Alchimicorum periti operantur sicut periti medicorum. Albert the Great's Account on Alchemical Transmutation

Mario Loconsole

Abstract: This article deals with the most relevant philosophical side of Albert the Great's analysis of alchemy, aimed at clarifying what alchemical transmutation consists in and whether this process can ultimately be accomplished by men. The Dominican master handles the problem differently in the earlier commentary on Lombardus' *Libri Sententiarum* and in works like the *De mineralibus*, in which a more mature idea of the connection between art and nature is developed. In this respect, Albert's interpretation intersects with Avicenna's *De congelatione*, a fundamental text for the Latin medieval debate on alchemy, whose reception has shaped his understanding of the alchemical art. The Dominican master gradually assumes a more lenient position towards the claims of the alchemical process of transmutation, which he explains by resorting to the similitudes between alchemy and medicine and the comparison of artificial transmutation with natural processes such as the *generatio ex putrefactione* and the natural formation of minerals.

Keywords: Albert the Great; alchemy; art; nature; transmutation.

> Recommencer! Messire, c'est vingt-sept ans de labeurs qui viennent d'échouer! Vingt-sept ans! Et l'or allait bel et bien apparaître dans ce creuset lorsque vous avez fait cette malséante et profane irruption.
>
> Raymond Queneau, *Les fleurs bleues*

1. Introduction

There was apparently no knowledge of alchemy in the West until it was introduced through Arabic works, a process beginning in the twelfth century as a consequence of the many translations that appeared in border regions like

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Spain and Sicily.[1] Alchemy had actually never been integrated into the academic *curricula*, as it struggled to move from the status of *ars* to that of *scientia*.[2] Yet, already in the mid-thirteenth century, Vincent of Beauvais' claims in his *Speculum naturale* shows that the medieval scientific *milieu* was highly traversed by the knowledge of alchemical sources and the debate on alchemy, as it was already defined a mechanical art depending on the science of minerals (*ab illa parte naturalis philosophie que est de mineris*).[3]

Probably in the first years of the 1250's,[4] Albert the Great wrote his *De mineralibus*, which offers the most detailed account of the art of alchemy considering all of his works.[5] Albert's purpose is very different from Vincent's: Albert mainly dealt with alchemy to extend and complement his philosophical treatise on minerals, thus undertaking what Chiara Crisciani has already defined as one of the first attempts to mediate between natural – and Aristotelian – philosophy and alchemy.[6]

In fact, the lack of scientific sources on minerals and metals prompted the Dominican master to explore alchemical literature and the alchemist's operations. Moreover, Albert recounts that, as he was never able to find Aristotle's text on minerals – a text probably never written –, he decided to investigate the transmutation of metals and to devote a lot of time to visiting sever-

1 For a history of alchemy and its expansion into the Latin West, see, among others: CARUSI 1987; BURNETT 1992; CRISCIANI 1976(2); CRISCIANI, PEREIRA 1996; HALLEUX 1998; CALVET 2018.

2 On this, see: NEWMAN 1989; CRISCIANI 2008; CRISCIANI 1993, 189–192; OBRIST 1982, 40–44; MANDOSIO 1990–1991.

3 On alchemy in Vincent of Beauvais, see: AIKEN 1944; CRISCIANI 1976(1); NEWMAN 1991, 15–25; DÉPREZ-MASSON 1998; MOUREAU 2012.

4 Concerning the chronological order of Albert's philosophical works, see: WEISHEIPEL 1980; ANZULEWICZ 2011(1).

5 Among the studies focused exclusively on Albert's account of alchemy, see: PARTINGTON 1937; KIBRE 1980; ANAWATI 1981; HALLEUX 1982; JECK 1994.

6 CRISCIANI 1976(1), 38.

al *loca metallica* across Europe in order to compensate by experience for the absence of *auctoritates* concerning the nature of metals.[7]

Avicenna himself had already dealt with the question of the validity of alchemy in his commentary on *Meteorologica*, so that Albert already had an authoritative example allowing him to include his discussion on alchemy in his philosophical works.

2. The commentary on Lombardus' *Libri Sententiarum* and the demons' transmutation

While dealing with demonology and precisely with the possibility for demons to accomplish the transmutation of substances, his commentary on Lombardus' *Libri Sententiarum* is the first work in which Albert very briefly makes a point concerning the alchemical art,[8] although showing scant consideration to it.

In the article dedicated to the topic, Albert lists four kinds of transmutation. The first is the case of compounded medical remedies that together bring about effects different from those of the individual components. This is considered an example of transmutation, although a less evident and rather feeble one.[9]

7 ALBERTUS MAGNUS 1890 [*Min.*, III 1 1], 59a-b.

8 ALBERTUS MAGNUS 1893–1894 [*Sent.*, II d.7 a.8], 154a–157a. On this, see: JECK 1994.

9 ALBERTUS MAGNUS 1893–1894 [*Sent.*, II d.7 a.8], 155b: "Et ad hoc intelligendum, notandum quod transmutatio corporum est quatuor modis: quorum unus est miscibilium ad actum mixti tantum, in quo miscibilia remanent secundum veritatem consequentem suas proprias species, licet non remaneant secundum formam suarum specierum, sicut miscentur medicinae compositae […]. Aliud autem est quod consequitur actum mixti quantum est ex omnibus, ut in tiriaca resistere veneno consequitur actum mixti in quantum ex omnibus est quae recipiuntur in ea: sed confortatio cordis, et hepatis, etc., consequitur particularia recepta."

A second kind of transmutation occurs when bodies are reduced in their components, as it happens when fire strongly acts upon matter, dissolving the compounds.[10]

The third type of transmutation is directly related to the second. Albert presents several operations proper to alchemical practices – *liquaefactio*, *sublimatio*, *cibatio* and *distillatio* – through which it is possible to eradicate (*expoliatio*) the properties of a substance in order to replace them with new ones.[11] In these artificial practices, the use of heat – and therefore of fire – is fundamental, as the elimination of certain properties is the direct consequence of the separation of the material components (*expoliationem sequitur separatio de necessitate*).[12] Here, the German master queries the authority of an Avicennian passage – hereafter identified with its opening words *Sciant artifices* –, which is part of a highly successful text that circulated in the Middle Ages under the title *De congelatione et conglutinatione lapidum* or simply *De mineralibus*.[13]

Avicenna's text – which will be thoroughly investigated later – includes a strong criticism of alchemy that hinges on the inability of the alchemical art to provide alchemical metals with real substantial forms (*alchimici non dant formas substantiales*), being only able to deal with and modify the accidents of substances. Albert, following the core of this argumentation, adds that alchemical gold is unable to gladden the hearts and that alchemical sapphire cannot rekindle passions or cure illnesses of the trachea, unlike real gold and

10 *Ibid.* [*Sent.*, II d.7 a.8], 155b: "Alia est transmutatio corporis in sua componentia: sicut dicimus ignem transmutare corpora, eo quod habet qualitatem vehementer activam."

11 *Ibid.* [*Sent.*, II d.7 a.8]; 156a: "Tertia est per exspoliationem proprietatum, et dationem aliarum per liquefactionem et cibationem et sublimationem et distillationem, quibus operantur alchimici."

