

VIRTUS AND SPECIES IN THE PHILOSOPHY OF NATURE OF ROGER BACON (C. 1220-1293)

VIRTUS Y SPECIES EN LA FILOSOFÍA DE LA NATURALEZA DE ROGER BACON (C. 1220-1293)

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Abstract

The paper examines Roger Bacon's use of the concept of *virtus* in the *Communia naturalium* and *De multiplicatione specierum*. It focuses on the roles which *virtus* and *species* play as vehicles of causality in the inanimate realm. It analyses the distinct functions played by *virtus* in the motion of celestial spheres, the power of natural place, the attraction of iron to magnet, and the universal nature. The analysis concludes that *virtus* is an efficient power, a feature of the form, capable of causing local motion and instigating natural processes. *Species* is matter's response to the stimulation made by *virtus* through which every natural action, to the exclusion of local motion, is made. *Species* is a non-efficient power, an 'appetite' internal to matter. It is an expression of matter's inherent inclination to promote and perfect itself, the result of matter's 'active potentiality'.

Keywords

Multiplication of Species; Efficient Causality; Natural Place; Magnet; Active Potentiality

Resumen

El artículo analiza el uso que Roger Bacon hace del concepto de *virtus* en los *Communia naturalium* y *De multiplicatione specierum*. Nos centramos en el papel que desempeñan la *virtus* y las especies como transmisores de la causalidad en el reino de lo inanimado. Se analizan las distintas funciones que desempeña la *virtus* en el movimiento de las esferas celestes, la fuerza del lugar natural, la atracción del hierro por el imán y la naturaleza universal. El análisis concluye que la *virtus* es un poder eficiente, una característica de la forma capaz de provocar el movimiento local y de instigar los procesos naturales. La especie es la respuesta de la materia a la estimulación realizada por la *virtus* a través de la cual se realiza toda acción natural, con exclusión del movimiento local. La especie es una potencia no eficiente, un "apetito" interno de la materia. Es

una expresión de la inclinación inherente a la materia para promoverse y perfeccionarse, el resultado de la “potencialidad activa” de la materia.

Palabras clave

Multiplicación de especies; Causalidad eficiente; Lugar natural; Imán; Potencialidad activa

Introduction

In his *Physics*, Bk. VIII, Aristotle argued that for an object in motion there needs to exist a mover, which must be distinct from the moving object. The mover is the active party; it transmits a causally relevant property to the passive object. The account of how this relevant property is transmitted from agent to patient, seemed obscure and insufficient to many of the Aristotelian commentators. It is therefore no wonder, that the concrete model of the Aristotelian idea of efficient causality received various interpretations over the long years of its reign. In this paper I reconsider one of the well-known solutions to this obscurity of the Aristotelian account, namely, the theory of the multiplication of *species* of Roger Bacon (c. 1214/1220-1290).

Bacon’s most fully developed account of natural action appears in his treatise *De multiplicatione specierum*, in which he explains the physical interactions between agents and patients in terms of *species*. He thought that *species* are issued constantly in all directions by every active nature (*natura activa*), and that they are similitudes of their agents. *Species* are supposed to be produced uniformly and naturally from the “active potentiality of matter (*potentia activa materie*)” of the recipient, and thus render the recipient similar to the agent, “in specific essence, in nature, and in operation (*in essentia specifica et natura et operatione*).” Bacon provided the following examples for this similarity: “if fire is the agent, it produces fire; if heat, heat; if light, light; and so for all things”.¹ The “active potentiality” of matter is defined by Bacon as matter’s appetite to receive new forms. He explained that the notion of “active potentiality” is meant to replace Aristotle’s notion of “privation”, which is matter’s aptitude to be actualized by a form. Note that this active potentiality is a feature of natural matter (which has the form of the genus, but not that of species), but not of prime matter.² “Natural matter”

¹ Roger Bacon, *De multiplicatione specierum* (=DMS) 1.1, edited and translated by D.C. Lindberg, *Roger Bacon’s Philosophy of Nature: A Critical Edition, with English Translation, Introduction and Notes, of De multiplicatione specierum and De speculis comburentibus* (Oxford: Clarendon Press, 1983), 7.

² For the notion of “active potentiality” in Bacon, see Anna Rodolfi, “Dicitur materia propriissime et strictissime. Roger Bacon and the Ontological Status of Matter”, in *Roger Bacon’s Communia Naturalium: A 13th Century Philosopher’s Workshop*, edited by P. Bernardini and A. Rodolfi (Firenze: SISMEL-Edizioni del Galluzzo, 2014), 83-102; Cecilia Panti, “Roger Bacon on Chance in Natural Generation in the *Questiones super octo libros Physicorum Aristotelis*”, in *Roger Bacon and Medieval Science*

on Bacon's use, is the substrate of natural change, a hylomorphic composite which is in potency of all natural things. Bacon thought that in the process of natural generation, the proximate genus plays the role of matter which receives its completion thanks to the *species*, acting as form. This "matter having the capacity to receive forms" is "natural matter", which is partly unformed. It is opposed to prime matter which is potency alone.³ He remarked: "the natural matter in the generation and corruption of a species is the incomplete essence of the proximate genus, which is apt by nature to be completed by the *species*".⁴ Natural action consists, then, in the agent's stimulating the recipient to produce *species* out of its own natural matter. The *species* resemble the agent and induce the patient to become similar to it in some respect.⁵

Following Bacon's declarations that "these *species* make every activity in the world (*haec species facit omnem operationem hujus mundi*)",⁶ David Lindberg asserts that "it is apparent that Bacon attributes all natural causation to the multiplication of *species*".⁷ In this paper I qualify this assertion in two respects. First, I show that physical interactions do not consist only of the phenomena accounted for by *species* which express qualitative change and generation. A considerable part of Aristotelian physics concerns local motions of bodies, their direction, velocity, and rest. The concept of *species*, as developed by Bacon in the *DMS*, does not cover these features of natural bodies, and Bacon invoked the term *virtus* to account for the local motions of bodies. Second, and more importantly, I demonstrate that *species* cannot be considered an efficient cause. *Species*, on Bacon's account, is the first effect of the efficient cause, namely *virtus*; it is not to be identified with the agent but is rather its effect. *Species* is indeed the mean by which natural power is transmitted, however, it is not the driving power itself. It is the first response by a material substance to an excitation coming from an agent.

and Philosophy - Studies in Honour of Jeremiah Hackett, edited by N. Polloni and Y. Kedar (London: Routledge, 2021), 36-53.

³ For Bacon's notion of "natural matter" see Michela Pereira, "Remarks on materia naturalis", in *Roger Bacon's Communia Naturalium: A 13th Century Philosopher's Workshop*, edited by P. Bernardini and A. Rodolfi (Firenze: SISMEL: Edizioni del Galluzzo, 2014), 103-138; Nicola Polloni, "Roger Bacon on the Conceivability of Matter", in *Roger Bacon and Medieval Science and Philosophy* (London, Routledge, 2021), 76-97; Panti, "Roger Bacon on Chance in Natural Generation", 36-53.

⁴ Roger Bacon, *Communia naturalium* (= CN), edited by R. Steele, *Opera hactenus inedita II-IV* (Oxford: Clarendon Press, 1910-1913), 1.1.2.1, 15-16: "materia naturalis in generatione specierum et corruptione est essentia generis proximi incompleta, que nata est compleri per species."

⁵ For the full account of natural action in Bacon, see Dominique Demange and Yael Kedar, "Physical action, species and matter: The debate between Roger Bacon and Peter John Olivi", *Journal for the History of Philosophy* 58 (2020): 49-59.

⁶ Roger Bacon, *Opus maius* 4.2.1, edited by J. A. Bridges, (Oxford/Edinburgh, 1897-1900, reprint Frankfurt am Main, 1964), vol. 1, 111.

⁷ David Lindberg, *Roger Bacon's Philosophy of Nature: A Critical Edition, with English Translation, Introduction and Notes, of De multiplicatione specierum and De speculis comburentibus* (Oxford: Clarendon Press, 1983), lvi.

