Chapter 13
Vegetal Analogy in Early Modern Medicine: Generation as Plant Cutting in Sennert's Early Treatises (1611–1619)

Elisabeth Moreau

Abstract This chapter examines the use of vegetal analogy in late Renaissance physiology through the case of the German physician Daniel Sennert (1572–1637). It is centered on Sennert's explanation of generation, in particular the transmission of life through the vegetative soul within the seed, as developed in his early works on medicine and alchemy, the *Institutionum medicinae libri V* (1611) and *De chymicorum…liber* (1619). This chapter first summarizes Sennert's account of generation and the seed's "formative force" according to Aristotle and Galen, as well as his appraisal of the medical debates on the origin of the seed's soul and form. Then, the next part explores Sennert's own interpretation of the origin of forms, for which plant physiology served as a common denominator of his medical, alchemical and theological inclinations. Finally, this chapter considers how Sennert attempted to harmonize his reasoning with the Paracelsian account of generation, seed and life.

13.1 Introduction

In Renaissance medicine, the vegetative soul was a central concept for the explanation of generation, growth and nutrition. In the case of generation, the faculties of the vegetative soul were considered as driving the development of the seed through its own "formative" force.[1] The origin of the soul within the seed, and more broadly, the transmission of life and physiological functions from parent to offspring, was one of the most difficult questions in the medical philosophy. Following Galen's

[1] "Generation" (*generatio*) here refers to reproduction as a physiological function common to all living beings. The same term could also designate the broader process of coming into being that applied to natural things, in reference to the Aristotelian physics.

E. Moreau (✉)
FNRS – Université libre de Bruxelles, Brussels, Belgium
e-mail: Elisabeth.Moreau@ulb.be

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The Construction of the Embryo, as well as Aristotle's *Generation of Animals*, many Renaissance physicians attempted to solve the origin of the vegetative soul by investigating the seed's "form" – in the Aristotelian sense of "essence" – as an active principle (Galen 1997; Hirai 2011a; Deer Richardson 2018; Roger 1997). Among them, the German physician Daniel Sennert (1572–1637) was constantly discussing this question throughout his medical and alchemical works.[2] A professor of medicine at the University of Wittenberg, Sennert was representative of the early modern German physicians learned in Aristotelian and Galenic philosophy, who strove to introduce the teaching of alchemy in the university program (Michael 1997, 2001; Stolberg 2003; Clericuzio 2000, 9–34). His works on natural philosophy, medicine and alchemy had a large audience in the seventeenth century as evidenced in the re–editions of his *Opera omnia* between 1641 and 1676.

Presented by historians as a precursor of van Helmont and a direct source for Boyle, Sennert has been the object of numerous studies on early modern science. Since the 1990s, his atomistic philosophy has garnered growing attention in the historiographical current on early theories of matter (Newman 2006, 85–156; Michael 1997, 2001; Lüthy 2005; Lüthy and Newman 2000; Clericuzio 2000, 9–34). It has been shown that Sennert merged the Aristotelian physics of elements and matter–form with atomistic concepts that he ascribed to Democritus. His theory of matter was grounded in late Renaissance natural philosophy as well as alchemical theory and practice, from late medieval Latin-Arabic authors to Paracelsus' followers and detractors.

Interestingly, Sennert's atomist philosophy had a medical side which has been explored regarding his theory of generation in the *Hypomnemata physica* (1636) (Stolberg 1993, 2003; Hirai 2011a, 151–172). In this treatise, Sennert considered seeds as living particles and atoms, which encapsulated the body's soul and superior form for their "multiplication" during generation. Following Galenic and Paracelsian accounts of generation, his interpretation was based on a theological conception of the transmission of the soul from parent to offspring, which stemmed from his Lutheran background.

While Sennert's theory of generation was imbued with medicine, natural philosophy, alchemy and theology, it also resorted to vegetal analogy to explain the phenomenon of reproduction. In this regard, Hiro Hirai has shown Sennert's analogy between spontaneous generation, the origin of forms and the formation of mushrooms in the *Hypomnemata* (Hirai 2011a, 151–172; Hirai 2015). However, prior to this treatise, Sennert already developed a vegetal explanatory model of generation in some of his medical and alchemical works. This vegetal representation was rooted in the longstanding medical concern with the vegetative soul. Among Sennert's sources on this theme, the Aristotelian and Galenic physiological texts abounded in the analogy between plants and the human being (Totelin 2018). As the most basic form of life, the vegetal realm was indeed the object of analogical reasoning in the medical tradition, as it provided visible and familiar evidence for otherwise obscure phenomena, especially in embryology (Holmes 2017).

[2] On this theme, see also Bigotti in this volume.

In addition to his vegetal model of generation, Sennert showed a broader interest in botany from his earliest works. For instance, his *Epitome naturalis scientiae* (1618) includes a book dedicated to the vegetative soul as well as the parts, differences and history of plants according to Aristotle and the Italian physician Julius Caesar Scaliger (1484–1558) (Sennert 1618, 409–494). Figuring prominently in Sennert's works, Scaliger applied an Aristotelian interpretation of matter–form to plant physiology, vegetal reproduction in particular, in his commentaries on ancient botanical treatises (Blank 2010, 53–72; Blank 2012, 503–523). These botanical works likely played an influential role in Sennert's medical philosophy along with Scaliger's *Exercitationes* (1557).

Moreover, from his alchemical "turn" around 1619, Sennert was familiar with the multiple vegetal metaphorical terms such as "seed", "root", "fruit" and "transplantation" in Paracelsian alchemy. One of his main sources, the Danish physician Petrus Severinus (c.1540–1602), claimed in his Paracelsian manifesto, the *Idea medicinae philosophicae* (1571), the importance of agriculture and the *res rustica* for the knowledge of nature (Severinus 1571, preface and 22; Shackelford 2004, 183 and 205). For this reason, Paracelsian alchemy also needs to be considered in the maturation of Sennert's view on generation and the vegetative soul.