12 Cf. ALBERTUS MAGNUS 1916–1920 [*De animalibus* XX 1 4], 1281, 18.

13 Hereafter, Avicenna's work will be cited as *De congelatione*. The recent critical edition can be found in AVICENNA 2016.

real sapphire. In other words, alchemical metals do not have substantial forms (*non habent species*) and therefore cannot accomplish all functions that are performed by natural substances; for the same reason, as it is experienced (*experimentum est*), they do not last long and dissolve much more easily into their components once they are exposed to fire.[14]

The fourth and last type of transmutation is operated by nature (*per naturam*) according to the process through which the formal principle is developed in a substance by means of the action of celestial powers considered instruments of divine providence; indeed, this is a typical idea of Albert's philosophy, although it is only briefly sketched in his commentary on Lombardus' *Libri Sententiarum*.[15] Furthermore, Albert also refers to the peculiar phenomenon of the *generatio ex putrefactione* here, according to which, thanks the combination of several natural factors, animals like frogs and snakes are generated from putrefied matter.[16]

The analysis of his commentary on Lombardus' *Libri Sententiarum* encompasses many cornerstones of Albert's mature discussion on alchemy: the fundamental role of heat in alchemical operations, the relation between art and nature in transmutation and the topic of generation from putrefaction.

14 ALBERTUS MAGNUS 1893–1894 [*Sent.*, II d.7 a.8], 156a.

15 *Ibid.* [*Sent.*, II d.7 a.8]; 156a: "Quarta transmutatio est per naturam, et tunc puto, quod a Deo qui primus auctor omnium est, omnis forma substantialis detur virtute coelesti: et ab ipsa etiam dantur proprietates conservantes illas species. In hac autem transmutatione quaedam sunt de facili transmutabilia, ut quae sunt similium corporum, et generatio eorum est facilis, ut ranae, et serpentes: fiunt enim de facili parvo calore putrefactorum etiam per artem juvantem naturam, sicut dicit Avicenna quod ex capillis praecipue mulierum in humido calido sub sole positis in loco convenienti sub terra aliquantulum fiunt serpentes, et ex atriplice in concavo arboris putrefactae, et stillante pluvia, fiunt ranae."

16 Albert's reference text with regard to the generation of snakes from female hair could be the *Maʿādin wa-Āṯār ʿulwiyya* (*Meteora*, II 6), translated in Latin as the *De diluviis*; the text is edited in AVICENNA 1949. Cf. BERTOLACCI 2013, 37–54; BERTOLACCI 2014, 123.

Furthermore, alchemical transmutation is already described in a metallurgical way, as the process performing the composition and splitting up of elements and aiming to transmute the species of a given metal into another through artificial operations linked to the use of heat. From the very beginning in Albert's understanding, alchemy neither allows space for the employment of biological material nor for therapeutic purposes. Among Franciscan authors, the understanding of alchemy tended to, in many ways, intersect with the medical tradition of the elixir of long life and to include also substances derived from vegetal and animal organisms in alchemical practices. For the Dominican master, on the contrary, the art of alchemy exclusively deals with manipulating metals in a strict 'chemical' way.[17]

Nevertheless, at this early stage of philosophical reflection alchemy was still considered a kind of art that did not cooperate with nature, producing second-rate beings that lack substantial forms, which only resemble real metals. The alchemical art is extrinsic to any natural process, and artificial transmutation is much closer to the idea of a miracle rather than to be considered an accomplishable task operated by craftsmen.[18]

3. *Ars imitatur naturam*

The strong link between art and nature – often converging with the well-known axiom *opus naturae est opus intelligentiae* – later became a milestone of

17 On the organic and medical 'drift' of Latin alchemy, see, for example: Pereira 1995; Pereira 2003; Paravicini Bagliani 2003; Carusi 2014.

18 Cf. Albertus Magnus 1893–1894 [*Sent.*, II d.7 a.8], 154a: "Item, In tempore Antichristi erit daemon majoris potentiae quam fuerit tunc, vel sit nunc: et tamen tunc non poterit facere vera miracula: ergo nec nunc veras transmutationes. Quod autem tunc non possit facere vera miracula, videtur in epistola II ad Thessal. II, 9 ubi videtur dici, quod erunt miracula illa secundum operationem Satanae in prodigiis et signis mendacibus: ergo videtur, quod non vere corpora ad formas aliquas transmutant."

Albert's natural philosophy, being at the base of his mature account of alchemy after the foundation of the *studium generale* in Cologne. Referring to the Aristotelian principle of mimesis between art and nature,[19] Albert frequently addresses the idea that both operate on a common basis: art, as it is also a way to imitate nature, represents the attempt to artificially reproduce the conditions in which nature itself operates. The real *artifex* thus needs in-depth knowledge of nature in order to be able to arrange and choose the appropriate moment so that a certain process occurs as planned and desired by him. It is hence not by chance that in the *De mineralibus* alchemy is defined as the art that imitates nature best among all arts (*inter omnes artes maxime naturam imitatur*)[20]; thus, the core of the criticism against alchemy raised in his commentary on Lombardus' *Libri Sententiarum* is completely overthrown.

It can sometimes happen that art violently forces nature to operate, that is, to a certain degree in contrast to nature or extrinsically.[21] However, the result of this action will never be as good as that of an *artifex* who is – as the physician or the alchemist – a *minister naturae*, able to operate in accordance with nature and to adjust to its principles:

> Ille [motus artis] est non a natura, sed a principio extrinseco, et est cum violentia aliqua, nisi quando artifex est naturae minister, sicut est medicus et alchimicus aliquando.[22]

19 On this: Flasch 1965; Muratova 1978. Concerning the relation between alchemy and nature, see: Obrist 1996; Carusi 2003; Newman 2004; Pereira 2015.

20 Albertus Magnus 1890 [*Min.*, III 1 2], 61b.

21 Albertus Magnus 1960–1964 [*Metaph.*, XI 3 2], 536, ll. 88–90: "Nec potest esse motus artis, quia tunc non esset naturalis, sed violentus nec umquam induceret aliquam formam substantialem."

22 *Ibid.*, [*Metaph.*, XI 3 2], 535, ll. 91–94.

The way to produce artificial things is twofold, and when art benefits nature – as it is sometimes the case in alchemy, the operations of which consist in mixing, digesting and transmuting bodies (*mixturae et digestiones et corporum transmutationes*) –, the process will follow the dynamics of nature, reaching the same results as nature:

> In artificialibus tamen figura est principalis forma, sicut patet cuilibet, nisi forte ars sit naturae iuvamentum, sicut in alchimicis et in his artibus quarum operationes sunt mixturae et digestiones et corporum transmutationes.[23]

Here, the gap between his commentary on Lombardus' *Libri Sententiarum* and his philosophical works is evident: art is not only limited to the production of *figurae* devoid of any specific form beyond their material form, but under certain conditions it may also produce real substances similar to natural ones. Nevertheless, art can confer a substantial form to a being only if it meets the natural principles,[24] while what is produced without following them will merely resemble real substances. The fact that art may operate according to or opposing nature is highly relevant. This is a particularly crucial difference with regard to medicine and alchemy, which are the arts that best understand the dynamics of the generation and corruption of beings.