Unlike the case of *species*, Bacon did not treat *virtus* systematically. Indeed, *virtus* was used by him as a generic term as well. I argue, however, that in matters related to inanimate bodies, this term had a specific meaning, which I wish to disclose. I therefore reconstruct the meaning and function of *virtus* in Bacon's philosophy of nature, drawing on the ways he applied it. I examine Bacon's use of the term *virtus* in the *CN*, and the *DMS*. Bacon's *CN* contains mature expressions of many of his theories. It was written in the 1260s, around the same time as the *DMS* or soon thereafter and was meant to present an exhaustive account of the various branches of knowledge. Apparently, it was not completed.⁸

I gather the meaning of *virtus* in Bacon's mature philosophy of nature by analyzing its various functions. Accordingly, the first section of this paper provides some partial definitions of *virtus*, found in the *CN* and the *DMS*. The subsequent sections consider – in this order – four types of *virtus*: (1) of heavens, (2) of natural place, (3) of the magnet, and (4) of universal nature. I show that common to all these cases are local motion and rest.

Like many other writers of his time, Bacon invoked *virtus* also for the soul's abilities to engage in operations of different kinds. I do not address this usage, since my concern in this paper is with the function of *virtus* regarding efficient causality in the inanimate domain alone.

In the final section I compare the ontological and physical features of *virtus* with those of *species*. I demonstrate that these features are in fact distinct in Bacon's theory of physical action. I further argue that *virtus* can be considered an efficient cause and hence as ontologically prior to *species*, since it is both the power which renders a nature active thus making it capable of producing *species* and the power which controls the *species'* activity, as will be shown below in the case of the law of universal nature.

1. *Virtus* defined

Bacon did not devote concentrated attention to the concept of *virtus*. Partial definitions, however, can be found. In the beginning of *DMS*, he wrote:

[E]ssence, substance, nature, power (*potestas*), potency, *virtus*, and force (*vis*) signify the same thing, but differ only in relation. For 'essence' is considered with respect to itself, 'substance' with respect to accident, the others in reference to the eliciting of an action.⁹

⁸ See Jeremiah Hackett, "Roger Bacon: His Life, Career and Works", in *Roger Bacon and the Sciences: Commemorative Essays*, edited by J. M. G. Hacked (New York: Leiden, 1997), 9–24.

⁹ Bacon, *DMS*, 1.1, 2–3: "essential, substantia, natura, potestas, potentia, virtus, vis significant eandem rem, sed differunt sola comparatione. Nam essentia dicitur secundum se considerate, substantia respectu accidentis, alia respectu operationis eliciende."

Bacon numerates five terms used to signify the power to elicit an action: nature, power, potency, *virtus* and force. How can these terms be further characterized or distinguished? Bacon provides the following answer:

But 'nature' means an aptitude for acting, apart from any further inclination. 'Potency' and 'power' mean the same thing, and they are commonly applied to either a complete or an incomplete operation. 'Virtue' and 'force' also mean the same thing, but they are applied only to that which completes an operation. And I speak here concerning a potency that elicits an action rather than that which accomplishes an action.¹⁰

Bacon reserved the term 'nature' for the mere aptitude for acting, without reference to the realization of this aptitude.¹¹ 'Potency (*potentia*)' and 'power (*potestas*)' on the other hand, could be used regardless of whether that realization occurred, while "'virtue' and 'force (*vis*)' are to be applied to powers that have been realized. He clarified that the realization of the power consists in a stimulation of the natural potency (namely, the active potentiality) of the recipient to elicit action, rather than in imparting an action to the recipient from an external source.

In the next *DMS* paragraph, Bacon again distinguishes two types of *virtutes*, the one (*species*) is the first effect of the other (namely, of *virtus*). At this juncture, Bacon tells us that *virtus* and *species* are similar in essence and operation, since "things of similar essence have similar operations".¹² He fails to give a more specific definition of the difference between the two *virtutes*. We can deduce, however, that the designation of *species* as the first effect of *virtus* means that it is its similitude, namely, its image or likeness. This would explain why the two are similar, according to Bacon, in essence and operation. Moreover, we can presume at this point that there is a primary *virtus* which grounds a secondary *virtus*, namely, *species*.

In the *CN* Bacon adds a significant detail: "*virtus* and *vis* are the utmost of potency or the utmost power of which Aristotle speaks in the first book of *De caelo*".¹³ Another statement specifying *virtus* as the highest or greatest potency appears two pages later,

¹⁰ Bacon, *DMS*, 1.1, 2-3: "Sed natura dicit aptitudinem operandi, cetera ulteriorem inclinationem. Sed potentia et potestas sunt idem, et communiter sumuntur respectu operationis complete vel incomplete. Virtus vero et vis sunt idem, sed dicunt solum complementum operationis. Et hic loquor de potentia que elicit actionem, non de illa que expedit."

¹¹ In an earlier text, Bacon identifies 'nature' with the active potentiality of matter. See Roger Bacon, *Q. octo. Phy.*, edited by R. Steele, *Opera hactenus inedita XIII* (Oxford: Clarendon Press, 1935), 86: "immo potentia activa dicitur natura solum."

¹² Bacon, *DMS*, 1.1, 2-3: "Aliter sumitur virtus pro effectu primo virtutis iam dicte propter similitudinem eius ad hanc virtutem, et in essentia et in operatione, quia similis est ei diffinitione et in essentia specifica; et per consequens est similis in operatione, quia illa quae sunt similis essentie habent similes operationes. Et hec virtus secunda habet multa nomina, vocatur enim similitudo agentis et ymago et species et ydolum et simulacrum et fantasma et forma et intentio et passio et impressio et umbra philosophorum apud auctores de aspectibus."

¹³ Bacon, *CN*, 1.2.2.4, 80: "virtus vero et vis est ultimum de potencia, seu potencia ultimata, secundum quod Aristoteles dicit in primo *Celi et mundi*."

in the context of Bacon's distinction between the active and passive potencies of matter. Part of the description of the active potency states that "It is therefore essence, as considered in itself; a potency as it has the appetite to be promoted and perfected, and as being promoted to perfection; and as it is the greatest potency, it is *virtus*".¹⁴ We find more details further on in the text:

But potency differs from *virtus* like the common differs from the specific. For *virtus* according to the first book of *De caelo et mundi*, is the greatest potency, that is, the utmost power, as he [Aristotle] verifies by an example. If a donkey can carry a hundred pounds and no more, its *virtus* comes to a halt in carrying a hundred pounds [it therefore can carry also] one, two and twenty [pounds], and so on, in any manner, and so is the potency in more things, and *virtus* is the perfect potency. Hence Aristotle said in *Physics* VII that each thing is perfect when it attains its proper *virtus*.¹⁵

While potency can be realized in various degrees, *virtus* is the power driving to the maximal realization possible for a certain subject, or put otherwise, to its appropriate perfection. In *De Caelo* I.11, Aristotle did not mention a donkey, but what he wrote there is close enough:¹⁶

We speak, for instance, of a power to lift a hundred talents or walk a hundred stades – though if it can effects the maximum it can also effect any part of the maximum – since we feel obliged in defining the power to give the limit or maximum. A thing, then, which is capable of a certain amount as maximum, must also be capable of that which lies within it. If, for example, a man can lift a hundred talents, he can also lift two, and if he can walk a hundred stades, he can also walk two.¹⁷

The context of Aristotle's discussion is the difference between what is possible and what is impossible. For a man whose maximum power is to lift a hundred pounds, lifting ninety-nine is possible, but lifting a hundred and one is impossible. Bacon built on this discussion to develop the idea that while potency is the general term for force or power, *virtus* is the specific term for the strongest potency or the power driving to a full

¹⁴ Bacon, CN, 1.2.2.4, 82: "Est ergo essentia in principii materialis et essentia et potentia. Essentia prout in se consideratur, potentia prout appetit promoveri et perfici, et prout est promovenda in perfectionem, et ut est potentia ultimata, est *virtus*."