In the context of his medical and alchemical interest in plants, Sennert began to develop his vegetal explanation of generation and seed propagation in two major treatises (Sennert 1611; Sennert 1619).[3] It was first presented in a physiological account of generation included in a systematic treatise on medicine, the *Institutionum medicinae libri V* (1611). This account was partially updated in a treatise on alchemy, *De chymicorum cum Aristotelicis et Galenicis consensu ac dissensu liber* (1619). As will be shown in this chapter, Sennert's interpretation of generation in these early treatises throws light on his medical theory of matter before his progressive "atomistic turn" around 1619.[4] Sennert indeed used the analogy with vegetal generation, an observable yet specific phenomenon, in order to explain the reproduction of all living beings at the level of their smallest components (Bailer–Jones 2002). Interestingly, his vegetal explanatory model of generation operated as a common denominator of the medical, alchemical and theological frameworks espoused in his works.

In this chapter, I explore the *Institutionum…libri* and *De chymicorum…liber* to elucidate Sennert's early theory of generation and his reception of the Paracelsian view on the seed and the transmission of life. This chapter first examines Sennert's medical account of generation and his appraisal of the main interpretations of the origin of forms. It then follows with his own explanation inspired from natural philosophy and horticulture. Finally, this chapter investigates how Sennert attempted to

[3] For the abridged version of these treatises, see Sennert, 1656, 1662.

[4] Sennert progressively adopted an atomistic view around 1619 as he considered elements as discrete fragments in the first edition of *De chymicorum…liber* (1619), while in the second edition of the same treatise (1629), elements were defined as discontinuous and intact units (Newman 2006, 85–156).

reconcile his account of generation and the origin of forms with the Paracelsian philosophy.

13.2 The Transmission of the Soul During Generation

Sennert provided his earliest medical account of generation in the *Institutiones medicinae* (1611). This systematic and didactic work consists of five books dedicated to physiology, pathology, "semiotics" (symptomatology), "hygiene" (dietetics) and therapeutics (Sennert 1611, 69a–86b). In structure and content, the *Institutiones* followed the example of late Renaissance Galenic *summae* along the lines of eponymous works by Leonhart Fuchs (1555) and Johan van Heurne (1592) (Fuchs 1555; Heurnius 1592). Sennert attempted to imitate both illustrious doctors from the reformed tradition by publishing his own *Institutiones* in Wittenberg, where he showed his mastery of Aristotelian physics and revealed his interest in alchemical pharmacology. In so doing, Sennert proposed his Aristotelian interpretation of debated notions, such as the union or "mixture" of elements and the "substantial form" of beings. His natural philosophy was indebted to that of Scaliger as an heir of the "Latin Pluralist" account of Aristotelian philosophy, which was promoted by the school of Padua in the Renaissance (Sakamoto 2016; Blank 2010, 27–52; Lüthy 2001). Following this current, Sennert posited that all beings were made of a hierarchy of substantial forms within discontinuous units of matter, also called "natural minima" (Michael 1997, 2001).

Sennert's treatise *De chymicorum…liber* (1619) was aimed to reconcile the Aristotelian–Galenic tradition with the "new" Paracelsian philosophy. In this work, Sennert maintained his stance on generation in the context of a chapter dedicated to the notions of substantial form and seed and to the Paracelsian account of "stars" (*astra*) (Sennert 1619, 189–230). Following the same interpretation as in the *Institutiones*, he added some brief remarks in reference to Scaliger and Paracelsian physicians, such as Petrus Severinus and Thomas Moffet (1553–1604). This led Sennert to posit a broader comparison between the Aristotelian and Paracelsian definitions of life. In the present and next sections of this chapter, I examine Sennert's discussion on the origin of forms in both the *Institutiones* and *De chymicorum…liber*, while the Paracelsian facet of his theory will be discussed in the last section.

In the first book of the *Institutiones*, Sennert explores the phenomenon of generation following Galen's *On Semen* (*De semine*) and Aristotle's *Generation of Animals* (*De generatione animalium*) (Galen 1992). He first states that generation aims at the conservation of living beings, including human, animal and plant species. Their seed contains a "generative" or "formative" force (*vis generatrix* or *formatrix*), through which they produce an animate being similar to themselves (Sennert 1611, 69b, 1619, 189). In the case of plants, this formative force is stimulated by solar heat and ambient air while, in the case of humans and "perfect" (achieved) animals, it

comes from the seed emitted by the male in the female uterus. The seed is then mingled with menstrual blood, which serves as a material principle within the uterus. There, the seed is retained, warmed up and nurtured in order to be developed at the end of gestation or pregnancy.

Having established the general role of the seed in the generation of the fetus, Sennert further examines the seed's nature and composition following Aristotle's *Generation of Animals*. He begins by describing the seed as a subtle body, hot and moist in nature. It is produced from a "nobler" matter, which is abundant in the body parts during nutrition (Sennert 1611, 71b). During the last digestive phase or "third concoction", the body parts provide the necessary material for producing the seed, which the medical "spirits" send to the testes.[5] During the development of the fetus, it is the seed's formative force that prepares the seminal matter by assigning it a size, number, figure, order and position. The seed material is then subject to a "delineation" and a "signature", in other words, it receives the visible features of the fetus' body parts (Sennert 1611, 71b–72a; Kikuchihara and Hirai 2015).[6]

As Sennert explains, the key to the formation of animate beings during generation lies in the seed's formative force, which is a faculty of the vegetative soul. In reference to Galen's *The Construction of the Embryo* (*De foetuum formatione*), he recounts that the formative force has long remained an obscure and elusive concept (Galen 1997, 200–201; Hirai 2011a, 151–172). Galen deplored that philosophers had been discouraged to ever elucidate its nature as testified the various theories on the active nature of the seed, which was sometimes called "formative reason" or "plastic power" (Sennert 1611, 74b).[7] Nonetheless, Galen contended that the seminal cause of formation necessarily required the highest "skill" (τέχνῃ) and "intelligence" (σοφίᾳ) to produce an animal. In Sennert's view, such requirements for the formation of an animate being can only be operated by the soul itself through its faculties and its essence or "substantial form". Consequently, it is the origin of the seed's substantial form which needs to be investigated to understand the generation of living beings and the transmission of the soul from parent to offspring.

Before unfolding his position on the origin of the seed's form, Sennert appraises two main interpretations of this question within his medical sources. First, he examines the Platonic accounts of an "external", i.e., celestial, origin of forms. Then, he discusses the Aristotelian views on the "internal" origin of forms within the seed. The core of his argument is very similar to that of his later *Hypomnemata* (1636),

[5] Arist. *Gen. an.* 1.18, 726a16–726a28.