In Albert's philosophy, art – even at its peak – never steps outside the borders established by nature, being art nature's *minister*, just because of nature's wider range of action. Here, the Aristotelian *topos* of the inferiority of the arts – which enjoyed great popularity in the 13th century – is certainly confirmed: nature cannot be exceeded or improved but only imitated. The

23 *Ibid.*, [*Metaph.*, V 1 3], 216, ll. 16–20.

24 ALBERTUS MAGNUS 1890 [*Min.*, III 1 9], 70b: "Sola ars non dare potest formam substantialem."

primary goal of any art is just to map the border of nature and to understand and simulate its processes.[25] Therefore, when art operates *cum violentia*, its operations will always be less effective; this is the case when alchemists, refusing to imitate nature and to adjust their actions to natural processes, fail in pursuing their own purposes.[26]

This is the biggest hurdle that they face regarding the transmutation of metals: alchemists not only have to possess solid practical skills – to be simple *mechanici* is not sufficient[27] –, they also need to have solid knowledge of how nature operates in itself.

Moreover, the informing powers of nature derive from the exercise of a superior intellect that moves the stars and uses a perfect instrument such as the natural heat. The coordination of these perfect principles of nature is smoothly designed and proportioned to be successful in every natural generative process. Of course, nature may fail, but this only happens by accident. On the other hand, the human intellect is subordinate to this superior intellect ruling nature, just like its instruments are clearly weaker. The complexity of pursuing alchemical transmutation may be a sign of the imperfect knowledge of the craftsman or it might as well be due to the means he uses, which are

25 Cf. OBRIST 1996, 227–232. It is well known that in Roger Bacon the relation between art and nature takes on a different balance, in which art seems to assume definitely a much more relevant role. In this respect, see: PEREIRA 1992, 123–133.

26 ALBERTUS MAGNUS 1890 [*Min.*, III 2 2], 76b: "Propter quod etiam in alchimicorum operatione probatur error incidere: quia propter multam mixturam alborum vel citrinorum corporum cum argento vivo in confectione quam elixir vocant, intra siccum super humidum in metallis eorum, et non sunt fortiter conjacentia et permixta: et ideo frequentissime scinduntur quando producuntur metalla quae faciunt alchimici, nisi valde imitentur naturam, et opus naturae attingant."

27 The criticism Albert raises against Ibn Juljul is explicative: ALBERTUS MAGNUS 1890 [*Min.*, III 1 4], 64a: "Haec autem inconvenienter et stulte dicta sunt: quoniam ipse Gilgil mechanicus et non Philosophus fuit, sed de mechanica alchimia praesumens praesumpsit mentiri de physicis."

appropriate only to a certain degree. This intrinsic inferiority of art is at the base of the relation between human and natural operations in Albert's philosophy.[28]

Hence, the best craftsman is the one that imitates the processes of nature to the greatest possible extent, operating almost as if he let nature itself operate in his place. For the same reason, choosing the favourable moment to carry out a certain operation is fundamental: alchemists should carefully consider the influence of the stars, which are, in Albert's cosmology, the major formal principle shaping the sublunary world.

Thus, it is not surprising that Albert quotes the idea – indeed well rooted in hermetic texts – of the correspondence of each planet to a kind of metal.[29] And – as declared in a passage on sea tides – since metals receive their formal features through the influence of the planets, expert alchemists (*bene periti*) avoid acting hastily; instead, they choose to wait for the opportune time (*opportuna tempora*), for example, when the moon is in a favourable place and rising in the sky, so that their operations will benefit from celestial virtues (*opus adiuvatur virtute caelesti*).[30]

Hence, according to Albert, the alchemical art should not be considered

28 *Ibid.* [*Min.*, I 1 3], 5a-b: "Cujus causa est, quia virtutibus coelestibus certis et efficacibus moventur virtutes in materia lapidum et metallorum existentes quando materia operatur: et illae virtutes sunt intelligentiarum operationes, quae non errant nisi per accidens, ex inaequalitate scilicet materiae. In arte autem nihil est horum, sed potius mendicata suffragia ingenii et ignis."

29 *Ibid.* [*Min.*, III 1 6], 66a. On Albert and Hermes, see: STURLESE 1980, 615–634.

30 ALBERTUS MAGNUS 1980 [*De caus. propr. el.*, I 2 8], 74, ll. 55–63: "Hi etiam qui in transmutatione metallorum et lapidum operantur, quos alchimicos vocamus, temporibus incrementi lunae, et confortante et ascendente ea a circulo hemisphaerii, puriora producunt metalla et puriores perficiunt lapides, et magis figuntur spiritus et certius operantur, et praecipue, quando sunt bene periti, non praecipitantes opera sua, sed exspectantes opportuna tempora, quando opus adiuvatur virtute caelesti."

a mere practical learning, but rather a system of operative knowledge that neither ignore phenomena such as the generation and corruption of beings or the combination and dissolution of elemental mixtures, nor the forces, principles and effects through which the heavens rule the world. In this respect, alchemy can indeed be compared to medicine: both arts are not merely a matter of manipulating things or bodies, but they require a high degree of philosophical knowledge.

4. Challistenes and Hermes: two accounts on alchemical transmutation

In his *De mineralibus*, Albert holds a position on alchemy that is certainly different: the purpose of dealing with alchemy is not, as in his commentary on Lombardus' *Libri Sententiarum*, to reject the higher ambitions of the alchemist's artificial operations, but rather to provide an explanation of how the transmutation of species may succeed when carried out artificially on the basis of natural principles. Before dealing with the main question (*utrum species metallorum possint ad invicem trasmutari*),[31] Albert refers to two different accounts – which he is about to reject – of the substantial forms of metals and the transmutation of their species; in addition to these, he presents the *opinio Avicennae* which guides Albert's conclusive argumentation and will be considered later.

The Dominican master presents the first opinion as shared by several alchemists such as Challistenes, who considered the form of gold as the sole form of all metals (*sola auri species est forma metallorum*), while any other kind of metal was considered an incomplete being (*incompletum*) on the way to perfection (*via ad perfectionem*). According to this doctrine, the preparation of a

31 ALBERTUS MAGNUS 1890 [*Min.*, III 1 9], 70b.

kind of medicine, called elixir, able to remove all infirmities (*aegritudines*) from imperfect metals, would allow them to reach their state of perfection, that is, to become gold.[32]

The reference here may be – as has already been noticed by Halleux[33] – the *Liber trium verborum*, attributed to Khalid bin Yazid, which entails both the idea that metals are imperfect beings and that alchemy has the goal to perfect their incomplete nature.[34]

The second doctrine is attributed to Hermes, Gilgil (probably Ibn Juljul)[35] and Empedocles, who maintained that many species of different metals are present in every metal (*in quolibet metallo plures esse species et naturas metallorum*), so that they always possess both a hidden form (*occulta*) and a manifest form (*manifesta*); lead, for instance, is believed to be lead on the outside but gold on the inside, having one form which is hidden and one which is directly perceivable.[36]

This position appears to be quite close to the idea expounded in the pseudo-Aristotelian *De perfecto magisterio*, in which the same distinction between metal qualities that are manifest and those that are hidden *in profundo* can be detected: in this case, alchemy would be nothing but the art to reveal the concealed qualities of metals at the expense of the manifest ones.[37]

32 *Ibid.* [*Min.*, III 1 7], 68a.