¹⁵ Bacon, CN, 1.2.4.3, 118: "Set potentia differt a virtute, sicut commune et speciale. Nam *virtus* secundum Aristotelem primo *Celi et Mundi* est ultimum de potentia, id est, ultimata potentia, sicut verificat in exemplo, ut si asinus potest ferre centum libras et non plus, ejus *virtus* consistit in lacione centum librarum, unius, et duarum, et 20, et sic de quocunque modo, et sic potentia est in plus, et *virtus* est perfecta potentia, propter quod dicit in 7^o *Phisicorum* quod unumquodque tunc perfectum est, cum attingit proprie virtuti."

¹⁶ The example of the donkey may have come from another source, such as ps-Aristotle's *De celo et mundo* or the commentary by Averroes.

¹⁷ Aristotle, *On the Heavens* I, 11 281a1, translated by J. Barnes, *The Complete Works of Aristotle – The Revised Oxford Translation* (Princeton: Princeton University Press, 1984), vol. 1, 447-511, 465-466.

realization of a certain capacity to move or to carry something. When a thing can realize its maximal capacity, it is perfect.

Another specification of *virtus* is that it is a feature of the efficient cause, distinct from the material principle:

[W]e have to consider that *virtus* and *vis* and potency and power (*potestas*) and nature are in one way from the part of the efficient [cause], considering that it effects an action and changes the material principle to the end term of generation. And this nature or potency or *virtus* is never in the material principle. Indeed, the efficient [cause] and matter never coincide, as Aristotle said in *Physics* II. And this is so because one and the same thing is never both in act and in potency and agent and matter in the same respect.¹⁸

Since the active potentiality of natural matter is entangled with matter, it depends on an external agent, which is the efficient cause, to stimulate it. This external agent is associated in this quotation with *virtus*, which is distinguished, in turn, from the material principle. Bacon defines the material principle in the *Opus tertium* in this way:

[A]ll that which is in potency to another, and is the foundation of the other, is called the material principle and matter [...] If therefore, we compare all things to their genera, rendering every species to its appropriate genus, then all [species] will be one genus, and therefore matter, because matter and genus are the same.¹⁹

The material principle is in fact natural matter, which, in natural generation, is the genus waiting to receive a specific form in order to be complete. This genus is not pure matter, since it has the form of the genus. The material principle is therefore a relative concept, which can be applied in any case in which there is a certain potency and a certain power which activates it by providing it with a more specific form. It is the material principle in relation to this specific power, but not absolutely.

The material principle is driven to action upon receiving stimulus from *virtus*. However, that *virtus* does not impart matter with inherent activity of its own, but rather excites it to produce *species*. The next quotation is pivotal in clarifying the relation between *virtus* and *species*:

¹⁸ Bacon, CN, 1.2.2.4, 82: “considerandum quod virtus et vis et potencia et potestas et natura uno modo sunt a parte efficientis considerande quod efficit accionem et transmutat principium materiale in terminum generacionis. Et ista natura vel potencia vel virtus nunquam est in materiali principio. Sic enim efficiens et materia nullo modo coincidunt, ut Aristoteles dicit 2° Phisicorum. Et patet hoc, quia nichil unum et idem est actu et potencia, et agens et materia secundum idem.”

¹⁹ Roger Bacon, *Opus tertium*, edited by J. S. Brewer, *Opera quedam hactenus inedita* (London: Longman, Green, Longman and Roberts, 1859) 38,128: “omne illud quod est in potentia ad aliud, et est fundamentum aliorum, vocatur materiale principium et materia, ideo genus vocatur materia... Si igitur comparemus omnia ad genera sua, reddendo singulas species coaequaivas singulis generibus, tunc omnia sunt unum genere, et ideo materia, quia materia et genus idem sunt.”

But even though it was debated before concerning the active principle in matter, and it is determined that in matter there is nothing active in the act of transmuting and effecting, quibblers show that although [matter] does not have the power of action from itself, yet it has it on account of the *virtus* of the agent which stirs it. And when it is stirred by it, it can act to the production of a form, or the end term [of a generation], which is called a form, although it is a composite. But they were deceived first because they imagine that the agent infuses into the patient something cooperative, which transmutes the depth of the patient, so that an effect arises from the power of matter. But this was rejected previously in the treatise *De efficiente*. It is also shown there that that which the agent does in the first part of the patient is incomplete and is called *species*. Subsequently, the continuity of the action performed by the agent is completed. And therefore, since the effect does not actualize itself, it is not active, and consequently does not give the potency of matter any power to act. Indeed, that which is produced by the agent in matter is a part of the generated [thing] and therefore, since matter has that part, it is no other than matter itself having a more complete essence than before, which has a nature of an effect, [namely, it is] made and generated, [and] is still essentially in potency to receive its completion. Therefore, there is no place for the act of causing and making, but [rather] for promoting and receiving. Therefore, matter has nothing except for a passive principle, generally speaking, which excludes efficient action, because the passive principle of matter has only the act of appetizing and desiring.²⁰

Bacon clarifies here that in natural action, the agent does not infuse anything into the patient. The so called ‘quibblers’ are deceived in arguing that the effect arises out of the power of matter. Matter, Bacon holds, cannot be considered active or efficient. By the power of *virtus*, the agent issues a *species* out of the active potentiality of matter, and this *species* generates another one, and so forth all the way to the depth of the

²⁰ Bacon, *CN*, 1.2.4.2, 113-4: “Set licet disputatum est prius de principio activo in materia, et determinatum sit quod in materia nichil est activum in accione transmutandi et efficiendi, tamen cavillatores ostendunt quod licet non a se habeat potenciam agendi, tamen habet per virtutem agentis que excitat eam, et ipsa excitata per hoc potest agere ad produccionem forme, sive termini ad quem, qui vocatur forma quamvis sit compositum. Set primo decepti sunt, quia ymaginantur quod agens fluat in paciens aliquod cooperativum | quod transmutet profundum patientis ut de potencia materie ducatur effectus. Hoc enim prius reprobatum est in tractatu De efficiente. Ostensum eciam est ibi quod illud quod agens facit in prima parte patientis non est nisi effectus quem intendit: set ille effectus primo est incompletus et vocatur species, postea per continuitatem accionis agentis completur, et ideo cum effectus non efficit seipsum, non est activum et per consequens non dabit potencie materie aliquam potestatem agendi. Quod vero fit per agens in materiam est pars generati, et ideo cum materia habet illam partem, non est aliud nisi quod ipsa materia habet esse complecius quam prius, et illud esse habet rationem effectus facti et generati, quod est adhuc in potencia essentialiter ad complementum suum recipiendum, et ideo non est in alico, actu agendi et faciendi, set promovendi et recipiendi. Materia igitur non habet nisi principium passivum, communiter loquendo, ut excludatur accio efficiendi quod principium passivum materie habet solum actum appetendi et desiderandi.”

recipient. Bacon denies, however, that a *species* can be ascribed with the power of action. Every natural action made in and from matter can only be considered a passive response, or a part of the inherent inclination of matter to be completed by receiving new forms. Bacon draws here an important distinction between efficient action and the ‘appetite’ of matter, which in no way can be considered efficient; it is an effect, not a cause. Matter, Bacon concludes, despite having an ‘active potentiality’, can never be considered an efficient cause. Matter’s response to an external excitation is called *species*, but it is a reaction only, lacking inherent activity of its own. While *virtus* is a power external to the material principle, *species* is the power internal to it (again, the matter discussed here is natural matter and not prime matter). As such, it cannot be considered a cause. Indeed, Bacon stressed that *species* are material. In the *Perspectiva* he wrote, for instance, that “a *species* of corporeal and material things will always have material and corporeal existence”.²¹ Moreover, he devoted a whole chapter of the *DMS* (3.2) to counter the claim raised by Averroes and Avicenna that *species* of material agents have spiritual being *in media*.

Virtus is therefore a power stirring natural matter, driving it to activity and complete operations. It is the driving force leading natural matter into producing *species*, that is, by rendering it active. At this point, the question of where the *virtus* originates is not answered but let us examine what more can be learned from the specific cases in which Bacon appealed to *virtus*.

