions of substantial form, essence, and species, he believes that, in nature, there are some changes on the level of substantial forms that amount to changes with respect to species membership. To be sure, he does not hold that any species could develop into any other species. For one, he believes that there are plants that are determined by nature not to undergo mutation.[16] Moreover, he maintains that wild varieties cannot undergo degeneration since he believes that they already possess the lowest possible degree of perfection (CA, p. 35). Clearly, for both reasons he would reject universal species mutability. Nevertheless, there are cases in which he regards it as a matter of natural necessity that species constancy does not obtain, such as when wild varieties of plants develop into cultivars and vice versa (ibid.). He mentions two examples that were widely discussed in ancient biological works: the change of darnel into wheat, and the change of

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13) CA, p. 16: "Hoc enim essentia est, & quam speciem appellamus."

14) CA, p. 19: "[S]pecies est totum essentiale."

15) Rudolph Goclenius, *Lexicon philosophicum* (Marburg, 1613), 1132: "quod constat ex partibus seu principiis essentiam constituentibus."

16) DP, fol. 177r-v: "Quod si natura constant omnes plantae, necessitate quoque constabunt tales. Tales, inquam, perpetuo, velut eae, quae non mutantur. Tales non perpetuo: sicut illae, quae mutantur, vel semine quod patitur Triticum: vel post sationem, quamadmodum de Menta dicebamus."

water-mint into mint. Scaliger points out a thoroughly Anti-Aristotelian consequence of such examples: It is not true that the seed of a plant is always produced by nature for the purpose of propagating the species because this is not the case when the seed is changed in such a way that "the whole species undergoes mutation" (ibid). Hence, Scaliger is committed to species flexibility.

Elsewhere, he distinguishes two kinds of transmutation (*transmutatio*). He describes the first kind as follows: "When mint changes into water-mint,[17] or vice versa, this happens due to the affinity of forms; and if the species differs also matter differs."[18] Subsequently, he characterizes the second kind of transmutation as follows: "[O]ut of the sap of a cut tree, which does not vivify in its own species, there arises by means of a secondary nature a mushroom; as from the liver of a human being a worm or a louse."[19] One of the differences between the two kinds of transmutation is that the first kind relates to cases in which a cultivar mutates into its wild variety, or vice versa, while the second kind relates to cases in which (putatively) a strongly dissimilar plant or even an animal arises out of a plant. The first kind of transmutation is characterised as revertible, while the second kind, as we will presently see, in Scaliger's view, is irrevertible.

For the time being, let us focus on the first kind of transmutation. Scaliger says that mint and water-mint are connected with each other through an "affinity of forms." What does he mean? Apparently, he does not believe that mint and water-mint have the same substantial form and differ only with respect to accidents. Were this his considered view, it would not make sense for him to say that "the whole species undergoes mutation." Apparently, he believes that mint and water-mint are different, though closely related, species. But are we to understand their relation? He explains it as follows, when he comments on Theophrastus:

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17) On *sisymbrium*, see Plinius, *Historia naturalis*, 19, 172. For the identification of this plant with water-mint, see Andrea Cesalpino, *De plantis libri XVI* (Florence, 1583), 473.

18) EE, fol. 386v: "[U]bi transit in Sisymbrium Menta, aut e contrario, propter formarum affinitatem: si species aliud est: materia quoque aliud."

19) Ibid.: "[E]x recisae arboris succo, qui non amplius sua in specie vivificus est, secundaria natura oritur fungus: sicut ex hominis iecore vermis, aut pediculus."

> At the same time, he shows the mode in which darnel arises and explains the reason by means of which this can take place. The mode is the following: if the seed is inwardly corrupted, the form of the plant is not abolished but becomes another form. He proves that this can take place when he says that the nature of plants is full of life, and indeed fuller of life than the nature of animals and therefore productive.[20]

Darnel is a case in which a plant of one species has its origin in the corrupted seed of a plant of a different species. The corrupted seed no longer carries the form of the plant from which it originated. But it is also not altogether different from the form of the plant from which it originated. Scaliger suggests that this is so because both the preceding and the subsequent forms, in a way still to be explicated, are produced by the nature of plants, which is said to be "full of life." Later in the same work, Scaliger explains:

> Only by means of alteration can plants be generated in plants, out of the common principles pertaining to the already existing plant, which the wise men call "symbola." In this way, … in the follicles of mastic and garlic there grow midges, not out of putrefaction but out of some principles that underwent a process of alteration …[21]

Hence, plants are "full of life" in the sense that they contain "common principles" that underlie the development of plants of various species. Since these "common principles" function as an explanation for the "affinity of forms" holding between mint and water-mint and for the way in which the form of a plant can become a different form in a partially corrupted seed, it seems most plausible to regard them as belonging to the category of form themselves. In fact, Scaliger writes about Theophrastus' conception of a "vital principle" contained in "humor"—the acqueous parts of plants:

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20) CA, p. 230: "Simul ostendit modum quo nascatur Lolium: simul explicat rationem, qua id fieri possit. Modus est, non corrupto penitus semine aboletur plantae forma, sed fit alia. Quod vero fieri possit, demonstrat, quum dicit plantarum naturam vivacem esse, ac sane vivaciorem quam naturam animalium atque iccirco proficere."

21) CA, p. 279: "Sola nanque alteratione produci posse plantas in plantis, ex subsistentis plantae communibus principiis, quae symbola vocant sapientes. Sic in Lentisci atque aliorum folliculis culices innasci … non ex putredine, sed ex principiis quibusdam alteratis …"

> Above, he said hat the vital principle is contained in the humor: here he says that the humor is contained in the vital principle. Rightly so at both places. The humor contains the vital principle as a vehicle: as matter contains form. The humor is contained by the vital principle, and hence also by what rules it. For the vital principle preserves [the humor], such that it is now what it has to be in the future.[22]

The vital principle functions as form with respect to the humor, but seems to differ from the substantial form of the entire plant because it fulfils this function only with respect to a part of the plant. In this sense, it is an example of a subordinate substantial form. If the common principles relevant for the generation of plants belonging to various species can be understood in analogy to the vital principle informing the humor, they most plausibly can be understood as subordinate forms contained in the plant. Moreover, with a view to irrevertible mutability Scaliger characterizes the secondary natures contained in the sap of a plant as "rudimentary principles of a future plant" (*rudi plantae futurae principia*, CA, p. 14). They are rudimentary principles of a future plant because they can develop into the dominant substantial form of a plant. Hence, the change that takes place in cases of revertible transmutation is a change in the relations of domination and subordination holding between dominant and subordinate forms. In cases of revertible transmutation, it seems plausible to assume this process does not involve the destruction of any previously existing form. Otherwise it would remain inexplicable how the transmutation could be revertible. In a partially corrupted seed, the previously dominant form loses this function, while a previously subordinate form acquires a dominating role. In this sense, the form of the plant arising out of the partially corrupted seed possesses a form other than the plant from which the seed originated. Nevertheless, there is an affinity of forms since in the new plant the same plurality of substantial forms is operative as in the plant from which it originated, albeit in a different hierarchical ordering. Moreover, the presence of the same set of substantial forms would explain why this kind of transformation is revertible: Once the relations of domination

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22) CA, p. 7: "Supra dicebat humore contineri vitale principium: hic dicit, humorem contineri vitali principio. Recte utrobique. Continet humor vitale principium tanquam vehiculum: sicuti materia formam. Continetur humor a vitali principio, perinde atque a rectore. Servat enim: ut sit nunc, quod futurum debet esse."

and subordination are restored, a plant with the same kind of substantial form as the first plant will be generated. In this way the apparatus of dominant and subordinate forms functions as the metaphysical underpinning for revertible formal mutability.

5. Subordinate Forms and Singular Species Mutability

As we have seen, what constitutes a biological species, according to Scaliger, is not a set of qualities. Qualities (and the quantities in which they come) may change without a change of biological species. Rather, what has to take place for a change of species is a change with respect to substantial forms. Hence, the question of "[w]hether new species, which never before existed, can be generated?" boils down to the question "[c]an a new form come into being that shapes matter for its own purposes?"[23] As Scaliger believes, if what is reported about the not clearly identified plant designated by the Latin term "silphium" is true—it was reported that this plant was newly generated through some extraordinary meteorological phenomenon—"we are forced to confess that a new form can arise."[24] Scaliger here regards singular species mutability as something that exists *if* certain botanical facts obtain. Characterstically for his mode of thought, he does not go out of his way to find out more about these botanical facts. Rather, he tries to think through the metaphysical implications that ancient botanical sources would have *if* they would turn out to be true. Nevertheless, even within his humanist and philosophical frame of mind cases of singular species mutability seem to face difficulties. It would seem as if the "common" principles that Scaliger ascribes to plants of different species are something that exists before they play a role in plant generation. So, given the close connection between the notions of species and substantial form, how can Scaliger maintain that previously existing substantial forms could explain the occurrence of species that did not previously exist?