33 HALLEUX 1982, 72.

34 Cf. KHALID IBN YAZID 1702 [*Liber trium verborum*], 189a: "Per istam enim artem metalla, quae in minera imperfecta, reducuntur ad perfectionem, de corruptione ad incorruptionem"; *Ibid.*, 189b: "Infirmitates oportet destruere in igne et per gradus igni." On the figure of Khalid ibn Yazid see: ULLMANN 1978; BACCHI, MARTELLI 2009.

35 HALLEUX 1982, 71.

36 ALBERTUS MAGNUS 1890 [*Min.*, III 1 8], 69b.

37 PS.-ARISTOTELES 1702 [*De perfecto magisterio*], vol. I, 639a: "Omnis etiam elementata res quator in se retinet qualitates activas et passivas, exterius sive interius […]: res si exterius est calida et humida, et mollis, interius est frigida et sicca et dura: quia omni rei ma-

The explicative case of lead reported by Albert is quite similar to the one present in the *De perfecto magisterio*: lead is cold and dry on the surface, at its core, however, it is hot and wet, which are the qualities of gold.[38]

Albert rejects the hermetic thesis using an Aristotelian argument and supporting it with a real alchemical *experimentum*. Since metals have to be considered homoeomerous substances, it is wrong to attribute to them a multifaceted nature and composition, as the matter that constitutes them is the same in every part.[39] This according to Dominican master is proven by the fact that if gold and lead are exposed to the action of fire, they react differently: the first will not be damaged, while the second will simply burn and its matter will be corrupted. Thus, if fire acts upon lead, it will never reveal a hidden golden part in it, as Hermes and his followers would expect.[40]

According to Callsthenes' opinion, all metals except gold are nothing but aborted foetuses of nature (*abortivi foetus naturae*) that are formally not fully developed;[41] Hermes' account, on the other hand, admits the coexistence of multiple formal principles and material compositions within the same substance. Yet, a strong hylomorphic tendency such as that structuring Albert's philosophical thought could not share these claims.

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nifestum suo contrario occulto: scias, quia est multum secretum. Unde si perfecte cognoveris exteriorum rerum consistentias, et interiores de levi tu cognosces, et e converso. Et si occulta manifestare sciveris, scies et manifesta occultare. Sed scias in quibusdam rebus ut in plumbo, totum manifastatum occultari, et totum occultum manifestari." A quite similar idea is presented in the KHALID IBN YAZID 1702 [*Liber trium verborum*], 189a: "Oportet ergo nos occultare manifestum, et id quod est occultum facere manifestum."

38 PS.-ARISTOTELES 1702 [*De perfecto magisterio*], vol. I, 641b: "Plumbum in sua altitudine frigidum et siccum est […]: in suo profundo est aurum calidum et humidum."

39 ALBERTUS MAGNUS 1890 [*Min.*, III 1 7], p. 69b.

40 *Ibid.* [*Min.*, III 1 7], 70a.

41 *Ibid.* [*Min.*, III 1 7], 68a.

Against the first opinion stands the principle according to which every regularity in nature is justified by a formal principle sustaining it; moreover, it would be totally absurd to assume each metal having different characterising and specific features – such as weight, colour, etc. – as deriving from the sole form of gold.[42] Against the second one Albert opposes the tendency to not postulate in nature more than the strict necessary principles in order to explain its dynamics: there is no need to affirm that a being must possess more than one substantial form.

Moreover, Albert shows how the transmutation of metals cannot be explained following the hermetic idea of the multiple coexistence of substances in the same being, while Callisthenes' opinion is even hyperbolic: if we do admit the existence of just one form for all metals, the act of transmutation in itself would not be possible (*alchimia non permutat*).[43]

5. Avicenna, Roger Bacon and Albert the Great: *transmutatio* and *prima materia*

Concluding his long digression on alchemy in his *De mineralibus*, Albert quotes almost the entire passage *Sciant artifices*, an excerpt of the already mentioned Avicennian *De congelatione*.[44] The Dominican master is actually one of the first mediaeval authors to restore the Arabic origin of the text, which was most of the times wrongly considered Aristotelian.[45] The *De conge-*

42 *Ibid*. [*Min*., III 1 7], 68b–69a.

43 *Ibid*. [*Min*., III 1 7], 68a.

44 On alchemy in Avicenna and in pseudo-Avicenna, see: THORNDIKE 1923–1958, vol. II, 249–253; RUSKA 1934; STAPLETON, AZO, LEWIS 1962; ANAWATI 1971; HASNAWI 2002; MOUREAU 2009; MOUREAU 2016, 9–32; CALVET 2018, 50–59.

45 ALBERTUS MAGNUS 1890 [*Min*., III 1 9], 70b: "Ex omnibus autem his inductis possumus considerare, utrum verum sit quod quidam Aristotelem dicunt dixisse, cum secundum rei veritatem dictum sit Avicennae, quod videlicet sciant artifices alchimiae species per-

latione is indeed that part of the *Kitab al-Sifa'* in which Avicenna briefly considers the formation of stones and metals; the text was translated by Alfred of Sareshel around 1200 and was annexed to his commentary to the *Meteorologica*,[46] in which a proper analysis of minerals is missing.[47]

In the passage *Sciant artifices*, Avicenna expressed his scepticism concerning the possibility of operating alchemical transmutation: alchemists, he says, may be able to purify a metal or to colour its substance in order that it will acquire a desired colour – so that, for example, a certain metal looks golden –, but they would never be able to transmute the species of metals.

This scepticism, which was tempered in the eyes of medieval scholars by the circulation of many apocryphal alchemical works attributed to Avicenna, is grounded in two main points.[48] First of all, the Aristotelian postulate of the inferiority of art with respect to nature plays a central role. Thus, craftsmen are seen as being able to create something similar to the products of nature – although they sometimes struggle in doing so –, but never as capable of reproducing the natural operation itself.[49] Second, alchemists are hindered by the limits of their knowledge and of their technical instruments; Avicenna, as Albert, supports the idea that the specific differences of minerals are unknowable, while other *sensibilia* that humans are able to perceive and

mutari non posse."

46 On the reception of Aristotle's *Metereologica* in the Arabic and Latin philosophy, see LETTINCK 1992; VIANO 2002.

47 On the reception and spread of Avicenna's text, see: MANDOSIO, MARTINO 2006; CARUSI 2014–2015; CRISCIANI 2018.

48 Cf. NEWMAN 1989, 427–430.

49 AVICENNA 2016 [*De min.*], 42–43, ll. 144–148: "Et artifices faciunt gelationem fere sensibilem artificialiter, quamvis artificialia non eo modo sunt, quo et naturalia, nec tam certa, licet propinqua sint et similia. Et ideo creditur, quod compositio eius naturalis sit hoc modo vel vicina huic, sed ars debilior est quam natura nec consequitur eam, licet multum laboret."

get acquainted with – like weight or colour – are nothing but accidents. Hence, if the specific differences are unknown, how could it be possible to modify them? And once one was able to modify the formal features of a metal, how could one be aware of their transmutation? Avicenna is clear in stating that the highest achievement that alchemists may accomplish is to treat and manipulate the accidents; but the transmutation of species is not to be confused with modifying accidental features, which are just the external expressions of the form.