2. The *virtus* of natural place

In the Aristotelian universe, each element has an internal inclination toward its natural place. Water and earth have an internal inclination toward the center of the universe, while the internal inclination of fire and air drives them toward the periphery. Bacon agrees with this description:

The elements indeed have internal principles of motion, which move them to their natural places; these internal principles are the heaviness and lightness in them. Therefore, the essence of the heavy and the light [elements] is [their] nature. For they can from themselves be carried to their places when they are not impeded. Whence they do not need another mover, just as fire does not need a mover in order to heat, for it can heat by itself if it has matter. Therefore, heavy and light bodies move by nature and from themselves, and the principle of motion is here not just appetitive as in the case

²¹ Roger Bacon, *Perspectiva*, edited and translated by D. C. Londberg, *Roger Bacon and the Origins of Perspectiva in the Middle Ages: A Critical Edition, with English Translation of Bacon’s Perspectiva with Introduction and Notes* (Oxford: Clarendon Press, 1996), 1.6.4, 88-89.

of matter, but rather effective because the heavy [body] divides the medium by itself and makes itself move downwards out of its own *virtus*.²²

The motion of the elements to their natural place is a special kind of motion in which there is no distinction between the substance of the mover or the efficient cause and the patient receiving the movement. It takes power to divide the medium when ascending or descending, and this power is a *virtus* internal to the substance. This seems like an exception to the maxim that a mobile is always moved by another. But Bacon solved this by distinguishing the *virtus* from the material principle of the mobile, as we have seen in the previous section. The *virtus* of natural place which moves the heavy body from within, ought then to arise out of the form, which is distinct from natural matter, namely, the specific form of the element.

The natural place toward which the heavy body is drawn, has its own *virtus* too. In fact, it is only having a *virtus* that entitles it to the status of a natural place. Bacon debated if the surface ought to be considered as the natural place. The criterion for answering this question is the possession of a *virtus*:

And now one asks whether the place, in the sense of a surface, is a natural place. Some would argue that this is not the case, because surface, as such, is a mathematical being. Also, the surface does not have some *virtus* that would conserve the located thing in its place, but place is said to have [such *virtus*]; of which the contrary is made clear by Aristotle, in the second book of *Physics*, where he says that lines and surfaces and things of this kind are, according to the truth of their being, natural things, which do not have being except in natural bodies, therefore place can be natural, even though it is a surface. And in this way the first argument is solved, for the same [thing] is a natural thing and mathematical, and it is called mathematical only due to consideration, not on account of being, as was explained before. The rest is solved by the fact that this surface indeed, which is a place, is the limit of a natural thing, namely, of the locating [body] which has in its substance that *virtus*, and therefore this surface can make a natural place, because of the essential relation that it has to the substance to which the *virtus* belongs. The surface is indeed the limit of that substance, and therefore it has a necessary relation to the *virtus* of that substance, on account of which it can be called not only a natural surface but also a natural place, namely, by that natural *virtus*.²³

²² Bacon, CN, 1.2.4.2, 116: “Elementa enim habent principia motus intra, que movent se ad loca naturalia, que sunt gravitas et levitas eorum, unde ipsa et eorum essentia gravis et levis est hic natura, possunt enim secundum se ferri in loca sua cum non prohibentur, unde non indigent alio motore, sicut nec ignis indiget motore ut calefaciat, per se enim potest hoc facere si materiam habeat, ideo gravia et levia moventur a natura et a se, et non est principium motus hic tantum appetitivum sicut in materia, set effectivum, ipsum enim grave dividit medium, et facit se deorsum ex propria virtute.”

²³ Bacon, CN, 1.3.2.6, 200: “Et nunc queritur utrum locus secundum quod dictus est superficies sit locus naturalis. Et aliquis argueret quod non, quia superficies in quantum hujusmodi est res mathematica. Item, superficies non habet virtutem aliquam conservandi locatum, set locus dicitur

The conclusion is that the surface can rightly be called a natural place, given the fact that it is the limit of the substance that has the *virtus*, or due to its essential relation to that *virtus*. The *virtus* is the power which draws the element to its place, and on account of which the surface is natural rather than mathematical. However, after further consideration, Bacon decided that the substance, not the surface, should more properly be considered a natural place:

A natural place is properly called so on account of the natural *virtus* which it has with respect to the located [body]. But the substance of the locating [body] has this *virtus*, not its surface. Therefore, if the surface is the natural place solely on account of a relation to that *virtus*, then much more rightly would the locating [thing] itself be called natural place, because it has that *virtus*.²⁴

But if the descending body has its own *virtus*, carrying it downwards, why is there also a need for another *virtus*, that of natural place? Bacon presented two opinions concerning the function that natural place plays in the motion of a body:

[N]atural motion is stronger at the end. Thus, the heavy [object], the more it approaches the bottom, the more forcefully it moves, as when iron approaches a magnet. But the cause of this strength is the heavy object's approaching the [natural] place. Therefore the place appears to have an influence, insofar as it is the cause of [the motion's] strength [...] But against this [it can be argued] that that which moves another through the influence of *virtus* does not move it, unless the moved thing is in the right distance with respect to what influences it [...] And it must be said that the *virtus* of place moves from a distance [...] but from a distance it does not move like an efficient cause [...] for from its nature it [the moved thing] strives and is moved in whichever distance it is placed, but [when] it has the right distance, it receives the *virtus* of place, by which it is altered to a stronger motion.²⁵

habere; cujus contrarium patet per Aristotelem, secundo *Phisicorum*, ubi dicit quod linea et superficies et hujusmodi sunt, secundum veritatem sui esse, res naturales, et non habent esse nisi in corporibus naturalibus, quapropter locus potest esse naturalis, licet sit superficies, et sic solvitur argumentum primum, nam eadem est res naturalis et mathematica, et non dicitur mathematica nisi propter considerationem, non propter esse, ut prius expositum est. Reliquum vero solvitur per hoc, quod superficies hec, que est locus, est terminus rei naturalis, scilicet, locantis que habet in sua substantia illam virtutem, et ideo superficies hec potest facere locum naturalem propter comparationem essentialem quam habet ad substantiam, cujus est illa virtus. Superficies enim est terminus illius substantie, et ideo habet comparationem necessariam ad virtutem illius substantie a qua potest dici non solum superficies naturalis, set locus naturalis, scilicet, ab illa virtute naturali.”

²⁴ Bacon, CN, 1.3.2.3, 201: “locus naturalis proprie dicitur propter virtutem naturalem quam habet respectu locati, set locantis substantia habet hanc virtutem et non superficies, ergo, si superficies est locus naturalis propter solam comparationem ad virtutem hanc, multo forcius ipsum locans, quia habet hanc virtutem, dicitur locus naturalis.”

²⁵ Bacon, CN, 1.3.2.3, 204-205: “motus naturalis est forcius in fine, unde grave, quanto magis appropinquat deorsum, tanto forcius movetur, sicut ferrum ad magnetem. Set istius fortitudinis causa est appropinquatio ad locum, ergo, locus videtur aliquid influere, ut sit causa istius fortitudinis.