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23) CA, p. 16: "An nova forma fieri potest quae materiae sese aptet?"

24) Ibid.: "Iam si quae de Silphio narrat vera sunt, novam exoriri posse cogimur fateri." On *silphium*, see Plinius, *Historia naturalis*, 19, 15.

The most detailed exposition of these issues is found in Scaliger's commentary to the pseudo-Aristotelian *De plantis*.[25] On the level of literary technique, Scaliger's commentary is a relaxed and loosely organized dialogue between Scaliger and three of his real-life acquaintances. Kristian Jensen has pointed out that Scaliger, the figure in the dialogue, takes up astonishingly little space in the text and often allows the views of his interlocutors to pass without critical remarks. One of Scaliger's interlocutors is Augier Ferrier, who declares that Christanity is compatible with Platonism and the Hermetic tradition but not with Aristotelianism. Another interlocutor is Johannes Pacuvius Baiulius, a Galenic physician and Platonist and, like Ferrier, interested in mysticism. The group is completed by Gabriel Minut, who holds that in some respects Plato and Aristotle are in agreement.[26] Jensen warns readers that the dialogue does not lend itself to easy interpretation, and that it is risky to hypothesise about Scaliger's philosophical stance on the basis of single quotations. Nevertheless, the contributions of Baiulius take up a large proportion of the dialogue and, as we will presently see, Scaliger puts some of his views as expressed in the *Exotericae exercitationes* into the mouth of Baiulius. Moreover, all the remarks on species degeneration that are relevant to the present context come from Baiulius. As far as I can see, these remarks are consistent with what Scaliger says elsewhere about species degeneration, although they contain additional matters of detail.

Consider the following passage from *De plantis*: "[N]ot every plant produces a seed that is similar to the seed from which it originated: for some become better, and from some bad seeds there arise good trees such as from bitter almonds and acid pomegradanes … Likewise, some plants transmute into another species …"[27] Baiulius (the figure in the dialogue) comments on this passage very much as Scaliger does when

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25) Nicholaus Damascenus, *De plantis*: Five Translations, ed. H.J. Drossaart Lulofs and E.L.J. Poortman (Amsterdam, 1989). On the textual tradition of *De plantis* in the Renaissance, see Lotte Labowsky, "*Aristoteles De Plantis* and Bessarion," *Medieval and Renaissance Studies*, 5 (1961), 132-154.

26) On the figures in the dialogue, see Kristian Jensen, *Rhetorical Philosophy and Philosophical Grammar: Julius Caesar Scaliger's Theory of Language* (München, 1990), 38-45.

27) *De plantis*, pp. 535-536: "Et omnis planta non producit semen simile semini a quo orta est: quedam enim melius faciunt: & a quibusdam malis seminibus bone arbores

he comments on similar passages in Theophrastus: "That plants, once they have lost their own forms, acquire new ones, is not miraculous since they share common principles."[28] The author of *De plantis*, however, puts forward an account of the nature of these common principles that does not seem agreeable to Scaliger. The passage from *De plantis* with which Scaliger disagrees runs as follows:

> Also in lagoons salt is generated, because freshwater becomes salty. Hence, the saltiness of the earth emits this saltiness: and there also remains some air included; and therefore this body will not be sweet … In the same way, plants and species are produced in no other way than by means of composition, not through a simple nature, as saltiness from seawater and the substance of sand, because the ascending vapors, when they coagulate, can contain those plants.[29]

In this passage, plant generation, like the generation of salt, is characterized in terms of a composition of parts. Likewise, the emergence of plants belonging to a new species is explained through the occurrence of a new compositional structure.