[6] Sennert 1611, 1.10, 71b–72a: '[…] sed [accipiendum est] quod illud, quod in partibus ad alendum superat et abundat, cum spiritibus ad testes mittatur, materiamque semini suppeditet. […] Plerique enim seminis materiam a tertia coctione peti existimant; et quia a tertia coctione seminis materia decidatur et suppeditur, rudem quasi delineationem, signaturam et formam praecipuarum partium in se complecti statuunt. […] quae tamen delineatio rectius soli animae et formatrici facultati tribuenda videtur.'

[7] Sennert 1611, 1.10, 74b: 'Alii enim in semine animam inesse, atque ab ea. omnes corporis partes delineari fabricarique statuunt: alii animam inesse negant in semine, et solum λόγον quendam πλαστικόν, seu δύναμιν πλαστικήν, et vires quasdam, potentiam et facultatem haec efficiendi in semine inesse dicunt. Verum alii aliter id explicant.'

which has been examined by Hiro Hirai (Hirai 2011a, 151–172). For this reason, I shall summarize the main steps of Sennert's appraisal before exploring his own explanation in the next section.

Sennert first considers the Platonic supporters of the celestial origin of forms in the medical tradition. One of his main sources, the French physician Jean Fernel (c.1497–1558), held this stance in his *Universa medicina* (1567), a systematic work on medicine, which was reedited many times in the early modern period (Sennert 1611, 74b–75a; Sennert 1619, 191–193). Fernel's medical philosophy was emblematic of the Renaissance Platonic response to the "materialistic" interpretation of Galen, which explained all physiological phenomena by the simple mixture of elements (Zanier 1987). In his treatise *On the Hidden Causes of Things* (*De abditis rerum causis*) (1548) included in *Universa medicina*, Fernel argued that all physiological functions, because they were related to the body's vital principle, had specific causes of celestial nature that were associated to their substantial form (Fernel 2005; Deer Richardson 1985). As Sennert points out, Fernel emphasized that the form of living beings had a celestial origin received by the seminal matter, which was well-disposed by the body's innate heat (Fernel 2003; Hirai 2011a, 46–79). According to this view, the heavens sent some "perfection" that stimulated life in the seminal species, whose matter was beforehand prepared. However, this reasoning leaves Sennert unconvinced.

In *De chymicorum…liber*, Sennert also alludes to the longstanding Avicennian account of celestial causation through a "giver of forms" (*dator formarum*). While Avicenna was an important authority in medical learning for his *Canon of Medicine*, he also provided an extensive work on Aristotelian natural philosophy. In his *Metaphysics*, he developed an account of celestial causation in the context of an emanationist cosmology. Accordingly, the "giver of forms" was a celestial emanation of the active intellect, which gave a form to the well-disposed matter of living beings. Sennert considers this notion as a subordinate deity, following Scaliger's criticism in *De plantis* (Sennert 1619, 190; Scaliger 1566, 29a).[8] In his view, forms are well and truly divine but cannot be transmitted by an external entity like the heavens because it would make the "equivocal" reproduction of "inferior" animals, that is spontaneous generation, impossible. This is the occasion for Sennert to recall the explanation of generation from *Genesis*. God created animals by endowing them with fertile forces within their seeds just as he did for plants, yet before creating the stars. With this reasoning, Sennert defends the internal origin of the seed's form, while maintaining its divine provenance following an interpretation compliant with the Scriptures.

Having expressed his doubts on the celestial "impression" of forms during generation, Sennert goes on to examine the Aristotelian view on the internal origin of

[8] Scaliger 1566, 1, 29a: 'Cum tamen ne inter primos quidem Philosophos satis constet: quis sit formarum dator, aut unde proficiscantur: ἐκτίνος ἐκμαγείου depromantur illae. Non enim facilis patere videtur ingeniis humanis aditus ad huiusce sacrarii penetralia. Adeo vero exagitati sunt sapientes, ut Deum quendam (loquar illorum more) sub alterum crearit Avicena tuus ille Scaliger: cuius Dei tum beneficio factae, tum officio datae formae reciperentur in materiam.'

the seed's form. In *De chymicorum…liber*, he begins by examining the theory of the "eduction" (*eductio*) of forms (Sennert 1619, 193–195). As he explains, this theory asserts the emergence of forms from the potency of matter, hence suggesting that the form of animate beings is subject to generation and corruption as it is coextensive of the body. Although Sennert correctly attributes this stance to the Aristotelian scholars of his time, it should be noted that scholastic philosophers rejected the "eduction" of forms applied to the rational (human) soul and affiliated it with the "materialistic" philosophy of Alexander of Aphrodisias (Pluta 2007). During the Renaissance, the philosophy of Alexander was, nonetheless, rediscovered and endorsed by some scholars from the University of Bologna and Padua, such as Pietro Pomponazzi (1462–1525), who claimed that Aristotle supported the mortality of the soul (Michael 2000). As for Sennert, he rejects the "eduction" of forms related to the vegetative soul because it assigns to matter the role of form as an efficient entity able to animate the seed. Since it presents matter as a "nobler" principle than the form, the theory of "eduction" subverts the Aristotelian physics of matter–form and needs to be dismissed.

Sennert then gives a closer look at the application of the "emergence" (*emersio*) of forms, following Scaliger's terms, to the physiological explanation of generation (Sennert 1619, 196; Scaliger 1557, 13v).[9] In his view, this theory implies that the form "draws" itself from the status of potentiality to that of actuality by preparing the seminal matter. At the same time, the progenitor's form moves from the status of "first actuality" to that of "second actuality" as a secondary instrumental cause able to vivify the seed (Sennert 1611, 75a–78a; Sennert 1619, 199–202). Sennert identifies this stance to that of the German physician Jacob Schegk (1511–1587), who was a professor at the medical faculty of Tübingen and a renown Aristotelian philosopher in the German intellectual world. In his *On the Plastic Faculty of the Seed* (*De plastica seminis facultate*) (1580), Schegk defined the seed's formative force or "plastic reason" (λόγος πλαστικός) as a "second actuality" related to the substantial form, hence potentially animate (Hirai 2011a, 80–103). Sennert deems this reasoning unsatisfying as it suggests that the seed's form is only an instrumental cause related to the spermatic moisture, which is still inanimate.