However, at the end of Avicenna's passage, translated by Alfred of Sareshel, it is stated that one metal cannot be transmuted into another unless it is reduced to its prime matter (*nisi forte in primam reducantur materiam*).[50] The interpretation of this sentence became crucial for the constitution of the Latin alchemical tradition and it served as tipping point for Albert's interpretation of the process of artificial transmutation.

What does it mean to admit that transmutation is possible if and only if metals are reduced to their prime matter? The passage is problematic be-

50 The entire Avicennian passage, AVICENNA 2016 [*De min.*], 43–44, ll. 164–183: "Sciant autem artifices alkimie species vere permutari non posse, sed similia illis facere possunt, et tingere rubeum citrino ut videatur aurum, et album etiam tingere colore quo volunt, donec sit multum simile auro aut eri, possuntque plumbi immunditias abstergere, verumtamen semper erit plumbum et si videatur argentum, sed obtinebunt in eo qualitates aliene, ut errent in eo homines, ut qui accipiunt salem et salem amoniacum. Ceterum, quod differentia specifica aliquo tollatur ingenio, ego non credo possibile et non est, quod una complexio in aliam convertatur, quia ista sensibilia non sunt differentie quibus permutantur species, sed sunt accidentia et proprietates. Differentie autem eorum non sunt cognite, et cum differentia incognita sit, quo modo potest sciri, utrum tollatur necne, vel quomodo tolli possit? Sed expoliatio accidentium ut coloris, vaporis, ponderis, vel saltim diminutio, non est impossibilis, quia contra hoc ratio non stat. Ceterum proportio compositionis istarum substantiarum non erit in omnibus eadem. Hec igitur in illam permutari non poterit, nisi forte in primam reducantur materiam, et sic in aliud, quam prius erat, permutetur. Hoc autem per liquefactionem non fit, sed accidunt ei ex hoc res quedam extranee."

cause, first, Avicenna leaves little room for the case of alchemical transmutation in a text that is basically meant to demolish its premises; second, this hesitant hypothesis is clearly unacceptable in Aristotelian terms, as it nature never allows for the occurrence of prime matter as it is.

It is probably for this reasons that authors like Arnold of Saxony, Vincent of Beauvais and Roger Bacon raised doubts regarding the attribution of the *Sciant artifices* to an Aristotelian author,[51] although the *De congelatione* was unanimously attributed to Aristotle himself or, as in the case of Albert, to Avicenna. Bacon actually foreran Albert in analysing what he called the *resolutio in materia prima* as described in the *Sciant artifices*, offering a possible interpretation regarding the process of the transmutation of species.

At the end of his commentary to the pseudo-Aristoteles's *De plantis* – written between 1240 and 1250 –, Bacon presents some questions on the grafting of plants, investigating if this kind of operation might be considered an act of plant transmutation.[52] Therefore, the last question is supposed to settle whether species of plants can transmute into one another (*utrum una species plante in aliam possit transmutari*). In this text, Bacon plainly postulates the capacity of nature (*per naturam*) to operate the transmutation of plant species, but he has to face a strong objection presented by what the Franciscan considered at that time an Aristotelian statement: the *Sciant artifices*. Hence, in Bacon's view, plant transmutation is impossible according to Aristotle, as the only way to perform this process requires the absurd *resolutio/reductio in primam materiam*.

In order words, Bacon had to conciliate the experiential data that con-

51 On this, see: PEREIRA 2017.

52 For the Latin philosophical debate on the transmutation of plants in Middle Ages, see: PANARELLI 2019.

firmed numerous transmutations of plants – the pseudo-Aristotelian *De plantis* itself approved of and shared this idea – with the Aristotelian-Avicennian statement in the *Sciant artifices* against artificial transmutation. In doing so, the Franciscan master attributed a double definition to the expression *prima materia* (*duplex est materia prima*): there is a *materia prima remota*, which cannot be reached at all – the Aristotelian and metaphysical prime matter –, and a *materia prima proxima*, which plays a role in the process of transmutation.[53]

As Pereira has shown,[54] what Bacon means by *materia proxima* is the *materia naturalis*, that is, the third level of the scale of matter as Bacon understands it, which starts from prime matter and the matter of the creation (also called *materia universalis*). Natural matter coincides with the four sublunar elements, the existence of which is confirmed by many *experimenta*, when substances are dissolved. Thus, this *materia pima proxima* is attainable and can be manipulated; this is the degree of matter that alchemists are acquainted with in exercising their art.

Nevertheless, at a deeper analysis of the *Sciant artifices*, it appears that the text was transmitted to Latin scholars bearing several inaccuracies due to Alfred's translation. One striking example concerns the problematic concept of the *reductio* or *resolutio in primam materiam*: Avicenna in particular speaks more precisely of 'composition' and of the 'relation between the elements', while Alfred of Sareshel translates 'prime matter'. Hence, when Avicenna intended the simplest component of matter – that is, the elements, the mixture of which composes the substances –, Alfred attributed to the text a much more metaphysical intention.

53 ROGERUS BACON 1932 [*Quaestiones super de plantis*], 251.
54 Cf. PEREIRA 2017. Cf. also PEREIRA 2014.

Bacon's interpretation is thus pretty close to the intention of the *Sciant artifices* in considering first matter the level of matter constituted by the elements; in doing so, the Franciscan almost reconstructs the original meaning of the Avicennian passage. The concept of prime matter as such does not appear in the Arabic text: as a matter of fact, Avicenna admits that transmutation is possible only *in extremis* and by decomposing substances into their elemental components, namely the elements.[55]

Albert's understanding of the passage provides a logical and philosophical coherence that follows the same path as chosen by Bacon. Although the Dominican master does not draft a proper question on the topic, he presents a precise hermeneutic interpretation in dealing with it: when he explicitly quotes the *Sciant artifices* – reconsidering the entire criticism of the process of transmutation –, he paraphrases the focal point of the passage in this way:

> Ipse [Avicenna] subjungit, quod non permutantur species, nisi forte in primam materiam et in materia metallorum reducantur.[56]

Albert quotes Alfred's translation slightly modified, but the change is quite meaningful: according to the Dominican master, the *reductio in materia prima* is equated with a *reductio in materia metallorum*. When Albert speaks about the prime matter of metals, he refers to something quite similar to what Bacon called *materia proxima*, that is, the prime elements that compose the substances in a strictly physical sense.[57] Numerous passages in Albert's *De mine-*

55 The Arabic text can be found in AVICENNA 1927. I am indebted to Prof. Paola Carusi for suggesting to look into the interpretation of the Arabic text and the literal translation of it. Moreover, a French translation of the same passage can be found in MOUREAU 2016, 14–17.