However, Baiulius (the figure in Scaliger's dialogue) objects: "[T]here would be a circle in nature. In this way, the efficient cause would have its own effect as its efficient cause, the form would have what it informs as its own form, or matter would have the resulting compound as its own matter."[30] The objection seems to be that such a compositional theory of plant generation meets difficulties with respect to the notions

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proveniunt ut ab amigdalis amaris & granatis acidis … Item plantarum quaedam transmutantur in aliam speciem …"

28) DP, 125v: "Herbas vero formis propriis amissis, alias induere non est mirum, habent enim inter se communia principia."

29) *De plantis*, p. 545: "Generatur quoque sal in lacunis, quia aqua dulcis fit salsa. Superat ergo salsedo terrae illam salsedinem: remanebitque aer inclusus: & non erit ideo illud corpus dulce … Eodem modo herbae et species non fient nisi per compositionem, non per naturam simplicem, ut salsedo ab aqua maris et substantia arenarum, quia vapores ascendentes cum coagulati fuerint poterunt comprehendere has herbas." Note that the author of *De plantis*, in addition to giving such a compositional account of plant generation, goes on invoking celestial influences that bring about the composition of parts.

30) DP, fol. 170r: "Esset igitur circulus in natura. Sic efficiens caussa suum haberet effectum pro caussa efficiente: aut forma formatum a seipsa pro forma sua: aut materia materiatum pro materia."

of matter, efficient cause, and form, although it is not very clear what the difficulties are with respect to matter and efficient cause. Baiulius' objection is the more puzzling since Scaliger elsewhere clearly acknowledges the existence of revertible formal mutability—hence, instances of a "circle in nature." Perhaps the most serious difficulty with a compositional account of plant generation is the one concerning form. Presumably, a compositional account of plant generation implies a compositional notion of form. If this is in fact an implication of the account in *De plantis*, the form of a plant would be nothing else but the organization of its parts. But then, in cases of revertible mutation the form of a plant that developed out of another plant would in turn be the formal cause of the specific form from which it originated. In Scaliger's view, such an account of revertible mutation is impossible because the relation between form and what is informed by it is asymmetrical. Because the *De plantis* account of the emergence of new species leads to such absurd consequences concerning revertible mutation, Scaliger believes that it is inadequate.

On the positive side, Scaliger's spokesperson Baiulius gives the following account of the emergence of new species:

> That new species can be generated can be understood in two ways: either things that already exist are mixed: such that they will not be inwardly and simply new; for they are made out of those that already exist, as it were, as out of parts: which we see happen in graftings which did not exist before. Or they are in the potency of an agent … For a rose can be produced which did not exist before. But there always is something there, because it is in the potency of the rose bush.[31]

In the first case, a plant belonging to a new species arises out of the combination of parts of two plants that belong to previously existing species. Obviously, there is something new to such a combination of parts, but as Scaliger is careful to point out, the resulting species nevertheless is constituted by previously existing species. In the second case,

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[31] EE, fol. 319v: "Species ergo novas gigni posse, duobus modis intelligere licet. Aut quod ea, quae iam sunt, misceantur: quae sic haud penitus, & απκως novae erunt; fiunt enim ex iis, quae sunt, tanquam ex partibus: id quod evenire videmus in insitionibus, quo non extabant modo. Aut quae sunt in agentis potestate … Rosa enim fieri potest, ut aliquando non extet. Est tamen aliquid semper, quia est in Rosarii potestate."

things are different. Here, too, something previously existing is involved. However, it is not a previously existing *species*. Rather, what exists previously is described as active principles present in the rose bush—principles, however, that were previously not actualized. Baiulius adds the following comment on Theophrastus:

> He assigns this reciprocal change only to elements. The other kind of change is not revertible but runs only in one direction. For out of a human being there does not arise a slime, out of which again a human being could arise. From a calf, bees are created, but the nature of bees never retuns back into a calf … Rather, out of those things that were in the first instance created together, other things follow on those things that decay at the same place. For it is manifest that some kinds of wood … have natural rudiments of another species within themselves. If this nature persists and remains intact, it does not so much re-integrate while being in the slime of decayed things; rather, a new generation out of old principles takes place.[32]