The main reason for Sennert's rejection of the Aristotelian theory of emergence is his understanding of the seed's formative force as the "formal agent" and "first actuality" pertaining to the soul. To support this view, he refers to Aristotle's *Generation of Animals* by stating that any form that accomplishes the operations of the soul is not only "noble" and superior but can only be the soul itself.[10] Such a form is an "efficient" entity that operates in actuality the vital functions within the seed in order to vivify and shape the fetus. Therefore, Sennert insists, the seed's

[9] Scaliger 1557, 6.5, 13v: 'Formam esse in semine canino: cuius in potestate dicitur esse, quia semen est potens dare formam, quam in se continet. Educitur autem de ea potentia remota, qui est actus primus, ad potentiam propinquam, qui est actus secundus: scilicet ut forma sit in eadem materia ad eum modum qui nullis egeat adminiculis: ut fine suo fruatur, ad quem comparatum est totum compositum. […] Caeterum est emersio potius, quam eductio.'

[10] Arist. *Gen. an.* 2.3, 736a24–736b20.

form stems neither from the heavens as claimed by Platonic physicians, nor from a subordinate instrumental cause as established by the Aristotelian supporters of the emergence of forms.

In concluding his appraisal, Sennert finds it more relevant to consider the transmission of the progenitors' soul to their seed as a "multiplication" of forms. On this point, he relies on the Paduan philosopher Giacomo Zabarella (1533–1589) who asserted, following Albert the Great, that any form was "multiplicative" of itself to the extent that all animate beings generated their own kind by multiplying their form (Sennert 1619, 196–197; Zabarella 1590, 589; Spruit 2008). While Zabarella developed this argument in the context of an Aristotelian theory of perception, Sennert uses it in a physiological framework in order to overcome the aporias in his medical sources, namely Fernel, Avicenna and Schegk. This leads him to espouse his own interpretation of the transmission of life by animate beings, which is examined in the next section.

13.3 Multiplication of Forms and Horticulture

Although Sennert denies the celestial origin of the seed's form, he acknowledges that its initial provenance is somewhat divine. In his view, this "noble" origin, which has long remained unexplained, comes from the divine blessing of germinating plants and multiplying animals and humans as expounded in *Genesis* (Sennert 1611, 80a; Sennert 1619, 197).[11] God created the forms of living beings, which henceforth have been propagated by each progenitor's seeds, a phenomenon that Sennert calls "traduction" (*traductio*) of forms (Stolberg 2003; Vidal 2011, 21–57). Established in theological sources, the traducian theory stated the transmission of the soul by a portion of the parent's seed. Adopted by the Lutheran Church, traducianism was nonetheless in the minority and poorly used in medical treatises. Instead, the doctrine commonly adopted by the Catholic and Calvinist Churches was the "creationist" interpretation of the soul as infused by God during the development of the embryo.

According to Sennert, the "traduction" of forms implies that of the soul from a physiological point of view. The soul within the seed is "latent" to the extent that it is alive and able to germinate if stimulated by heat and moisture. As Sennert points out, this is manifest in the case of plants, whose seeds are preserved by the vegetative soul. Even at rest, vegetal seeds remain fertile for a certain duration, so that they are able to operate the actions of the soul if placed in a suitable material (Sennert 1611, 75b–76a, 1619, 197–198).[12] While the case of plant generation corroborates

[11] See *Genesis* 1:11, 22 and 28.

[12] Sennert 1611, 1.10, 75b–76a: 'Quodvis enim semen, ut in plantis manifestum est, vegetante anima conservatur et aliquandiu prolificum permanet: et quandiu integrum, et incorruptum est, in loco idoneo, et praesente alimento, ut vivens operatur et exercet suas actiones in eam, quae praesto est, materiam, non secus, ut ipsum vivens integrum omnibus partibus […]. Nam eaedem

the presence of a "latent" soul in the seed, Sennert still has to show the relevance of vegetal generation for the rest of the living world, in particular, "perfect" animals, including human beings.

For this purpose, Sennert first considers plant reproduction by taking the example of the willow and rosebush. Both multiply by cutting, i.e., through the section of a stem planted in the earth in the same way as grafting and layering. According to Sennert, the botanical phenomenon of plant cutting, which the current horticulture calls vegetative "multiplication" or "propagation", is the explanatory model for the generation of all living beings – plants, animals and humans. Vegetative propagation is, indeed, the object of an analogical reasoning that Sennert extends to the reproduction of all living beings to build an interpretation of generation upon a familiar and observable phenomenon (Bailer–Jones 2002). From the ancient times, plant propagation had been known by naturalists and gardeners, while cutting was common horticultural practice (Ambrosoli 1997). If Wittenberg did not offer a botanical garden in the early seventeenth century, Sennert still had access to private gardens and longstanding botanical literature on vegetal reproduction, from Theophrastus and Pliny to Cesalpino (Bellorini 2016).[13]

In the late Renaissance, the analogy with vegetal reproduction went beyond the common biological framework as it stimulated original interpretations in medicine and natural philosophy. Plant grafting, in particular, raised the attention of scholars following the works of Giambattista Della Porta (1535–1615) on botany and natural magic. In this regard, Della Porta's theory and experiments concerning plant grafting inspired Gaspare Tagliacozzi on plastic surgery, William Gilbert on magnetic polarity and Francis Bacon on the prolongation of human life (Savoia 2017; Oppenheimer 1953; Rusu 2020). In the case of Sennert, it was the broader phenomenon of vegetative propagation that was at the center of his medical theory of generation in order to buttress his interpretation of matter–form and the vegetative soul.

Throughout Sennert's discussion on generation, the analogy with vegetative propagation allows to visualize and explain the essential mechanisms of embryological growth despite its hidden and complex character (Holmes 2017). What vegetal propagation reveals, according to Sennert, is the status of the plant's torn stem as a material which contains a "particle" of its soul and form. The latter, in turn, allows the cutting to grow (Sennert 1611, 78b; Sennert 1619, 202–203).[14] Although

operationes in semine, et in planta omnibus numeris integra conspiciuntur […]. Eadem enim est omnino operatio, cum anima in semine latens ex attracta materia corpus plantae fabricat […].'

[13] On ancient accounts of vegetative propagation, see for instance Theophr. *Hist. pl*. 2; Plin. *HN* 17.12. In the early modern period, Robert Sharrock, an English botanist and friend of Robert Boyle, dedicated a treatise on this topic in his 1660 *History of the Propagation and Improvement of Vegetables* (Webster 1966).

