

# ABSOLUTE SPATIAL DIFFERENCES: GROSSETESTE'S READING OF ARISTOTLE'S *ON THE HEAVENS*

## DIFERENCIAS ESPACIALES ABSOLUTAS: LA LECTURA DE GROSSETESTE DEL *SOBRE EL CIELO* DE ARISTÓTELES

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### Abstract

This article deals with Robert Grosseteste's account of 'spatial differences', such as 'up', 'down', 'right', 'left', 'before', and 'behind'. More specifically, attention is focused on Grosseteste's *De differentiis localibus*, which is a concise scientific treatise arguing for the objectiveness of the differences of place pertaining to all living bodies, including heavenly ones. The article has a two-fold goal: to present the contents of such an understudied opuscle, and to check if there is some compelling reliance on any of the Latin versions of Aristotle's *On the Heavens*. Such an analysis reveals that Grosseteste's reading of Aristotle's *On the Heavens* is angled by Averroes' *Long Commentary on the Physics*, on which Grosseteste relies as well to build his conception of mathematical and natural differences.

### Keywords

Robert Grosseteste; Aristotle; *On the Heavens*; Space; Universe; Mathematical Dimensions; Natural Dimensions

### Resumen

Este artículo trata sobre la descripción de las 'diferencias espaciales' de Roberto Grosseteste, como 'arriba', 'abajo', 'derecha', 'izquierda', 'antes' y 'detrás'. Más específicamente, se presta especial atención al *De differentiis localibus* de Grosseteste, que es un breve tratado científico que defiende la objetividad de las diferencias de lugar y su pertenencia a todos los cuerpos vivos, incluidos los celestiales. El artículo tiene un doble objetivo: presentar el contenido de este opúsculo tan poco estudiado y comprobar si presenta alguna dependencia respecto a alguna de las versiones latinas del *Sobre el cielo* de Aristóteles. Este análisis revela que la lectura de Grosseteste de *Sobre el cielo* de Aristóteles está condicionada por el *Comentario largo sobre la Física* de Averroes, en el que Grosseteste también se basa para fundar su concepción de las diferencias matemáticas y naturales.

### Palabras clave

Roberto Grosseteste; Aristóteles; *Sobre el cielo*; espacio; universo; dimensiones matemáticas; dimensiones naturales

All theories of motion deal with spatiotemporal quantities and call for determining whether these are absolute or relative.<sup>1</sup> Namely, they demand to decide if a motion of a given kind, say locomotion, entails something moving with respect to either an arbitrary (i.e., relative) or a privileged (i.e., objective) reference object. This issue stands for classical as well as post-Newtonian mechanics.<sup>2</sup> Within an Aristotelian setting, which is what this article is concerned with, such interest is fostered by questions concerning the structure of the universe as well as the movement of bodies, such as: Is there an absolute ‘right’ or ‘left’ when we talk about the structure of the universe or the movement of the four elements? Aristotle tackles this topic in his *Physics*, openly referring to spatial quantities as absolute: right, left, up, down, behind, and before are ‘spatial differences’ not given by human convention, but rather by nature.<sup>3</sup> It is in his *On the Heavens* that he extensively deals with this topic, specifying that absolute spatial quantities are such by nature and are not determined based on the place from which the observation is made.

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<sup>1</sup> I express my gratitude to Cecilia Panti for her valuable insights into Grosseteste's cosmological theories and, more broadly, for inviting me to delve into an understudied treatise by Grosseteste such as *De differentiis localibus*.

<sup>2</sup> Two recently updated sister-entries in the *Stanford Encyclopedia of Philosophy* take stock of this issue in ancient and modern physical theories. See Carl Hofer, Nick Huggett, and James Read, “Absolute and Relational Space and Motion: Classical Theories”, in *The Stanford Encyclopedia of Philosophy* (Winter 2022 Edition), edited by E. N. Zalta and U. Nodelman. URL = <<https://plato.stanford.edu/archives/win2022/entries/spacetime-theories-classical/>>. And Nick Huggett, Carl Hofer, and James Read, “Absolute and Relational Space and Motion: Post-Newtonian Theories”, in *The Stanford Encyclopedia of Philosophy* (Spring 2022 Edition), edited by E. N. Zalta. URL = <<https://plato.stanford.edu/archives/spr2022/entries/spacetime-theories/>>.