The motion of the heavy body becomes stronger as it gets closer to its natural place. On the one hand, it seems that the natural place attracts the heavy body since it moves more forcefully when approaching it. According to another opinion, however, the natural place can only exert its influence from a due distance, hence it cannot be the cause of this motion. Bacon's resolution is given at the end of the quotation: the *virtus* of natural place is the cause of the body's motion from any distance, yet up to a certain distance it is not the efficient cause of this motion, but rather its final cause, as will be shown in the following. Although the text does not state this explicitly, it seems reasonable to infer that when the body reaches its due distance, the natural place becomes the efficient cause of its motion, rendering it stronger. When the attracted substance is beyond that distance (that is, beyond the range of the natural place's influence), its internal *virtus*, which is a feature of its particular nature, namely, the form of the specific element, functions as the efficient cause. Bacon concluded that the *virtus* of place is not the first and only cause of motion in this case, but it is the only cause of the strength of motion when in the right distance. In most cases, Bacon continued, what provides matter with perfection is the same thing that sets it in motion, namely the efficient cause, and not the final cause, which is not active. But natural place is a special case, because it is both a final and efficient cause:

[F]or the generating agent gives matter its complete being, and not the end of generation, which is the desired end, for that end is not active but this end of motion, which is the place, is active, and gives this [matter] being. Because the end of generation is not as yet in the nature of things, nor does it have being, therefore it cannot act or cause alteration. But [natural] place is a substance in actuality having the power to operate and to alter another being.²⁶

It is agreed that the natural place is the final cause of the element's motion. Bacon wanted to show here, that it can also be considered the efficient cause of its motion, at least from a certain distance. In most cases of generation, the efficient cause can be clearly distinguished from the final cause, especially since the efficient cause exists, while the final cause is a desired goal yet to be achieved. Natural place, however, which is the final cause of the heavy element's motion, does exist. Hence there is no difficulty in considering it the generating agent, or the efficient cause as well. The consequence is that according to Bacon, natural place is efficient and has the power of setting bodies

[...] Set contra, illud quod movet aliud per influenciam virtutis, non movet illud, nisi cum est in debita distancia respectu influentis. [...] Et dicendum quod hec virtus loci movet a longe [...] set a longe non movet sicut efficiens [...] unde ex natura sua appetit et movetur, in quacunque distancia ponatur, set cum in debita distancia venerit, recipit virtutem loci, per quam alteratur in forciolem motum."

²⁶ Bacon, *CN*, 1.3.2.3, 206: "nam generans dat materie esse complecius, et non terminus generacionis, qui est finis desideratus, ille enim finis non est activus, sed hic finis motus, qui est locus, est activus, et dat istud esse. Quia terminus generacionis non est adhuc in rerum natura, nec esse habet; et ideo, non potest agere nec alterare. Set locus est substantia in actu habens potestatem operandi et alterandi aliud."

in motion by reason of its *virtus*. This *virtus* is twofold: one is internal to the substance of element, and the other external.

3. The *virtus* of heavens

Bacon used *virtus* to account both for the movement of the celestial bodies and for the influence which the celestial bodies exert on the spheres of the elements. A widespread explanation for the motion of the celestial bodies, originating from Aristotle, was that the orbs had immaterial, spiritual movers, causing motion by will and desire.²⁷ The idea that an intelligence or angel could move an orb by will alone was condemned in 1277, the rationale being that only God could move things by will alone.²⁸ Edward Grant argues that a new approach was devised by Richard of Middleton (fl. second half of the 13th century), Godfrey of Fontaines (d. 1306) and Hervaeus Natalis (c. 1260-1323), who added a motive force (*virtus motiva*) to the intelligences, by which they move the orbs. This power was assumed to guarantee direct contact between the angel and the orb. The intelligences, however, still moved the orbs voluntarily and not naturally, according to this view.²⁹ As we shall see, the idea that the celestial bodies are moved by *virtus* is present in Bacon's *CN* prior to the condemnation of 1277 and the abovementioned writers.³⁰ His source was the Muslim astronomer Alpetragius (Al-Bitruji, d. 1204), who proposed a non-Ptolemaic astronomical system, and opted for a physical rather than a voluntary cause of celestial motions.³¹

²⁷ See Edward Grant, *The Foundations of Modern Science in the Middle Ages – Their Religious, Institutional, and Intellectual Contexts* (Cambridge: Cambridge University Press, 1996), 110-112. Grant notes that there were other explanations as well. For example, John Blund (c. 1175-1248) and Robert Kilwardby (d. 1279) argued that each celestial orb possessed a natural, intrinsic capability of self-motion, thus sparing the need for an angel or a soul as a mover.

²⁸ See Richard C. Dales, "The De-animation of the Heavens in the Middle Ages", *Journal for the History of Ideas* 41/4 (1980): 531-550.

²⁹ Edward Grant, "Cosmology", in *The Cambridge History of Science, 2 (=Medieval Science)*, edited by D. C. Lindberg and M. H. Shank (Cambridge: Cambridge University Press, 2013), 436-455, esp. 449.

³⁰ Bacon was not the first to use *virtus* and sometimes *virtus motiva* for celestial motions and their influence. Albert the Great (1200-1280) used *virtus formativa* for similar purposes. See Adam Takahashi, "Nature, Formative Power and Intellect in the Natural Philosophy of Albert the Great", *Early Science and Medicine* 13/5 (2008): 451-481.

³¹ See Pierre Duhem, *Le système du monde – Histoire des Doctrines cosmologiques de Platon à Copernic* (Paris: Hermann, 1914; repr. 1958), vol. 2, 131. Alpetragius' book *Kitāb fī al-haya* was translated into Latin by Michael Scot around 1220 and was well known among the scholastics. See Francis J. Carmody, *Arabic Astronomical and Astrological Sciences in Latin Translation: A Critical Bibliography* (Berkeley: University of California Press, 1956), 264-267. The text is found in Francis J. Carmody, Al-Bitruji, *De motibus celorum. Critical Edition of the Latin Translation of Michael Scot* (Berkeley: University of California Press, 1952), as well as in Bernard R. Goldstein, *Al-Bitrujī: On the Principles of Astronomy* (New Haven and London: Yale University Press, 1971). For further studies on Alpetragius' astronomy, see Edward S. Kennedy, "Alpetragius's Astronomy", *Journal for the History of Astronomy* 4 (1973): 134-136; Abdelhamid I. Sabra,

Bacon presented the idea (upheld by Alpetragius) that the velocity of an orb is linked to its distance from the *virtus* of the first orb:

And since the heavens are divided into many orbs, this motion is conformed to the first orb, and thanks to the *virtus* of this heaven, which it receives from its motor, all the inferior orbs are moved, and all the elements except for earth. But because every finite *virtus* derived from a motor is stronger when proximate than when it is remote, and because following a greater remoteness it reverts proportionally, and so a greater velocity of motion is caused by a stronger *virtus*, it is necessary that the orbs nearer to the first orb move faster following this motion, and that the more distant move slower.³²

This is a pretty accurate description of Alpetragius' theory, according to which the delay becomes progressively more noticeable in the planetary spheres that are further away from the first moved sphere. Alpetragius had used this idea to suggest an explanation for the phenomenon of the tide. Bacon presented Alpetragius's solution in these words:

In water, he said, the same aforementioned motion is apparent in the flow of the sea, although its motion is that of an incomplete circulation; yet this is because of the [water's] weight. Its motion to the west, which is called flow, is by the said *virtus*, which, due to its weakness, on account of being very remote from its source, and due to the weight of the water, which inclines it to an opposite motion, is not enough to make it complete the circulation. And therefore, before the completion [of the circulation] it is thrown back by the *virtus* of its heaviness. And this motion is called ebb. Yet the motion of water, which it has from the *virtus* of heaven, is slower than the motion of air, and the motion of air [is slower] than the motion of fire. The earth, however, because of its heaviness and the weakness of the said *virtus* remains immobile in the unqualified sense.³³

“The Andalusian Revolt against Ptolemaic Astronomy: Averroes and al-Biṭrūjī”, in *Transformation and Tradition in the Sciences: Essays in Honour of I. Bernard Cohen*, edited by E. Mendelsohn (Cambridge: Cambridge University Press, 1984), 133-153; George Saliba, “Critiques of Ptolemaic Astronomy in Islamic Spain”, *Al-Qanṭara* 20 (1999): 3-25.

³² Bacon, *CN*, 2.5.1.7, 425: “Et cum celum per plures orbis distinguitur, hic motus orbi primo appropriatur, et virtute hujus celi, quam recipit a suo motore, moventur omnes orbis inferiores, et elementa omnia preter terram. Set quoniam omnis virtus finita, a motore derivata, forcior est propinqua quam remota, et eciam secundum remocionem majorem proporcionaliter revertitur a forciori virtute major velocitas motus causatur; necesse est orbis propinquiores orbi primo velocius secundum hunc moveri, et remocios tardius.”