[14] Sennert 1611, 1.10, 78a: 'Atque animam in semine haec omnia efficere, neque formationem corporis animati alterius rei opus esse: satis quoque videtur probare plantarum nonnullarum generatio, quae ex parte a planta avulsa propagantur; cum scilicet particula animae cum parte materiae cohaerens avellitur, unde planta priori similis excrescit. […] sicut in hoc propagationis modo ab animae parte cum parte corporis avulsa plantae formantur: ita etiam in semine vim formatricem partium non ulli alii attribuendam esse.'

Sennert does not state here that the form of an animate being is a divisible quantity, he believes that it is somewhat divided at the same time as matter during generation (Roger 1997 [1963], 84–86). The part of the soul that is detached with the seed's body makes an animate being which is similar to the parent. As Sennert acknowledges, reproduction by cutting does not occur in all plant species, nor does it exist in animals, either oviparous or viviparous. A similar phenomenon, however, is observed in the case of animals: their seeds or eggs act as cuttings to the extent that they are torn particles, which enclose a part of their soul. Sennert further supports the idea of a division of the soul during generation by quoting the Greek atomist philosopher Epicurus. As reported by Pseudo-Plutarch's *On the Opinions of the Philosophers* (*De placitis philosophorum*), Epicurus defined the seed as a "detached portion" or "particle" of body and soul (Sennert 1611, 70a, 1619, 204; Perseus Digital Library 2020).[15]

Sennert's accent on the form's ability to tear further reflects his theory of matter in the first edition of the *Institutiones* (1611) and *De chymicorum…liber* (1619). At that time, he was in the early stage of his Aristotelian matter theory following the "Averroist" account of elements and mixture (Newman 2006, 85–156; Michael 2001; Lüthy 2005). Before around 1629, Sennert adopted this stance along the lines of Zabarella and Scaliger as representatives of the "Latin Pluralism" promoted by Aristotelian philosophers of Padua in the Renaissance (Michael 1997, 2011). According to this view, elements were the smallest or "minimal" parts of bodies. When subject to a "mixture" for the constitution of a new being, they gathered as contiguous portions, which joined into a homogeneous compound. During mixture, their substantial forms tore and united in a plurality of subordinate forms, which constituted the new "median" form of the compound. Such a "tearing" (*refractio*) of forms in a range of diverse degrees reflected the hierarchy of beings as suggested by Aristotle's *Metaphysics*. Sennert fully supported this claim as he regularly insisted that the creation of natural beings obeyed a hierarchy of increasing degrees, which ended with the human being as the "noblest" living being.

Within a framework indebted to the "pluralist" Aristotelian physics of matter–form, Sennert's theory of matter was shaped by his progressive adherence to ancient atomism. Previous studies on Sennert's alchemical theories have shown that he later defined compounds as "atoms" endowed with a superior form (Newman 2006, 85–156). For this interpretation, he referred to Democritus, who was an important figure for the Renaissance "atomist revival" from the late sixteenth century (Lüthy 2000). Interestingly, in his early medical explanation of generation, Sennert rather alluded to Epicurus by way of *De placitis philosophorum*, hence providing an additional clue to his interest in atomistic explanations and authors. He openly shared Epicurus' approach to body and soul as discrete entities that were subject to division and tearing during the generation of living beings. This reasoning coincided with Sennert's "pluralist" stance that the matter of beings was made of contiguous parts, while their substantial form was subject to some "tearing". In this context, Sennert

[15] Sennert 1611, 1.10, 70a: 'Verum non incommode Epicurus, […] ψυχῆς καὶ σώματος ἀπόσπασμα esse dicebat. Viventia enim dum generant, aliquid de sua materia et sua forma largiuntur, semen exhibendo […].'

considered that Epicurus' account of the seed corroborated his own definition of seeds as torn particles, which contained a "latent" soul.

In claiming the presence of a latent soul within the seed, Sennert recalls Aristotle's description of the seed and its cause of formation in *Generation of Animals*. In this treatise, the seed was presented as a foamy body, which enclosed vital heat as a "spirit" (*pneuma*) whose nature was analogous to the element of the stars (Sennert 1611, 70a; Sennert 1619, 204).[16] In the late Renaissance, this statement was propagated by a major source of Sennert's medical philosophy: Jean Fernel. For his Platonic account of Galenic medicine, Fernel stressed the celestial and divine part of the living body as related to its soul and form (Hirai 2011a, 46–79; Walker 1958). At the physiological level, this celestial entity corresponded to "innate" heat, which served as an instrument of the soul to operate vital functions such as generation, growth and nutrition. For Sennert, the presence of innate heat within the seed makes the seminal matter suitable for the propagation of the soul and the generation of a similar animal. With the help of innate heat and the medical "spirits," the latent soul within the seed deploys its virtues and shapes the seed's material into a new animate being (Sennert 1611, 79a, 1619, 204–205).[17]

Because the soul makes for itself a suitable instrument to perform its duties, Sennert considers it as the "architect" of its own home (Sennert 1611, 89ab, 1619, 205). With this explanation, he seeks to comply with Aristotle's requirement of a principle of motion within the seed coming from the parent's form in actuality.[18] At the same time, Sennert's statement refers to Themistius, via Scaliger, who asserted that the seed's form had a most "noble" and "intelligent" virtue comparable to the architect of the Temple (Sennert 1619, 188; Scaliger 1557, 14r; Hirai 2011a, 151–172). In *De chymicorum…liber*, Sennert adds that the seed's formative force is an admirable aspect of divine providence (Sennert 1619, 205).[19] During the creation, God ordained the multiplication of such a "smallest" body, which was efficient enough for the conservation of species until the end of time. As Sennert explains, it was the ignorance of the Christian doctrine of creation that prevented Galen from being able to explain the origin of the formative force within the seed of animate beings.

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[16] Sennert 1611, 1.10, 70a: '[…] estque semen corpus quoddam spirituosum, calidum et humidum, in testibus genitum, seu spiritu et θέρμῳ θειοτέρῳ τῶν καλούμενων στοιχείων, καὶ ἀναλόγῳ τῷ τῶν ἄστρων στοιχείῳ plenum, ad animae propagationem, et similis animalis generationem aptum.' See Arist. *Gen. an*. 2.3, 736b29–737a6.