Since the "natural rudiments of species" and "old principles" contained in a living being develop into the substantial forms of livings beings belonging to another species, they can most plausibly be understood as subordinate forms dominated by the substantial form of the plant. If this is what Scaliger has in mind, this passage indicates that he is committed to the existence of irrevertible formal mutability: The substantial forms of the newly generated living being cannot revert back to the substantial forms of the living beings from which they originated. Note also the theological implications of this passage: According to Scaliger, all forms have been created at once in the act of creation.[33] Since then, some forms always function as subordinate forms, such that no actually existing living being corresponds to them. However, once

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32) DP, fol. 178r: "Eam mutationem reciprocam solis assignat elementis. Altera non recurrit, sed recta tendit. Non enim ex homine fit limus, ex quo fieri possit homo. Ex vitulo concreantur apes: nunquam retro redit in vitulum apiculae natura … Sed quibus primordiis illis in locis concreabantur olim iis, qui fuerunt ibi contriti, subnasci alios. Ligna enim quaedam … habere illiusce speciei secum rudimenta naturalia, manifestum est. Qua natura superstite, atque incolumi permanente, non tam redintegratur in contritorum tabo, quam nova ex veteribus principiis substituatur generatio."

33) With one notable exception: With respect to the origin of human souls, Scaliger accepts the theological doctrine of separate acts of divine creation (EE, fol. 16v).

the domination relation breaks down, these subordinate forms become the active principles of living beings.

For Scaliger, the occurrence of new species does not have to do with the occurrence of new substantial forms but rather with the occurrence of new relations of domination and subordination between previously existing substantial forms. As long as the domination relation holds, a subordinate form informs some portion of matter that is part of a living being but is not a living being itself. It is not a living being itself, for two reasons: first, according to Scaliger's theory of mixture, the portion of matter forms a material continuum with the rest of the body of the living being; and second, the operations of the subordinate form are directed towards the goals of the dominant form. When the hierarchical ordering of substantial forms breaks down, subordinate forms become themselves dominant forms with active powers of their own—powers that are not directed towards the goals of any other dominant form. Moreover, in cases in which the previously dominant form ceases to exist (as in the death of the living being) or to function properly, it is not transformed into a subordinate form under the dominion of a previously subordinate form. This is why such transmutations are irrevertible. What is more, the portion of matter informed by this form retains boundaries of its own. It is individuated not only physically but also mathematically. This portion of matter, together with its dominating substantial form, *is* a living being. While the substantial form now active in the living being did exist previously (albeit not as a dominating form), the living being itself did not exist previously. Moreover, since the composite substance individuated by a subordinate form is not a living being itself, it does not belong to any biological species, either. Hence, a substantial form determines membership in a biological species only when it functions as the dominant form of a living being. If a substantial form of this kind never before functioned as a dominant form, the living being that is now dominated by this form belongs to a biological species that did not exist before. In such a case, while the substantial form dominating in this living being is old—indeed, as old as the universe—the living being belongs to a species that is new. In this sense, Scaliger is committed to singular species mutability.

6. Conclusion

Somewhat paradoxically, in Scaliger's case quite traditional modes of thought led to innovative biological conceptions.[34] In his metaphysics of composite substances, Scaliger is thinking through the implications of an idea already present in medieval philosophy: the idea of a hierarchically ordered plurality of substantial forms within each living being. Biological species, according to his view, are mutable because living beings contain a plurality of substantial forms that can develop into the dominating forms of new living beings. While these forms are old, their functional role as dominating forms and, hence, their role in defining a biological species can be new. Scaliger makes use of this idea, and finds further support for it, when interpreting ancient biological works. Doing so leads Scaliger to results that amount to an upheaval of some of the most firmly entrenchend tenets of Aristotelian natural philosophy: Where the hierarchical ordering of substantial forms breaks down, plants can bring forth plants that belong to a different species; and it is even possible that the newly generated plant might belong to a species that never existed before. Obviously, Scaliger's biological views are oddly out of touch with the evolving early modern interest in new observational and experimental techniques. Yet, at the same time—and maybe partly just for this very reason—they vividly illustrate the role that metaphysics and textual interpretation played in the emergence of early modern conceptions of mutable biological species.

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[34] On the presence of traditional and not-so-traditional modes of thought in Scaliger's physics, see Christoph Lüthy, "An Aristotelian Watchdog as Avant-Garde Physicist: Julius Caesar Scaliger," *The Monist*, 84 (2001), 542-561.