<sup>3</sup> Aristotle, *Physics*, III, 5, 205b32, translated by J. Barnes, *The Complete Works of Aristotle: The Revised Oxford Translation* (Princeton: Princeton University Press, 1984), vol. 1, 45: “Further, every sensible body is in place, and the kinds or differences of place are up-down, before-behind, right-left; and these distinctions hold not only in relation to us and by convention, but also in the whole itself”; and *ibid.*, IV, 1, 208b9: “Nor do such distinctions (up and down and right and left) hold only in relation to us. To us they are not always the same but change with the direction in which we are turned: that is why the same thing is often both right and left, up and down, before and behind. But in nature each is distinct, taken apart by itself.” For an overview of the interpretations of Aristotle's account of place and local movement, see Johannes Fritsche, “Place and Locomotion in *Physics* Δ 4, 212a14-30”, *Revue de philosophie ancienne* 34/1 (2016): 61-90.

As much as the two works are consistent on this point, they do leave Aristotle's thought open to possible misinterpretations, as we will see. In book 1 of *On the Heavens*, Aristotle expands on the up- and downwards movement of natural bodies. Rectilinear locomotion is a kind of simple movement that characterizes simple bodies (i.e., the four elements) moving either away or towards the center of the universe. Such rectilinear, up- and downwards locomotion somehow precedes the mixed movement proper to composite bodies (i.e., those composed of simples ones). In this sense, we might speak of two main, objective 'spatial differences', i.e., 'up' and 'down', to the detriment of the other four.<sup>4</sup> However, as specified throughout book 2, absolute 'spatial differences' include also right, left, behind, and before and they concern all ensouled beings – not only animated sublunar bodies, but also the heavens themselves.

Such inconsistency, however small it might be, did not elude Robert Grosseteste (ca 1170-1253), philosopher, theologian, translator, and polymath to whom this special issue is dedicated. Among his early scientific works, composed between 1220 and 1230, we count an opuscle titled precisely *On Spatial Differences* (*De differentiis localibus*), which is aimed at arguing for the objectiveness or absoluteness of all six spatial differences.<sup>5</sup> This brief text targets precisely the minor discrepancy between book 1 of *On the Heavens*, on the one hand, and the *Physics* and book 2 of *On the Heavens*, on the other. As it will be shown, the inconsistency Grosseteste observes between the two Aristotelian works depends on his reading of *On the Heavens* mediated by Averroes' misjudgment. In any case, this does not prevent him from developing a fully Aristotelian account of spatial differences, which remains mainly rooted in *On the Heavens*.

This article has two-fold goal: to present the contents of such an understudied scientific opuscle by Grosseteste, and at the same time to check if there is some compelling reliance on any of the Latin versions of Aristotle's *On the Heavens*.<sup>6</sup> Before delving into the contents of *On Spatial Differences* (hereafter OSD), let us briefly recall which Latin versions of Aristotle's *On the Heavens* were available at Grosseteste's time and explain why some puzzlement might arise concerning the chronology of his

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<sup>4</sup> Aristotle, *On the Heavens*, I, 2 (268b11-27) and I, 8 (277a18-23). Another kind of simple locomotion is circular. The movements of composite bodies can be mixed (i.e. rectilinear and circular) in accordance with their predominant component.

<sup>5</sup> For the chronology of Grosseteste's works see Cecilia Panti, "Robert Grosseteste and Adam of Exeter's *Physics of Light*: Transmission, Authenticity, and Chronology of Grosseteste's Scientific Opuscula", in *Robert Grosseteste and His Intellectual Milieu*, edited by J. Flood, J. R. Ginther, and J. Goering (Toronto: Brepols, 2013), 165-190. *On Spatial Differences* has been edited in L. Baur, *Die philosophischen Werke des Robert Grosseteste, Bischofs von Lincoln* (Münster: Aschendorff, 1912), 84-87. Hereafter simply OSD, followed by the page and line number.