³³ Bacon, *CN*, 2.5.1.7, 425-426: “In aqua autem dixit motum predictum apparere, in fluxu scilicet maris, licet motus ejus sit incomplete circulacionis; hoc autem est propter ejus ponderositatem. Motus igitur ejus ad occidentem, qui appellatur fluxus, est a virtute predicta que, pro sui debilitate, cum sit ibi multum remota a sua origine, et propter aque ponderositatem, que inclinat aquam ad motum oppositum, non sufficit ipsam complete circulacione movere. Et ideo, ante complementum virtute sue ponderositatis regiratur. Et hic motus dicitur refluxus. Motus autem aque quem habet a

The first sphere receives its *virtus* from the first mover. It then transmits this *virtus* to the other spheres, and therefore they are moved naturally according to the motion of the first sphere. The inferior orb is moved according to the movements of the first orb and follows its motion as much as it can. The spheres of the elements are the last to receive this *virtus*, and they move more slowly since *virtus* weakens with distance. Water is the most remote element except for earth, which does not move at all. Its motion is slowed down and hindered by two factors: it is heavy, because according to Bacon's account, its internal *virtus* drives it toward the center of the universe, and the *virtus* it receives from above is very weak. Thus, water is set in circular motion, but cannot complete it. Hence the recurring cycle of ebb and flow.

Bacon rejected this theory of the cause of tide and favoured the moon as at least one principal cause of tide.³⁴ He gathered from Alpetragius' account that the motion of the water following the first heaven is slower and more irregular than that of other bodies of the universe.³⁵ He argued that this account does not fit with the observation that "the ebb and flow are determined and fixed" and "move as the moon varies in the parts of heavens".³⁶ He did not deny that the first heaven moves the bodies of the world, but claimed that its power is too far removed and, therefore, that the "proper *virtus* of the water" prevails, striving to remain at rest in its own place.³⁷

Bacon held to another idea of Alpetragius, namely, that each *virtus* has a specific direction. When the same body receives two *virtutes* of opposing directions, then if the *virtutes* are equal, they will cancel each other out and the substance will not move at all. If one *virtus* is stronger than the other, the substance will move in the direction of the stronger one, but slower than the case in which the stronger mover would be moving it alone:

If a certain orb, inferior to the first orb, is moved to the east by the first motion to the west, these motions will be by different *virtutes*. These *virtutes* are either equal or unequal. If they are equal, then the motions on both sides will be equal, and then [the orb] will either rest in its place or be in two places at the same time. If [the powers] are

virtute celi tardior est motu aeris, et motus aeris motu ignis. Terra autem, propter sui ponderacionem et predictae virtutis debilitatem, simpliciter immobilis perseverat."

³⁴ On Bacon's rejection of Alpetragius' theory of tide, see Yael Kedar, "The Nomological Image of Nature: Explaining the Tide in the Thirteenth Century", *Annals of Science* 73/1 (2016): 68-88.

³⁵ Alpetragius held that the motion of the heavenly bodies was in fact spiral rather than circular. See Edward Grant, "Celestial Motion in the Late Middle Ages", *Early Science and Medicine* 2/2 (1997): 129-148, 134.

³⁶ See the Latin in the next footnote.

³⁷ Bacon, *Opus maius*, 1, 4.4.6, 139-140: "Sed non placet hic, quia fluxus et refluxus sunt determinati et certi, et currunt sicut luna variatur in partibus coeli. Sed motus aquae a motus coeli est confusus et inordinatus et irregularis propter hoc, quod virtus coeli primi nimis elongatur ab ejus origine, quando est in aqua, et ideo praevalet virtus aquae propria, scilicet sua gravitas."

unequal, then it will move according to the motion of the stronger *virtus*, albeit less rapidly.³⁸

This idea was a part of an attempt by Alpetragius to account for the apparent recessions of the planets, without recourse to the Ptolemaic epicycles. In the ensuing discussion, Bacon accepted Alpetragius' analysis of composed motions of celestial bodies, albeit with a significant difference: instead of one motive agent, located exclusively in the prime mobile, he posited two motive agents.³⁹

The calculus of the various *virtutes* can become extremely complicated. There is the simple case in which different motive powers (*virtutes motive*) are received in the mobile over a straight line or the two contrary parts of a circle. In this case, if they are equal, they cancel each other out, or the stronger one effects a slower motion in its direction.

If therefore, several diverse moving *virtutes* are received on one straight line in a mobile, or on the same circle in contrary parts, and if they were equal, then [the body] would not move, but rest. If [the *virtutes*] were unequal, [the body] would move according to the direction of the stronger moving *virtus*, though slower than if [the stronger mover] would move it on its own. But if the motive [powers] act upon different straight lines, or different circles, whether they are equal or unequal, or if they move to the same part, or to different [parts], the mobile will not rest, but will be moved with one motion, as stated; and this motion will be differentiated according to a plurality of motors and their difference and weakness and strength and according to different parts to which they are able to move.⁴⁰

The important point here is the strong link between the *virtus* and the local motion of the orbs. It is clear from these passages that the various *virtutes* are what set the mobile in motion; moreover, the combination of the direction and strength of the *virtutes* determines the direction and velocity of the mobile's motion. It is as if the *virtutes* can be described by vectors.

³⁸ Bacon, *CN*, 2.5.1.12, 431: "Si moveatur orbis aliquis inferior primo orbe ad orientem per motum primum ad occidentem, erunt illi motus a diversis virtutibus. Iste igitur virtutes aut sunt equales aut inequales. Si equales, tunc et motus ad utramque partem erunt equales, et ita aut quiescet, aut erit simul in duobus locis. Si inequales, tunc movebitur secundum motum forcioris virtutis, quamvis minus velociter."

³⁹ See Grant, "Celestial Motion."

⁴⁰ Bacon, *CN*, 2.5.1.12, 433: "Si igitur recipiuntur in mobili alicuius diverse virtutes motive super unam lineam rectam, vel super eundem circulum in contrarias partes, et fuerint equales, non movebitur, sed quiescet. Si inequales, movebitur ad partem illam ad quam motiva virtus est forcior, tardius tamen quam si sola moveret. Si autem sint motive super diversas lineas rectas, vel diversos circulos, sive virtutes moventes sive sint equales, (sive inequales,) sive ad eandem partem motive, sive ad diversas, non quiescet mobile, set movebitur uno motu, ut dictum est; et ille motus diversificabitur secundum pluralitatem motorum, et eorum diversitatem et debilitatem et fortitudinem et secundum diversitatem partium ad quas sunt motive."

4. The *virtus* of the magnet

Bacon saw a resemblance between the way iron is attracted to the magnet and the way the elements are drawn to their natural place; in both cases the motion gets stronger the closer the mobile and the attracting bodies are:

The motion of iron to the magnet is similar to the motion of the located [body] to its place [...], but this motion occurs by the influence of some *virtus*. Likewise, natural motion is stronger at the end, whence a heavy [body] moves more strongly the more it is approaching the bottom, just like iron [when it approaches] the magnet. But the cause of this strength is the body's approaching its [natural] place. Therefore, [natural] place seems to influence something, so that it may be the cause of this strength.⁴¹

Yet there is also a difference:

[T]hat which moves another by the influence of *virtus*, does not move it, except when it is in the right distance in respect to the influencing [*virtus*], like the magnet; the iron does not move except when it is in the right distance, so it can receive a certain impression of *virtus* by which it is changed so as to move. But the heavy [body], placed in any given distance, is carried to its place below, even if it were placed in the hollow orb of the moon.⁴²

The iron is drawn to the magnet only when it is at a certain distance from it; the heavy (or light, for that matter) body, by contrast, is carried to its natural place from whichever distance. It is also true, however, that when it gets closer to its natural place, its motion intensifies. We have followed the explanation for this phenomenon above. But why is the iron not drawn in the same way to the magnet? Bacon suggested the following explanation:

But iron does not have such an appetite of itself, but only an aptitude to that appetite, nor does it agree from its nature only with the magnet, as it desires [other things] yet is not moved [by them] but [it] only agrees insofar as it is naturally suited to receive its *virtus*, and then to seek [it] and move.⁴³

⁴¹ Bacon, *CN*, 1.3.2.3, 204: "motus ferri ad magnetem est similis motui locati ad locum [...] set hic motus fit per influenciam alicujus virtutis. Item, motus naturalis est forcior in fine, unde grave, quanto magis aporpinquat deorsum, tanto forcius movetur, sicut ferrum ad magnetem. Set istius fortitudinis causa est aporpinquacio ad locum, ergo, locus videtur aliquid influere, ut sit causa istius fortitudinis."