56 ALBERTUS MAGNUS 1890 [*Min.*, III 1 9], 71a.

57 Cf. *Ibid.* [*Min.*, V 1 1], 98a: "Ille qui convenienter intendit metallum ad metallum conver-

ralibus, in which he uses the expression *materia prima* with reference to the elements or the first components of the substance of mineral bodies, validate this hypothesis;[58] moreover, an excerpt from Albert's *Metaphysics* is even clearer in this respect, crossing – at once – the concepts of *trasmutatio*, *reductio*, *prima materia* and *elementa*:

> Et quaecumque sic per corruptionem habitus transmutantur ad invicem, haec, si debeat fieri regressus a privatione ad habitum, oportet redire ad materiam primam. Ut si ex mortuo debeat fieri animal, oportet, quod mortuum resolvatur ad primam materiam quae est elementa quatuor, et deinde per mixtionem et complexionem et compositionem horum fiat animal.[59]

Hence, in view of interpreting Avicenna's text, Albert considered the first matter of metals as the composition of sulphur and quicksilver, which constitutes the material substrate of all metals and is derived from a specific aggregation of the four elements.

To sum up, Avicenna's *Sciant artifices* was transmitted through Alfred of Sareshel's translation to Latin scholars with some inaccuracies, which prompted authors like Bacon and Albert to interpret the passage consistently and in accordance with Aristotelian physics. The passage conveyed an authoritative criticism of the alchemical art, undermining its principles and ren-

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tere, oportet quod primo deducat ipsum ad naturam primam, hoc est, generi metallico proximam. Tunc enim aptitudine sua juvata virtutibus disponentium, facile naturam accipit et veram speciem metalli quod intenditur."

58 Cf. *Ibid.* [*Min.*, III 1 2], 60b: "Per artem autem quae jam in Meteoris tradita est, scimus quod omnium liquabilium prima materia est aqua." *Ibid.* [*Min.*, III 1 4]; 64a: "Haec igitur materia liquabilium et materia prima et remota una communis, hujusmodi videlicet humidum." *Ibid.* [*Min.*, III 1 2], 61b: "Patet igitur primam materiam esse metallorum humidum unctuosum subtile, quod est incorporatum terrestri subtili fortiter commixto, ita quod plurimum utriusque non tantum cum plurimo utriusque, sed etiam in plurimo utriusque."

59 ALBERTUS MAGNUS 1960–1964 [*Metaph.*, VIII 2 3], 404, ll. 81–88.

dering the process of artificial transmutation practically impossible, unless someone was able to decompose metals into their components – although this last hypothesis is presented with explicit caution. Nevertheless, Bacon and Albert were able to read Avicenna's text almost with a philological insight, nearly reconstructing its original words and wisely interpreting it in the light of a profound knowledge of Aristotelian works.

6. What is it like to transmute a metal?

Bacon's exegetic concern and Albert's interpretation reveal the need of Latin scholars to tame Avicenna's passage, which was transmitted in quite an ambiguous translation. In addition, the topic of the transmutation of substances was a hot one: on the one hand, it undermined the Aristotelian assumption of the eternity of species,[60] while on the other, from a religious perspective, it almost excessively exalted the power of humans with respect to God.

Surprisingly enough, in Albert's *De mineralibus* precisely the hypothesis of the *reductio* – which, as said before, the Arabic philosopher presented with great caution and almost as a preposterous argument – was used to explain how alchemical transmutation technically works. Albert indeed considers the *reductio in primam materiam* or *in materiam metallorum* as the first step that the alchemist must perform in order to eventually operate his coveted *transmutatio metallorum*.

Albert, pushing at the extreme Avicenna's suggestion, presents alchemical transmutation as the operation in which the decomposition of a metal into its own components – namely sulphur and quicksilver – is followed by a

60 On the problem of the eternity of species, see: PORRO 2009.

reorganisation of them in a new form.

And although the Dominican master shares with Avicenna both the idea of the inferiority of art with respect to nature and the claim that the specific differences of metal species are unknowable, it is precisely through his understanding of the dynamics between art and nature developed in the course of the interpretation of Aristotle's work in Cologne that he can give value to the operations of the alchemists. In some particular cases, like alchemy and medicine, art is able to imitate nature almost assimilating to it, in a process in which human and celestial intelligences are conflated. According to an often-repeated metaphor, the instruments of nature are just like the hand of the craftsman, while the intelligence of the *artifex* has the very same function as the informing virtues of the stars. Thus, when the *artifex* operates according to nature, the conceptual division between artificial and natural operations is alleviated, so that the borders between them almost blur; therefore, to establish a strict dichotomy here – discriminating the products of art as less valuable – does not stand to reason.[61] At this precise point, even the alchemist is able to transmute a metal just as nature produces it, as long as the former follows the latter.

For this reason, experts in alchemy are said to operate just like experts in medicine:

> Alchimicorum periti operantur sicut periti medicorum: medici enim periti per medicinas purgativas purgant materias corruptas et facile corruptibiles et impedientes sanitatem quae est finis intentus a medico, et postea per confortantia na-

61 ALBERTUS MAGNUS 1890 [*Min.*, III 1 9], 71a. Cf. *Ibid*. [*Min.*, II 3 3], 51b: "Ars resolvitur in principium naturae: quia principium artis prout diximus natura est, secundum quod exivit a suo caelesti principio, cuius principium est intellectus practicus, sicut idem intellectus est principium artis."

turam juvant virtutem naturalem, ut digerendo sanitatem naturalem inducant.[62]

And it is actually because nature operates effectively (*effective*) – while art operates as its instrument (*organice et instrumentaliter*)[63] – that physicians achieve their goals. Indeed, they rely on purgative medicine in order to cure a patient so that they are able to rid themselves of all corrupted matter hindering the process of healing. By means of cleansing remedies they remove corrupt matter that prevents health and thereafter, by strengthening nature, they support the power of nature, directing it so as to bring about natural health. Thus, health is brought about by nature as the efficient cause and also by art as the means and instrument.[64]

Skilful alchemists proceed in entirely the same way when they transmute metals: first, they thoroughly cleanse the material of quicksilver and sulphur, which – as said before – represent the fundamental material structure of all metals. When it is clean, they strengthen the elemental and celestial powers in the matter according to the proportion of the mixture of the metal they intend to produce. In this case also, natural powers then do the work, while art is the technical instrument allowing alchemists to produce and make real gold and real silver:

62 *Ibid*. [*Min.*, III 1 9], 71a.

63 *Ibid*. [*Min.*, III 1 9], 71a: "Ita enim procul dubio sanitas effectus erit naturae effective, et artis organice et instrumentaliter."

64 Something similar is stated in the pseudo-Avicennian *Declaratio lapidis*, a text that, at this point, can be considered part of Albert's readings with reasonable certainty: PS.-AVICENNA 1659–1661 [*Declaratio lapidis*], vol. IV, pp. 987: "Sed solummodo artifex organice et instrumentaliter operatur formam auri et argenti ex materia ad hoc disposita eliciens et motum dans naturae, ut per temperatam artis coctionem excitata de potentia in actum deducatur."

> Per omnem autem eumdem modum dicemus operari alchimicorum peritos in transmutatione metallorum. Primo enim quidem purgant multum materiam argenti vivi et sulphuris, quam inesse videmus metallis, qua purgata, confortant virtutes materiae quae insunt ei elementales et coelestes ad proportionem mixtionis metalli quod intendunt inducere: et tunc ipsa natura operatur, et non ars, nisi organice, juvando et expediendo, ut diximus: et sic verum aurum et verum argentum educere et facere videntur.[65]

The technical alchemical process appears to be essentially bipartite. A first phase consisting in the *expoliatio* or the *reductio* (or, to use Albert's medical metaphor, the *purgatio*) of the substance of a certain metal – which reduces it to its mere material components – is followed by the composition of a new substance, through the combination of the same elements that were previously decomposed. A desired *proportio mixtionis* leads to the production of a new substance designed by the *artifex*, who lets nature operate itself by strengthening natural forces.