<sup>6</sup> The starting point of this study, especially with regard to Grosseteste's reliance on Simplicius, is Cecilia Panti, "Il *De caelo* nel medioevo: le citazioni e la translatio di Roberto Grossatesta", *Fogli di filosofia* 12/2 (2019): 67-107.

works.<sup>7</sup> One compendium and three translations of *On the Heavens* circulated in the Latin world up to the first half of the 13<sup>th</sup> century. (1) The *Liber celi et mundi* is a compendium made by Hunayn ibn Isah and based on Abu Yahya Ibn Al-Bitriq's translation of *On the Heavens* into Arabic.<sup>8</sup> The compendium was anonymously translated into Latin and known under the name of Aristotle and then of Avicenna, which assured this text a wide circulation even after the actual Latin translations of *On the Heavens* came into play. (2) The first integral translation of *On the Heavens* into Latin is due to Gerard of Cremona (1114-1187) and is based on Abu Yahya Ibn Al-Bitriq's Arabic version. It is the result of Gerard's work in Toledo, where he built a network of collaborators committed to translate many other scientific and philosophical texts according to a specific program based on the classification of the sciences given by Al-Farabi.<sup>9</sup> Gerard's translation was the most widely known in the Middle Ages, until the translation by William of Moerbeke made its appearance.<sup>10</sup> (3) The second translation from the Arabic is by Michael Scot (1175 – 1232). In Toledo, Michael translated Averroes' 'big commentaries', including the one on *On the Heavens*, which comprises the lemmata of Aristotle's text.<sup>11</sup> Grosseteste might have known all the versions mentioned so far, but the only Latin translation from the Greek of *On the Heavens* available to him was (4) the one made by Grosseteste himself, which also included Simplicius' commentary.<sup>12</sup> His translation is nevertheless partial, for it goes from book 2 up to the very beginning of book 3 of *On the Heavens* (i.e., up to 299a12), covering the respective passages of Simplicius' commentary.

Now, we know that Grosseteste's activity as translator marked the years of his episcopate, that is, from 1235 until his death in 1253. Theoretically, his translation of *On the Heavens* and Simplicius' commentary traces back to that circumscribed period of

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<sup>7</sup> I don't address William of Moerbeke's translation here for obvious chronological reasons, since it was made after Grosseteste's time.

<sup>8</sup> Pseudo-Avicenna, *Liber celi et mundi*, edited by O. Gutman (Leiden and Boston: Brill, 2003).

<sup>9</sup> See Charles Burnett, "The Coherence of the Arabic-Latin Translation Program in Toledo in the Twelfth Century", *Science in Context* 14 (2001): 249-288.

<sup>10</sup> Gerard's Latin translation is edited in Albert the Great, *De caelo et mundo*, edited by P. Hossfeld, *Alberti Magni Opera omnia* 5.1 (München im W.: 1971). Hereafter cited as Gerard, *Translatio De caelo*, followed by Bekker numbering and page number in Hossfeld's edition.

<sup>11</sup> Averroes, *Commentum magnum super libro De celo et mundo Aristotelis*, edited by F.J. Carmody and R. Arnzen, *Recherches de théologie et philosophie médiévales*, Bibliotheca 4 (Leuven: Peeters, 2003), 2 vol. Hereafter cited as Michael, *Translatio De caelo*, followed by Bekker numbering and page number in Carmody's and Arnzen's edition.

<sup>12</sup> On the Latin transmission of Simplicius' commentary, see Donald J. Allan, "Mediaeval Versions of Aristotle's *De Caelo*, and of the Commentary of Simplicius", *Mediaeval and Renaissance Studies* 2 (1950): 82-120; and Fernand Bossier, "Traductions latines et influences du commentaire *In De caelo* en Occident (XIIIe-XIVe s.)", in *Simplicius. Sa vie, son oeuvre, sa survie. Actes du colloque internationale de Paris (28 sept. - 1er oct. 1985)*, edited by I. Hadot (Berlin and New York: De Gruyter, 1987), 289-325. For recent insights concerning the dissemination and the reception of Grosseteste's translation of Aristotle's *De caelo* and of Simplicius' commentary, see Pieter Beullens, "Robert Grosseteste's Translation of Simplicius' Commentary on Aristotle's *De caelo*. Tracking Down a Second Manuscript and the Greek Model", *Mediterranea*, 8 (2023): 565-594.

time, whereas scientific works such as OSD were supposedly composed before 1230. Here comes the jigsaw puzzle. While analyzing the possible references to Aristotle's *On the Heavens* in some of Grosseteste's scientific works, Cecilia Panti pointed out how problematic Grosseteste's alleged reliance on Simplicius' commentary might be in OSD.<sup>13</sup> Panti remarked that Grosseteste does seem to rely on Simplicius, warning that such closeness would lead to reconsidering OSD's chronology and perhaps to push back its date of composition. In the following sections, along with with an analysis of the contents of OSD, the reader will be given some references to the closest parallel passages of the Latin versions of *On the Heavens*.