⁴² Bacon, *CN*, 1.3.2.3, 204-205: "illud quod movet aliud per influenciam virtutis, non movet illud, nisi cum est in debita distancia respectu influentis, sicut de magnete; non enim movet ferrum, nisi quando est in debita distancia ad ipsum, ut, scilicet, possit recipere aliquam virtutis impressionem per quam alteretur ut moveatur. Set grave, in omni distancia positum, fertur in suum locum deorsum, eciam si poneretur in concavitate orbis lune."

⁴³ Bacon, *CN*, 1.3.2.3, 205: "Set ferrum non habet appetitum talem de se, set solum aptitudinem ad illum appetitum, non enim ex sua natura convenit in tantum cum magnete, ut appetat nec ut

While bodies have an appetite for their natural place (in fact, as we have seen, they have more than an appetite; they have an efficient *virtus*), the iron does not have a natural appetite for the magnet; it only has an aptitude to develop such an appetite when it is the right distance from a magnet. The iron needs to receive the magnet's *virtus*, then the appetite for the magnet appears, and it is drawn to the magnet. It seems that the iron does not have its own *virtus*, directing it to the magnet, hence it is drawn to the magnet by reason of the magnet's *virtus* alone. This is the reason why Bacon writes that it desires other things as well, but since these things do not exert their *virtus* to direct it, it is not moved by them.

It appears then, that there is no uniformity among the *virtutes*; each type has its own characteristics and can move only certain bodies or substances. *Virtus* is specific and acts only on the substances that are suited to receive it. It does not act uniformly on whatever it meets. This can be gathered from another quotation, in which Bacon draws a comparison between the celestial *virtus* and the magnet:

If you say that the *virtus* of heaven will not pass to the eighth [heaven] except through the ninth [heaven], and that therefore the influence will be received in the ninth and therefore that this straight motion will first occur in the ninth – I say that this does not follow, for we see that iron follows the motion of the magnet, but air and other bodies do not because they are not suited to receive this *virtus* insofar as it is a principle of motion, although they receive it absolutely, insofar as it is an absolute form.⁴⁴

Virtus may pass through all sorts of mediums, such as the ninth heaven or air, without moving them, although it is in them absolutely. *Virtus*, by contrast with *species*, affects only the substances suited to receive its influence, namely, those with an appropriate potency. Bacon held that a *species* interacts also with the media that are not its final recipients by being incorporated in them, namely, by taking on their matter. A *species* takes the matter of the medium not in the same manner as a proper form does, since its existence there is intentional and hence diminished.⁴⁵

moveatur, set in tantum convenit, ut aptum natum sit recipere ejus virtutem, et tunc appetere et moveri.”

⁴⁴ Bacon, *CN*, 2.4.1.3, 392–393: “Si tu dicas quod virtus celi non transibit ad octavum nisi per nonum, ergo recipietur hec influencia in nono, et ideo motus ille rectus primo fiet in eo; dici potest quod hoc non sequitur, sicut nos videmus quod ferrum sequitur motum magnetis, set aer et alia corpora non sic, quia non sunt nata recipere hanc virtutem in quantum est principium motus, licet recipient eam absolute in quantum est forma absoluta.”

⁴⁵ For Bacon's understanding of the intentional being of *species* in the medium, see Katherine H. Tachau, *Vision and Certitude in the Age of Ockham—Optics, Epistemology and the Foundations of Semantics 1250–1345* (Leiden: E. J. Brill, 1988), 12.

5. The universal nature as a *virtus regitiva*

As we have seen in the previous section, *virtus* can both set things in motion toward a certain place and be the cause of their rest when they reach their destination. The *virtus regitiva* of the universal nature is the kind of *virtus* which prevents bodies from motion, and in certain circumstances prevents their motion toward their natural place.⁴⁶

Bacon deemed natural place a particular nature or cause.⁴⁷ He defined the particular nature in this way: “a *virtus* reigning over the species with its individuals, and therefore it is twofold, that is, a *virtus* reigning over the species and a *virtus* reigning over the individual”.⁴⁸ The purpose of this *virtus* is the preservation and well-being of the species (in the Porphyrian sense of a class sharing common features) and the individual. Apart from the particular nature, Bacon referred also to the universal nature, defined as a “*virtus* reigning over the universe (*virtus regitiva universi*)”.⁴⁹ By using the distinction between particular and universal natures (or *virtutes*) Bacon was able to explain phenomena which seemed to defy natural regularity. Since he considered both the particular and the universal natures to be natural, unusual phenomena such as a man with six fingers or water not descending to its natural place received a natural explanation. In the ordinary course of events, bodies behave in accordance with their particular natures. But sometimes they are forced to obey the universal nature, which overrules the internal inclinations of bodies and restrains the influence of the particular *virtus* in order to maintain the balance and order of nature as a whole.

Take for example the case of water in the clepsydra, a vessel filled with water with small holes at the bottom. As long as the opening at the top is covered, the water remains in the clepsydra and does not follow the *virtus* which directs it downward. The water in the clepsydra remains suspended, Bacon argued, because the universal nature works to prevent the formation of a vacuum so that the order and continuity of matter be preserved.⁵⁰

Another example of a clash between particular and universal *virtutes* is the restraining of the activity of celestial matter. Since celestial matter has a stronger *virtus* than elemental matter, it can transform the elements and render them celestial. But that would destroy all terrestrial corporeal natures and consequently the order of the

⁴⁶ An extensive study of the medieval idea of universal nature is found in Nicolas Weill-Parot, *Points aveugles de la nature - la rationalité scientifique médiévale face à l'occulte, l'attraction magnétique et l'horreur du vide (XIII du XV siècle)* (Paris: Les Belles Lettres, 2013).

⁴⁷ On this topic see Yael Kedar and Giora Hon, “Roger Bacon (c. 1220-1292) and his System of Laws of Nature: Classification, Hierarchy and Significance”, *Perspectives on Science* 26 (2017): 719-745.

⁴⁸ Bacon, CN, 1.2.3.(1)7, 93: “Natura particularis est virtus regitiva speciei cum suis individuis et ideo hec est duplex, scilicet, virtus regitiva speciei et virtus regitiva individui.”

⁴⁹ Bacon, CN, 1.2.3.(1)7, 92.

⁵⁰ Bacon, CN, 1.3.2.6, 224.

universe, hence the universal nature prevents that from happening.⁵¹ The universal nature is therefore a *virtus*, which administers the workings of the more particular *virtutes*. Both particular and universal natures are defined as *virtutes* by Bacon. However, the one is weaker than the other, and while the one causes motion, the other can withhold this motion.

The source of Bacon's concept of universal nature was most likely Avicenna (c. 970-1037). However, while as Nicolas Weill-Parot argues, Avicenna held that the universal nature exists as an intention,⁵² Bacon endowed it with real existence, and considered it an active power in nature. Indeed, he was not the only one to do so. Albert the Great (c. 1200-1280) defined universal nature as the one force proceeding from the first cause, which spreads among all natural things and becomes their principle of motion and rest.⁵³ The similarity between Bacon and Albert is in rendering the universal nature real; however, the principle of motion and rest in Bacon is not the universal nature but *virtus*. The universal nature is a kind of *virtus* indeed, but it is not the only such kind.

6. *Virtus and species*

In the beginning of this paper, I noted that Bacon distinguished between two types of *virtutes*. The one, properly called *virtus*, is a feature of a form, while the other, properly called *species* is entangled with matter. Hence *virtus* is the power of efficient causality, and *species* is matter's response to that power, formed as a part of the internal inclination of matter to be promoted by the reception of new forms.