For this reason, alchemical transmutation is compared to another process operated by nature, namely the *generatio ex putrefactione*, which is proper to animated beings such as plants and imperfect animals:

> Coelestis enim virtus valde communis est, et accipit determinationem per virtutes eorum quae sunt subjectum ejus in rebus commixtis: hoc enim modo virtutes coelestes operari videmus in tota natura generatorum, maxime in his quae ex putrefactione generantur. In his enim videmus virtutes stellarum influere virtutes in id ad quod convenientiam habet materia. Alchimia autem per hunc modum procedit, scilicet corrumpens unum a specie sua removendo: et cum juvamine eorum quae in materia sunt, alterius speciem inducendo[66].

65 ALBERTUS MAGNUS 1890 [*Min.*, III 1 9], 71a. Cf. *Ibid.* [*Min.*, III 1 9], 71b: "Omnium operationum alchimicarum, melior est illa quae procedit ex eisdem ex quibus procedit natura, sicut ex purgatione sulphuris per decoctionem et sublimationem, et ex purgatione argenti vivi, et bona permixtione horum cum materia metalli: in his enim ex virtutibus horum omnis metalli species inducitur."

66 *Ibid.* [*Min.*, III 1 9], 71b.

The theory of generation from putrefaction goes back to Aristotle, but is understood by Albert in the light of the synthesis of Avicenna's and Averroes' theories.[67] As such, putrefaction, which is the last stage of corruption[68] and a process that is opposite to generation[69], is considered very close to the process of *expoliatio* and *reductio*, which characterises the artificial transmutation of alchemy. Both are processes of extreme decomposition of matter from which – through the action of given informing forces – new substances can be generated[70].

Hence, transmutation is never a passage *de actu in actum*, but always *de potentia ad actum*.[71] The goal of reaching the stage of prime matter explicitly has the function to dissolve a metal's initial form in order to obtain a kind of matter that has the potency to assume another form. The process then will follow the passages:

actuality → potentiality → actuality

67 On the theory of *generatio ex putrefactione*, see: HASSE 2007; LENNOX 1982; KRUK 1990; HENRY 2003; VAN DER LUGT 2004, 131–187; BERTOLACCI 2013, 37–54; TAKAHASHI 2017, 158–163.

68 Cf. ALBERTUS MAGNUS 2003 [*Meteor.*, IV 1 2], 211–213.

69 Cf. *Ibid.*, [*Meteor.*, IV 1 4], 214–216.

70 It is once again useful to underline the similarity between Albert and pseudo-Avicenna's *Declaratio lapidis*. PS.-AVICENNA 1659–1661 [*Declaratio lapidis*], vol. IV, 989: "Huius artis fundamentum et operis exordium est corporis in aquam resolutio, quod Philosophi corruptione seu putrefactione nominant, sine qua circularis metallorum transmutatio non fit ad invicem. Corruptio unius est generatio alteri. Quia generationis et corruptionis eadem sunt principia."

71 Also, the transmutation of plants follows the same rules. Cf. ALBERTUS MAGNUS 1867 [*De veget.*, V 1 7], 313: "Quod autem quidam dicunt, non posse species ad se invicem permutari, hoc quidem verum esse scimus, quod non est transmutatio de actu ad actum, sed de potentia ad actum. In terra autem destituitur materia ab actu uno, et fit potentia ad alterum, et sic fit transmutatio plantae ad plantam. Et hic quidem est modus hujusmodi transmutationis plantae in plantam."

initial form → prime matter → new form

In the case of alchemical transmutation, the initial form stands for the metal the alchemist has at his disposal in the beginning, while the new form is the form of the metal that is produced by the process. For example, in order to produce silver starting from lead, the lead must first be purged so as to break down its material structure into sulphur and quicksilver or a mixture of these; after treating the obtained components – which are the first matter and something like the *universalia*[72] of every metal –, they assume the form of silver.

Moreover, the movement from potentiality to actuality and vice versa is undoubtedly facilitated by the closeness to matter of minerals (*vicinitas ad elementa*). In fact – as it is stated in a passage of the *De nutrimento et nutrito* –, the reason why minerals cannot serve as nourishment for animals is their proximity to the elements of their matter; this feature offered a host of opportunities for alchemists:

> Signum autem, quod haec *[sc. mineralia]* vicina sunt elementis, est quod facilis est eorum transmutatio ad invicem sicut et elementorum. Quod patet in operibus alchimicis, in quibus de facili unum metallum alterius recipit colorem et proprietatem.[73]

This so-called *vicinitas ad elementa* is an often-used concept when Albert explains transmutation of plants and minerals.[74] The transmutation can occur

72 ALBERTUS MAGNUS 1890 [*Min.*, IV 1 1], 83a.

73 ALBERTUS MAGNUS 2017 [*De nutr. et nutr.*, 1 1], 2, ll. 21–31.

74 Cf. ALBERTUS MAGNUS 1890 [*Min.*, I 1 5], 8a: "Mineralia proxima sunt elementis, et elementa secundum parum in ipsorum materiis transmutantur: propter quod etiam in eis qualitates elementorum remanent parum alteratae." Cf. ALBERTUS MAGNUS 1980 [*De caus. propr. el.*, I 1 2] 52, ll. 4–13: "Corpora quaedam magis recedunt ab elementis in operationibus suis, et quaedam minus recedunt ab eis. Quae autem minus recedunt ab eis,

precisely at these lower ontological levels: on the one hand, the formal principles that determine these substances are weaker, as the form of a metal is clearly less complex and structured compared to that of animals, whose substances are more complex, as they are composed of different parts and determined by the combination of several formal principles. On the other hand, a material structure that is much closer to the elements is easily manipulable if compared to the humoral physiology of animals, in which more articulated processes of digestion take place.[75]

Further, if the forms of minerals can almost be considered *formae corporales*,[76] plants, as they are endowed with soul, have a higher degree of being. Therefore, it is not by chance that the strongest transmutation that humans can induce in plants is the simple mutation of their complexion, as it happens when specific nourishments are administered in agriculture or certain species are planted in different climates.[77] Conversely, the alchemical art aims to achieve – among other operations – that kind of transmutation that changes the species of a being into another, which has effects not only on its accidents but on the whole substance.

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sunt lapides et minerae. In his enim expresse elementorum videmus operationes, propter quod immediate componuntur ex elementis. Plus autem his recedunt plantae, in quibus imperfecte animae videmus operationes, et ideo talia corpora sequuntur elementorum operationes, licet non immediate componantur ex his"; ALBERTUS MAGNUS 1867 [*De veget.*, III 1 3], 175: "Semina enim plantarum vicina sunt elementis, habentia in se et virtutem masculi et feminae"; *Ibid.* [*De veget.*, V 1 7], 312: "Commixtio ejus proxima est elementis et materiae inter ea, quae approximata sunt, et ideo multum mutatur ex elementis."