### 1. What Are Spatial Differences?

OSD opens with a characterization of spatial differences. Like all differences stemming from a genus, they can be found within a species as well as within an individual being. Yet, two or more differences of same kind cannot be in the same species or individual being at the same time: a human being cannot be, for instance, hook-nosed and snub-nosed simultaneously. This applies as well to those differences concerning the place, which are six in number: up, down, right, left, before, and behind. From this perspective, no place is both left and right simultaneously.<sup>14</sup>

As Table no. 1 shows, Grosseteste's definition of spatial differences as well as their number is quite similar to that presented by Simplicius in Grosseteste's translation. Cecilia Panti pointed out this similarity and conjectured that Simplicius might even have inspired Grosseteste in titling his text *On Spatial Differences*.<sup>15</sup> However, the definition of the three pairs of places as 'differences' is also put forward in James of Venice's translation of Aristotle's *Physics* and Michael Scot's translation of Averroes' *Long Commentary on the Physics* (which includes the text of the *Physics*, too).<sup>16</sup> Without dismissing the resemblance

<sup>13</sup> Panti, "Il *De caelo* nel medioevo", 98-100.

<sup>14</sup> OSD, 84, ll. 18-24: "Differentiarum idem genus condividendum nulla cum alia simul est in eadem specie vel individuo illius generis. Sed sex sunt differentiae locum primo condidentes scilicet: sursum, deorsum, dextrum, sinistrum, ante et retro. Ergo in nullo eodem loco est aliqua illarum simul cum alia. Sed unaquaeque pars horizontis sursum est: ergo nulla earum est dextrum vel sinistrum, vel ante vel retro." From my viewpoint, differences of place refer to the spatial structure of things. In this sense, they could be also called local differences.

<sup>15</sup> Panti, "Il *De caelo* nel medioevo", 98. Simplicius' *Commentary* is edited in: Robertus Grosseteste translator Simplicii, *In De caelo*, consultable on the AL Database (VIII, 1). Hereafter, Simplicius, *Commentary*, followed by Heiberg numbering.

<sup>16</sup> Iacobus Venetus translator Aristotelis, *Physica*, edited by F. Bossier and J. Brams, *Aristoteles Latinus* VII, 1 (Leiden and New York: Brill, 1990). The Latin version of Averroes' *Long Commentary on the Physics* is printed in *Aristotelis De physico audito cum Averrois Cordubensis Commentariis*, Aristotelis opera cum Averrois commentariis IV, Venice 1562 (reprinted by Minerva, Frankfurt am Main, 1962). On the Latin translation of Averroes' *Long Commentary on the Physics* attributed to Michael Scot, see Horst Schmieja, "Der Physikkommentar von Averroes in der Editio Iuntina: Die mittelalterlichen Quellen für Buch 6, Text 87", *Bulletin de philosophie médiévale* 43 (2001): 75-93;

between OSD and Simplicius' *Commentary*, the parallels with the Latin versions of the *Physics* invite us to be more cautious in accepting Panti's hypothesis.

OSD, p. 84, ll. 19-21	Simplicius' <i>Commentary</i> , transl. by Grosseteste (Heiberg 395)	<i>Physica</i> , transl. by James of Venice (205b), p. 123	<i>Physica</i> (in <i>Averroes' Long Comm.</i> ), transl. by Michael Scot (205b), col. 109M
Sed sex sunt <b>differentiae locum</b> primo dividentes scilicet: <u>sursum,</u> <u>deorsum,</u> <u>dextrum,</u> <u>sinistrum,</u> <u>ante et</u> <u>retro.</u>	... quae autem secundum locum terminata <u>sursum et</u> <u>deorsum et dextrum</u> <u>et sinistrum et ante et</u> <u>retro</u> ; ipsae enim sunt <b>locorum</b> <b>differentiae.</b>	Amplius, omne corpus sensibile in loco est, <b>loci</b> autem species et <b>differentie</b> <u>sursum,</u> <u>deorsum,</u> <u>ante,</u> <u>retro,</u> <u>dextrum et</u> <u>sinistrum.</u>	Et omne corpus sensibile est in <b>loco</b> , et <b>differentiae eius</b> sunt <u>superius et</u> <u>inferius,</u> <u>et dextrum</u> <u>est sinistrum,</u> <u>et</u> <u>ante et retro.</u>