There is also an ontological difference between *virtus* and *species*: *virtus* is a real being, and the capacity for the full realization of a potency; a *species* is its first effect, having a deficient being. *Virtus* exists absolutely in the medium; *species* exist there intentionally. Bacon had a unique understanding of the meaning of the 'intentional' existence of the *species in medio*. While among his contemporaries 'intentional' was considered equivalent to 'spiritual' (though not necessarily 'mental') and opposed to 'natural', Bacon thought of 'intentional' as having a weak and incomplete being.⁵⁴ A *species*, Bacon wrote, in relation to a 'real' being is so deficient that it cannot be enumerated among the things of this world. It "is not called a thing, but more the similitude of things".⁵⁵

Moreover, it seems that *virtus* is considered as the very capacity to perform work: "for a *species* has active *virtus (virtutem activam)* by which it can produce its like along

⁵¹ See Bacon, *DMS*, 1.6, 84-85.

⁵² See Weill-Parot, *Points aveugles*, 288.

⁵³ See Weill-Parot, *Points aveugles*, 295.

⁵⁴ For a thorough analysis of the nuances of the Medieval discussions of intentional existence in the medium, sense and intellect, see Robert Pasnau, *Theories of Cognition in the Later Middle Ages* (Cambridge: Cambridge University Press, 1997).

⁵⁵ Bacon, *CN*, 1.1.2.2, 23: "non vocantur res, set magis similitudines rerum."

all diameters in the part of the medium immediately adjacent to it”.⁵⁶ The active power of the production of *species*, which enables it to multiply and regenerate, is *virtus*. Bacon argued that only active natures produce *species*, and what renders a nature active is its *virtus*. The material principle, which Bacon distinguished from *virtus*, does not produce *species* by its own proper nature, since it is passive and receptive.⁵⁷ Quantitative properties (such as the natural place’s surface) do not produce *species* according to Bacon, since they belong to matter.⁵⁸ Hence *virtus* is the power which renders a nature active and capable of producing *species*.

Both *virtus* and *species* are vehicles of natural causality. *Virtus* is the power used by the prime mover to keep the celestial substances in motion, by the natural place to attract its appropriate element, by the magnet to attract iron, and by the universal nature to administer the natural balance. It works by stimulating a natural appetite in the attracted substance, which is always directed toward a specific end. *Species*, in its turn, are the product of this natural appetite (or the ‘active potentiality’ which all material things share). It is the universal apparatus allowing all material things to be acted upon by *virtus*.⁵⁹ Hence, it has the same features and the same mode of activity in all things natural. The *virtutes* may vary, but the reaction of matter will always be the same. In this sense, the activity of *species* is ‘blind’ or automatic. It receives its direction from the *virtus* which administers it.

A *species* resembles its agent in essence and operation. Bacon followed here the Aristotelian causal synonymy principle, according to which like causes like.⁶⁰ *Virtus* need not adhere to this principle, since it does not account directly for generation, but does so by the mediation of *species*. A *species* must be similar to its agent also because “the agent directs its efforts to making the recipient similar to itself”.⁶¹ This is a feature of either qualitative change or generation, but irrelevant to locomotion. Indeed, when Aristotle spoke about four kinds of motion and change – those in substance, in quality, in quantity and in place – it seems that his principle of causational synonymy did not

⁵⁶ Bacon, *DMS*, 3.1, 185: “sed quia habet virtutem activam qua potest sibi similem producere parte medii coniunctur illi in qua est secundum omnes diametros.”

⁵⁷ Bacon, *DMS*, 1.2, 33. “sed quia habet virtutem activam qua potest sibi similem producere in parte medii coniuncta illi in qua est secundum omnes diametros [...] Sed species solum requirit medium postquam est in medio iam multiplicata; et potest sibi similem per se facere ex sua potestate activa.”

⁵⁸ Bacon, *DMS*, 1.2, 37-41. In Bacon’s account, the quantitative properties belong to prime matter before it has been specified by a form. Prime matter, in opposition to specific matter (namely, matter compounded with form), does not produce *species*. See also Bacon, *Opus maius*, 4.4.10: “Figuratio vero est passio materiae, et invenitur in rebus ratione materiae, sicut et quantitas.”

⁵⁹ For the universal and uniform propagation of *species* in Bacon’s philosophy of nature, see Kedar and Hon, “Roger Bacon (c. 1220-1292) and his System”, 724-729.

⁶⁰ Helen S. Lang, *The Order of Nature in Aristotle’s Physics: Place and the Elements* (Cambridge: Cambridge University Press, 1998), 71, calls this the “suchlike principle”, according to which the actuality of the mover and the potentiality or rather the actuality received in the thing moved must be of the same type.

⁶¹ Bacon, *DMS*, 1.1, 7: “agens intendit assimilare sibi patiens.”

include locomotion.⁶² One reason for this is that locomotion affects the substance the least; it does not change the being of the moved object.⁶³

A *species* does not advance in the medium by locomotion; it regenerates itself in consecutive parts of the medium. The production of a *species*, Bacon explains, involves a true and natural transmutation of the substance of the patient, which is made by true generation (*per veram generacionem*). The patient in this case is any receiver of a *species*, be it the medium or the final recipient.⁶⁴ A *virtus*, by contrast, passes through all sorts of mediums without affecting them; it affects only the substances predisposed to receive its influence.

7. Conclusions

In *Physics* VIII, Aristotle declared that locomotion is the primary motion:

[A] thing is in motion in the strict sense of the term only when its motion is motion in respect of place; if a thing is in process of increase or decrease or is undergoing some alteration while remaining at rest in the same place, we say that it is in motion in some particular respect; we do not say it is in motion without qualification.⁶⁵

Following the analysis of the ways the term *virtus* is treated by Bacon, it would seem that Bacon took Aristotle seriously, and thus made the cause of locomotion, namely *virtus*, the primary physical power. ‘Primary physical power’ means, in this context, three things: (1) that it is an efficient cause, responsible for all motions of inanimate bodies with respect to place. Bacon explained physical effects other than locomotion by an appeal to the activity of *species*, yet not as efficient causes; (2) that it is first in the order of dependency, namely, that the power called *species* depends on and receives its ability to act from *virtus*, while *virtus* is not equivalently dependent on *species*; (3) that it is an inherent feature of the nature, essence or form of things, and as such it enjoys a firm ontological status, namely, that of a being in the full sense of the term. It has a real being rather than a deficient one.

Virtus appears in Bacon’s natural philosophy as a matrix of forces, and there is a play between different intensities of *virtus* coming from different directions and distances: the water is too remote from the first orb, therefore its own *virtus* prevails and it cannot complete a circle; when the internal *virtus* of a substance is joined with

⁶² Aristotle, *Physics*, III, 2, 202a9-12, translated by J. Barnes, *The Complete Works of Aristotle – The Revised Oxford Translation* (Princeton: Princeton University Press, 1984), vol. 1, 315-446, 344.

⁶³ Aristotle, *Physics* VIII, 7, 261a20f, translated by J. Barnes, vol. 1, 436. See Istvan Bodnar, “Aristotle’s Natural Philosophy”, in *The Stanford Encyclopedia of Philosophy* (Spring 2018 Edition), edited by E. N. Zalta: <https://plato.stanford.edu/archives/spr2018/entries/aristotle-natphil/>.

⁶⁴ Bacon, *DMS*, 1.3, 47.

⁶⁵ Aristotle, *Physics* VIII, 9 266a1, translated by J. Barnes, vol. 1, 444.

the *virtus* of a natural place, the motion intensifies; equal *virtutes* coming from opposite directions cancel each other out and slow or annul the orb's rotary motion.

Following the analysis of the role of *virtutes* in moving the celestial orbs, the elements to their natural place and the iron to the magnet, and following their comparison with the function of *species*, we can now safely say that *virtus* has a distinct status as the efficient cause in Bacon's physics, since it is that by which a thing is made active and able to produce *species*. This conclusion is reinforced by the definition of a *species* as the 'first effect' and similitude of *virtus*.

Bacon's theory of *virtus* is not entirely worked out. It leaves some questions unanswered, such as how exactly is *virtus* related to form and what does it mean for it to exist in an intermediary recipient 'absolutely'? Similarly, it is not entirely clear how a *virtus* links to the nature of things. Nevertheless, it seems clear that except for the case of local motion, *virtus* operates through the material production of *species*.

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