75 Cf. ALBERTUS MAGNUS 1980 [*De caus. propr. el.*, I 1 2] 52, ll. 16–19: "Animalium autem corpora recedunt maxime et ideo non generantur ex elementis proxime, sed oportet elementa commisceri in umores, et ex umoribus constitui animalium corpora."

76 Cf. ALBERTUS MAGNUS 1955 [*De nat. et or. animae*, 1 3], 5–9.

77 Cf. ALBERTUS MAGNUS 1867 [*De veget.*, I 2 10]; 94.

6. Conclusion

The inclusion of alchemical teachings in the rising Aristotelian philosophy was an ongoing process in the 13th century and explicitly in progress in Albert's philosophical works. In said, alchemical transmutation was considered technically possible, although the process was seen as complex, requiring skilful craftsmen to perform it. The fact that, in this case, art must follow nature does not dissolve all the hurdles hindering the success of alchemical transmutation,[78] but it is precisely this link between art and nature that enables the operations of the alchemists and the artificial production of real gold and real silver. Only an alchemist with great expertise – that is, having technical skills, advanced knowledge of natural principles and the ability to interpret and choose the favourable astral conditions – may be able to accomplish the alchemical transmutation of metals, treating the right and proportioned matter with the appropriate use of heat sources.

Albert describes the process that produces alchemical metals as a kind of *digestio*. The role that the interaction between heat and moisture plays in Albert's philosophy is huge and it is the basis for any process in nature. Although he distinguishes between animate and inanimate beings, their generation, corruption, operations, functions and inner structures are ruled by the relation between these two principles. Hence, *digestio* first designates the process in which *calor* and *humidum* are involved - as active and passive qualities - in shaping, transforming or modifying matter according to the form and the species that is about to be generated[79]. The term *digestio* subsumes in Al-

78 Cf. ALBERTUS MAGNUS 1890 [*Min.*, I 1 3], 5a–5b: "Et hoc quidem operatur ars cum labore et erroribus multis: natura vero sine difficultate et labore."

79 ALBERTUS MAGNUS 2003 [*Meteor.*, IV 1 3], 214, ll. 29–33: "Subiecta enim activarum virtutum in rebus mixtis naturalibus sunt passivae virtutes, quae sunt humidum et siccum, ex quibus subiectis calidum et frigidum generant res mixtas, quando proportionaliter

bert both the understanding of chemical processes and the biological life – also intersecting with the medical tradition –, and the dynamics of these processes are common to the generation of animate and inanimate beings, the digestion and cooking of food, the production of *humores* and artificial operations such as the transmutation of metals.

This idea of a universal heat as a natural force designated to inform matter also paves the way for the theory of art mimesis as described before. The process of the modification and shaping of matter through its cooking is indeed the basis for both the processes of the artificial production of metals and the natural generation of minerals – and the same is true for many other processes proper to plant and animal physiology, including their generation. In all these cases, the formal principles conveyed by heat act upon the moist part of matter through digestion.[80] Sulphur and quicksilver themselves – the prime matter of all metals – are conceived the first as the hot and informative principle and the second as the moist substrate.[81]

As has been shown, some of these ideas were already sketched out by Arabic and alchemical sources in which Galenic and Aristotelian texts were reworked in order to guarantee the harmony of medical-humoral terminology and the processes of generation and digestion. Meanwhile, many alchemical texts expounded the action of cooking and digestion performed by heat in the sphere of mineralogy and in alchemical transmutation from a new perspective. In this respect, also the idea of a universal heat, as assumed by

vincunt materiam humidi et sicci, hoc est, quando agunt permutando ista secundum exigentiam formae et speciei eius, quod generatur; ita tamen quod aliter agat generando agens calidum et aliter agens frigidum, quia unum agit ad speciem et alterum coadunando et continendo partes materiae, supra diximus."

80 Cf. OBRIST 1996, 233.

81 Cf. ALBERTUS MAGNUS 1890 [*Min.*, IV 1 1], 63b.

Averroes, must have played a significant role.[82]

Moreover, the use of allegories and similes structured the alchemical language right from the start and the comparison with medicine regarding transmutation has a solid background within the alchemical tradition.[83] And despite the fact that alchemy is conceived as a metallurgical art by Albert, it is not uncommon in his philosophical works that the process of metal transmutation is explained through the analysis of biological processes – such as the generation *ex putrefactione*. Also, the art of alchemy is often compared to the art of medicine as the art that is useful in the treatment of illnesses and in maintaining the state of health in humans.

In this respect, the connection between *digestio* and *putrefactio*, which derives from the ideas expressed in Galen's *Tegni* and was elaborated on the basis of Aristotle's *Meteorologica*[84] and of Avicenna's *Canon*,[85] was common within scholastic physiology.[86] Within this scheme, Albert suggests to understand the artificial process of alchemical transmutation in the same way as the natural process of the generation of minerals or as particular cases of generation like the *generatio ex putrefactione*. In all of these cases, a kind of no longer informed matter undergoes a process of coction and digestion through the workings of heat, while the formal powers are guided exclusively by the celestial bodies.[87] And both in the case of alchemy and in the case of this peculi-

82 On the use of Averroes in Albert's philosophical works, see: TAKAHASHI 2017.

83 For example, in pseudo-Avicenna's *De anima in arte alchimiae*, medicine is presented almost as the maidservant of alchemy. The text has recently been edited by Sébastien Moureau (MOUREAU 2016). In this respect, see also: MOUREAU 2013, 296–300.

84 Cf. ARISTOTELES 1962 [*Meteor.*, IV 1], 379 a1–b10.

85 Cf. AVICENNA 1507 [*Liber canonis*], lib. I, fen 1, doct. I, summa VI, cap. 3.

86 OTTOSSON 1984, 271–275. Cf. PEREIRA 2002, 158.

87 In these kinds of generation, the presence of the semen would be totally unnecessary, as lower-level beings have no soul.

ar type of generation, a substance – on the basis of its *vicinitas ad elementa* – can be reduced to its prime material components, maintaining the aptitude to be informed.

In Albert's view, the link between medicine and alchemy is not only appropriate because they share, as two kinds of arts, the same epistemological state, being halfway between science and mere technical knowledge. Medicine and alchemy also intersect in their way of operating on matter and substances. In fact, both initially have a purgative aim: physicians should cleanse the ill body of impurities, while alchemists have to purify sulphur and quicksilver.[88] Following this purification, both aim at achieving the same goal, namely to assist nature in changing the state of the body they act upon. From this perspective, to restore the health of a patient and to produce the most perfect among metals are not that different. In both cases, the core of the endeavours is to improve the inner structure of a being, perfecting the material and physiological structure of a given substance.

MARIO LOCONSOLE

UNIVERSITÀ DEL SALENTO, LECCE – UNIVERSITÄT ZU KÖLN

88 Cf. ALBERTUS MAGNUS 1890 [*Min.*, III 1 1], 60a-b: "Quemadmodum in animalium corporibus praecedere humorum temperantiam oportet in materia, ita ante formas metallorum contemperantias oportet praeexistere sulphurus et argenti vivi, et depurationem istorum."

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