[17] Sennert 1611, 1.10, 79a: '[…] ex semine ob hanc animam iam novum animal exoritur, dum anima in semine latens sese exserit et suas virtutes explicat, et operando sese manifestat, calidoque et spiritibus utens, omnia, quae ad animalis constitutionem necessaria sunt, fabricare exorditur, subiectamque materiam distinguit, disponit, ordinat, format, et effingit […].'

[18] Arist. *Gen. an.* 2.1, 734b19–735a4.

[19] Sennert 1619, 9, 205: 'Neque quem exiguum illud seminis corpus offendat, sed potius Creatoris sapientiam, potentiam, bonitatem, qui cum exiguo corpore formas ad specierum conservationem ad finem usque mundi transferri et multiplicari in prima creatione et voluit et iussit, hic attentius admiremur: formarumque praeterea nobilitatem aestimemus, quae in minimo corpore aeque suam essentiam et potentias integras retinere possunt, ac in maximo.'

To support his interpretation of the "vegetal" multiplication of forms, Sennert had two possible and non–exclusive sources: Scaliger and Tertullian. As Sennert's priority source, Scaliger mentioned the case of the graft's transmission of its form but limited it to spontaneous generation, without adopting a traducian interpretation of the soul (Sakamoto 2016, 130–131). On the other hand, the Church father Tertullian (ca.160–225) used the same metaphor of vegetative multiplication to establish his view on traducianism – the Latin term *tradux* meaning "graft". This doctrine provided a corporeal interpretation of the soul by stating the transmission of the original sin by individuals of each generation as the "grafts", namely the offspring, of the previous generation.[20] In his treatise *On the Soul* (*De anima*), Tertullian explained that all shrub, stem and offspring contained the force of its soul and the things necessary for the generation of its own kind.[21] Setting aside the traducian interpretation of generation and ensoulment, the works of Tertullian raised discussion among early modern German reformed scholars, for instance Melanchthon in Wittenberg, in an essentially theological context (Fraenkel 1982).

In his turn, Sennert naturalizes Tertullian's metaphor to describe the propagation of the soul and form in a physiological framework. This allows him to clarify the mode of transmission of the seed's form by conforming to Aristotle's requirement of a form in actuality and to Galen's description of the formative power. Sennert merges this point with late Renaissance physiological theory of the body's vital heat as an instrument of the soul. He is careful, however, to clarify that his account is only centered on the vegetative soul present in the seeds of all living beings. Cautiously, he refrains from pronouncing on the origin of the rational and immortal soul that is specific to humans (Sennert 1611, 80b, 1619, 221).[22] However, this did not prevent Sennert from being the target of a controversy, in 1632–33, about his conception of the soul, form and innate heat as well as his atomistic matter theory (Clericuzio 2001, 30–32). Beyond his original interpretation of the Aristotelian and Galenic tradition, it was, overall, his status as a Paracelsian philosopher that was under attack. While the particulars of this controversy lie beyond the scope of this chapter, Sennert's appeal for Paracelsian alchemy in his early theory of generation is examined in more details in the following section.

[20] Traducianism was opposed to the doctrine of creationism as a divine infusion of the soul in each individual during generation, as was promoted by Lactantius (245–325) (Givens 2010, 99–128; Hirai 2011b).

[21] Tert. *De anim.* 19: 'Siquidem et illis necdum arbusculis, sed stipitibus adhuc, et surculis etiam nunc simul de scrobibus oriuntur, inest propria vis animae. […] Aut unde mox illis et frutices inoculantur, et folia formantur, et germina inflantur, et flosculi inornantur, et succi condiuntur: si non in ipsis omnis paratura generis quiescit, et partibus promota grandescit?'

[22] Sennert 1611, 1.10, 80b: 'An vero haec, quae de anima in semine existente hactenus diximus, et quibus animae vegetantis, ut et sentientis, praesentiam in semine probavimus, de Rationali quoque anima intelligenda sint: hic non decidimus. Neque enim gravissimam illam quaestionem, de animae Rationalis, quae immortalis est, origine, hic discutiendam proposuimus, sed solum vim formatricem corporis animati inquirere voluimus.'

13.4 Forms, Seeds, and "Stars": A Paracelsian Reconnection

Sennert's works in natural philosophy and medicine took an alchemical "turn" in 1619 with the publication of *De chymicorum…liber*. The project of this treatise was to show the utility of alchemy for the preparation of medicinal drugs. Once a substance was subject to the extraction or "separation" of its alchemical principles, its powerful volatile part could be "fixed" into a moderate substance. For Sennert, this meant that poisonous minerals could be tamed into safe and efficacious remedies. Following this reasoning, he intended to reconcile Paracelsian alchemy with the medical tradition. In promoting such a "chemical compromise", Sennert nonetheless recommended to reappraise a series of debated ideas in the Paracelsian philosophy. In particular, he had in mind the Paracelsian penchant for neologisms, the excessive correspondence between macrocosm and microcosm and the reference to some religious vocation (Sennert 1619, 108–124).

Whereas Sennert did not deny the status of alchemy as an ancient source of knowledge, he rejected its sacred character promoted by Paracelsus and his followers, who at times considered themselves as "priests of nature". Moreover, the Paracelsian terminology reflected, in Sennert's eyes, a new "way" of acquiring knowledge, which diverged from the tradition based on reason and experience. As a typical Aristotelian philosopher, Sennert strongly believed that correct speech clearly expressed the meaning of thought, while erroneous discourse required a long process of deciphering and understanding. For this reason, he proposed to demystify the Paracelsian philosophy in light of Aristotle and Galen.

In *De chymicorum…liber*, Sennert recounts the concepts of "seed" and "star" at the center of the Paracelsian theory of generation (Sennert 1619, 178–182). His account mainly comes from Severinus' *Idea medicinae philosophicae* (1571), one of the earliest digests of Paracelsian medicine. Aimed at late Renaissance humanists, the *Idea* synthetized the works of Paracelsus with ancient philosophers, above all Hippocrates and Plato, hence making a major contribution to the diffusion of Paracelsianism in the early modern period (Shackelford 2002; Hirai 2005, 217–265; Bianchi 1982). In this treatise, Severinus considered "seeds" (*semina*) as the foundation of nature and knowledge but noted that the tradition gave them the restricted meaning of a fertile material involved in the reproduction of living beings. In contrast, Severinus more broadly defined seeds as the invisible and incorruptible principles of generation of all natural things, including mineral and celestial bodies.[23] He also called the seeds "stars" (*astra*) to the extent that they were at the origin of celestial cycles. Through their status of link (*vinculum*) between the higher and lower worlds, seeds as "stars" also influenced all beings of the terrestrial world

[23] The Paracelsian "generation" refers not only to reproduction but to the progressive coming into being and growth of natural things.

(Severinus 1571, 46–54). For this reason, they were considered as causing the regularity and durability of natural cycles.

As Severinus explained, seeds were incorporeal, dimensionless and only accessible by thought thanks to their link with the "elements". The latter were described as mere receptacles, envelopes, "abysses" and "matrices", which sheltered the seeds for generation (Severinus 1571, 54). For this reason, Severinus refused to base his philosophy on elements as the material components of natural change. He even disqualified the medical tradition by calling it "anatomy of death" for its approach to the living body in terms of perishable entities. For Severinus, the traditional elements established by the Aristotelian physics were "invalid" in the sense that they were devoid of any active properties.[24] In contrast, the Paracelsian "vital anatomy" that was based on the flow of the eternal seeds was believed to cause the fertile properties of beings at the origin of their active powers. Consequently, Severinus' account of generation diverged from the Galenic doctrine and proposed, instead, the idea of a "progression" of seeds following a Paracelsian interpretation.

During generation, the seeds incarnated in natural beings following a "progression" from their fundamental unity and perfection to the multiplicity of the world (Severinus 1571, 62; Hirai 2005, 249–261; Shackelford 2002, 180–185). They were first subject to incubation (*fomentatio*) in the elements as "receptacles" and "abysses," before progressing from a fundamental and obscure place called "darkness" and "Orcus" (Hades).[25] The latter was an underground reservoir, which constituted the starting and ending point of every being, where the cyclic flow of seeds took place. At the end of their progression from the elemental "abysses" to the "light" of the world stage, the seeds differentiated and separated to complete the multiplication of "fruits", i.e., the generation of natural beings. The seeds then assigned "signatures" to the new beings, namely their individual characteristics, such as size and figure (Kikuchihara and Hirai 2015; Bianchi 1987). In order to do so, the seeds deployed their own "knowledge" (*scientia*), that is a plan and internal know–how to develop bodies, which they received as a "gift" from divine providence.[26]

From this Paracelsian approach to seed and generation, Sennert seeks to establish a common lexicon with the Aristotelian and Galenic tradition. For this reason, he deems the Paracelsian notions of "seed", "star" and "root" as equivalent of the Aristotelian notions of form and soul (Sennert 1619, 181–182 and 222).[27] At first, Sennert is conciliatory toward this new terminology for a series of reasons. He agrees with the fact that "seeds" and "stars", as forms related to the soul, are dimensionless and incorporeal, and that they cause the life and powers of beings across

[24] See *De gradibus rerum naturalium et compositionibus remediorum* (Paracelsus 1589–1591, VII, 17–18).

[25] See *Philosophia de generationibus et fructibus quartet elementorum* and *De Meteoris* (Paracelsus 1589–1591, VIII, 54–159 and 206).

[26] See *Labyrinthus medicorum errantium* (Paracelsus 1589–1591, II, 215–220).

[27] Sennert 1619, 9, 222: 'Ut ergo ad institutum redeamus, appellant Chymici Recentiores, Astra Semina et Radices rerum, quae Philosophi et Medici hactenus appellarunt formas et animas.'

generations (Sennert 1619, 222–223). In addition, Sennert attempts to naturalize the Paracelsian notion of seed "progression" from the "abyss" towards the "world's scene" by analogy with vegetal physiology. As he explains, plants come up from seeds sown underground, which first grow in tiny leaflets. At this stage, they do not display a perfect structure as they need to draw from the earth an appropriate nutriment to thrive and acquire the "perfection" of their kind. This happens thanks to the plant's (vegetative) soul which shapes a suitable body for its nature. Outside of this reasoning based on the cyclic growth of plants, Sennert believes that the Paracelsian notions of "abyss" and "progression" are incomprehensible (Sennert 1619, 226).

Further to his project of conciliation, Sennert states that the Paracelsian concepts of "seed" and "star" correspond in many respects to the Galenic notion of formative force related to the seed's substantial form. As he explains in his *Institutiones* and *De chymicorum…liber*, the form attributes all the body's characteristics during generation. Through the functions of the vegetative soul, it enlivens and shapes the seed's body by assigning its size, figure, order, position and many other features. Sennert sees there a parallel with the distribution of "determined signatures" by the "internal star" that Severinus highlighted in his *Idea*. In the same way, he states that the formative force deploys something similar to the Paracelsian notion of "knowledge" (*scientia*) contained in the seeds for the development of beings. In this sense, the seminal knowledge is very close to the "art" (*ars*) and "wisdom" (*sapientia*) that Galen praised in his *Construction of the Embryo* (Sennert 1619, 185–187). Thanks to the divine providence, which introduced a formative force into them, the seeds are a divine instrument playing the role of God's "working hand". Sennert, thus, considers that the Galenic philosophy did emphasize that the soul and form contained the "knowledge" of making the body through the formative force. Nonetheless, the Galenic theory of generation had to be enlightened by Christian religion to show that this power was received during the divine creation.

Despite his compromising attitude, Sennert appears inflexible with some aspects of the Paracelsian theory of generation. In his view, Paracelsian philosophers are wrong in defining "seeds" and "stars" as celestial entities in the same way as Avicenna and Fernel were in positing the celestial origin of forms. Sennert more broadly considers that philosophers have tended to make the same conclusion because they have observed that living beings develop thanks to solar heat (Sennert 1619, 223). Moreover, because the movement of the heavens is regular and subject to cycles, philosophers have considered that the heavens are likely causing the "movement" of creatures living on earth. On this point, Sennert concedes that the Paracelsian philosophers are right to emphasize the "moments" and "terms" related to seeds as "stars" in the course of generations (Sennert 1619, 183). As he notes, it is well-known by botanists that plants produce flowers, fruits and seeds at regular and definite moments each year (Sennert 1619, 225).[28] In the same way, physicians are aware that physiological processes are subject to periodic times during

[28] Sennert 1619, 9, 225: '[…] et qui ignorat, plantas in producendis floribus, seminibus, fructibus; exarescendo quasi et rursum repullulascendo et revirescendo, stata tempora observare, rei botanicae plane ignarus est.'

digestion, generation, growth, pulse, menstruation and fevers. However, Sennert recalls, this does not imply the celestial nature of "seeds" and "stars". As the latter amount to the Aristotelian notion of form, they are actually transmitted through the seeds of living beings. Initially created by God, they contain a form and soul causing the order, regularity and periodicity of their vital functions (Sennert 1619, 225–226).

Sennert concludes his appraisal of the Paracelsian account of generation by comparing the Aristotelian and Paracelsian definitions of life. Aristotelian philosophers and Galenic physicians have held only the animate beings as living to the extent that life is a certain actuality and "vigor" of the soul. To be considered as living, one needs to display at least the operations of the vegetative soul, in particular nutrition (Sennert 1619, 226).[29] However, Sennert explains, Paracelsian philosophers have broadly extended the acceptation of life as they believe that celestial bodies, metals, minerals, gems and stones are alive too. Because the latter are endowed with a "seed" and "star", they allegedly possess an active power or a "spirit", which makes them alive (Sennert 1619, 227).[30] In this regard, Sennert refers to the English physician Thomas Moffet who, in his *Dialogus apologeticus* (1584) on the supremacy of Paracelsian drugs, defined life as the *energeia* – the Aristotelian notion of actuality – inserted in beings, in other words, their disposition to act (Moffet 1584, 29–30). With this reasoning in mind, Paracelsian philosophers have considered any active principle within beings as "vital" even if it is limited to sensory qualities or faculties. In the same way, they have considered as dead anything devoid of active and efficient powers.

For Sennert, the Paracelsian definition of life is not only excessive, it is based on a major confusion between living and acting. The latter, Sennert insists, is by far more general than living. For instance, physically dead bodies and substances subject to the alchemical process of "mortification" may still have sensory qualities and active powers. In Sennert's view, life is different and more specific than the *energeia* and disposition towards action. For this reason, he deems the Paracelsian definition of life as inappropriate and requiring reconsideration in light of the Aristotelian distinction between soul and nature (Sennert 1619, 229–230).[31] While bodies may

[29] Sennert 1619, 9, 226: 'Hactenus quidem Philosophi Aristotelici et Medici Galenici vitam tantum animatis tribuerunt, vitamque animae quendam actum et vigorem esse dixerunt: et nihil vivere concesserunt, nisi in quo aliqua animae, ad minimum vegetantis, operatio appareat; et quicquid vivit nutriri, et contra quicquid vere nutritur, vivere docuerunt.'

[30] Sennert 1619, 9, 227: 'Verum Chymici recentiores vitae nomen multo latius extendunt, et cum stellis vitam tribuunt, easque vitali seminum potestate perfundi, nec mortua esse corpora […] docent; tum etiam metalla, mineralia, gemmas, lapides, vivere statuunt, et omnino quicquid semen vel astrum, quod appellant, in se continet et agendi vim habet, seu ut alii loquuntur, omne corpus, quod Spiritum habet, vivere dicunt.'

[31] Sennert 1619, 9, 229–230: 'Rectius vero Aristoteles et eius sectatores sentiunt, qui inter Naturam et animam distinguunt, et ab iis etiam in Natura rebus, quae animata non sunt, vi a Creatore indita, definitas et ordinatas actiones provenire statuunt; vitae vero principium tantum animam esse, quibus vitae principium est anima, et ubi anima non est, ibi vitam non esse docent […].'

have particular virtues due to their nature, they can be considered as alive only to the extent that they are animate, in other words, that they hold a vegetative soul.

13.5 Conclusion

In his early physiological theory, Sennert proposed the model of vegetative propagation by cutting in order to explain generation and the transmission of life from parent to offspring. He tackled this question by discussing the transmission of the vegetative soul from the parent's seed. Following the Galenic and Aristotelian tradition, he stated that the seed was endowed with a formative force which operated the development of the embryo. To elucidate the origin of such a force, Sennert emphasized its relationship with the substantial form of the seed, which was "latent" though in actuality in order to perform physiological functions through the faculties of the soul. In support of this claim, he referred to *Genesis* by explaining that the seminal forms were initially created by God but remained immanent to the seeds in order to be subject to multiplication during generation.

With this interpretation, Sennert proposed an original account of the Aristotelian philosophy of matter–form by literally understanding the Epicurean notion of seed as a "detached portion" following the traducian view on the transmission of the soul. This led him to establish the propagation of forms as "detached particles" of the progenitor's soul in the same way as plant cuttings. During this process of propagation, the seminal form acted as an entity that was "torn" from the parents' substantial form within a material "minimum". In his *De chymicorum…liber*, Sennert applied his account of the substantial form within the seed to the Paracelsian notions of "seed" and "star" in order to enhance the form's active power, its relationship with the vegetative soul and its major role in physiological cycles.

In many regards, Sennert's early account of generation gives an insight into the maturation of his medical and alchemical ideas. First, it shows his longstanding view on body and soul, matter and form, as discrete entities which constitute the living body. Sennert's description of the seed's matter and form was nourished by the account of Epicurus, who thus needs to be included among his previously established sources: medieval alchemy, Democritean atomism and Renaissance "pluralist" Aristotelianism. In shaping his explanation of generation, Sennert merged a plurality of definitions of the seed and soul from diverse frameworks and contexts that all used the analogy with plant physiology. Most notably, he extended the vegetal analogy from the Aristotelian and Galenic views on the vegetative soul to the theological theory of traducianism and to the Paracelsian approach to generation. Such a "cross–pollination" of diverse epistemic frameworks allowed Sennert to provide a physiological explanation of generation that encompassed all living beings by taking into account their formal and material composition as well as their active alchemical properties.

In early modern medicine and natural philosophy, Sennert paved the way to a clear synthesis of Galenic and Paracelsian explanations of generation by harmonizing their most diverging views on the nature of life. In doing so, he provided a stimulating interpretation of matter–form through the notion of seed, which emphasized the celestial nature and powers of the substantial form while suggesting the atomic nature of matter. It is, therefore, unsurprising that Sennert's account of generation was widely read and discussed throughout the seventeenth century by an audience ranging from students of *Chymiatria* at the University of Marburg to experienced scholars such as Robert Boyle.

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