Table no. 1

According to Grosseteste, the three pairs of spatial differences are grounded on the distance that is enclosed by different limits (*ex terminis distantiarum differentibus*): opposite the limits, opposite the differences of place. For instance, what we call 'up' and 'down' are such based on the distance between two opposite limits: what is 'up' cannot be drawn from itself but, rather, only from an opposite place, that is, what is 'down'. Distance is key, therefore, to speak of spatial differences and this precisely represents another reason why two spatial differences cannot be in the same place at the same time.<sup>17</sup> Aristotle describes such differences mainly on the basis of them being the starting point of a movement, and this is consistent with what we read in Gerard of Cremona's and Michael Scot's translations. 'Up' is a 'difference' that can be called 'principle' in so far as it is the starting point of a specific kind of motion, that is, growth.<sup>18</sup> Differently, Grosseteste presents the differences of place according to the space bounded by spatial limits. An echo of the terminology used in OSD can be found

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and Dag Nikolaus Hasse, *Latin Averroes Translations in the First Half of the Thirteenth Century* (Hildesheim: Olms, 2010). Differently from James of Venice's and Michael Scot's translations of the *Physics*, in Gerard of Cremona's and Michael Scot's translations of *On the Heavens*, right, left, up, down, behind, and before are labelled as *partes*, *dispositiones*, or *principia*. See Gerard, *Translatio De caelo*, 285b, 109; and Michael, *Translatio De caelo*, 285b, 279-280.

<sup>17</sup> OSD, 84, ll. 25-30: "Item loca solum differentias habent ex terminis distantiarum differentibus: ergo ex oppositis oppositas et ex diversis diversas. Quod ergo sursum et deorsum sint diversae differentiae, hoc erit ex distantia unius ad alterum. Ergo cum idem locus a se non possit distare, in eodem loco naturaliter non erit dextrum et sinistrum."

<sup>18</sup> Aristotle, *On the Heavens*, II, 2, 284b27-31. Grosseteste does not reject this stance, but he expands on it specifically with regard to 'natural dimensions'; see OSD, 86.

in his translation of Simplicius' *Commentary*: when introducing book 2 of *On the Heavens*, Simplicius summarizes it by stressing its focus on 'spatial distances' (*locales distantiae*) and their 'limits' (*termini*).<sup>19</sup> This might suggest that Grosseteste relied on Simplicius' reading in conceiving of spatial differences as something enclosing some distance.

After specifying what the spatial differences are, Grosseteste delves into Aristotle's inconsistency that I have mentioned earlier about the prevalence of two main absolute differences over the other four. In Grosseteste's view, in *On the Heavens*, Aristotle maintains that the center and circumference (*medium* and *horizonta*) of the universe are the only two 'natural places'. As a consequence, 'up' and 'down' would be the only absolute spatial differences (*secundum naturam*), whereas the remaining four would be relative (*quoad nos*).<sup>20</sup> What is the reason for such a farfetched (and in any case erroneous) interpretation of Aristotle's text? As already said, this might be due to the stress Aristotle himself puts in *On the Heavens*, book 1, on the rectilinear movement of simple bodies away and towards the center of the universe.<sup>21</sup> Considering this, Grosseteste might have (over-)interpreted Aristotle's thought, and spotted in *On the Heavens* a predominance of the spatial differences of 'up' and 'down', contrasting with Aristotle's more balanced view in the *Physics*. Nevertheless, there is a more substantial explanation, for Grosseteste's interpretive mistake has a striking similarity to Averroes' account exposed in his *Long Commentary on the Physics*. Averroes, too, maintains that in *On the Heavens*, Aristotle spoke of two main 'natural places'. Like Grosseteste, he stresses that in *On the Heavens* 'up' and 'down' (*inferius* and *superius*) are by nature whereas the other spatial differences are identifiable according to our (changing) position, and not by nature, as it is said in the *Physics*. Such a shared mistaken reading of *On the Heavens* leads us to suppose that Grosseteste read Aristotle's *On the Heavens* through Averroes' lenses.<sup>22</sup>

OSD, p. 84, ll. 19-21	Averroes' <i>Long Comm. on the Physics</i> , transl. by Michael Scot (205b), col. 110A
Item dicit Aristoteles in libro <i>de caelo et mundo</i> quod <b>tantum duo sunt loca naturalia</b> scilicet medium et horizonta. Ergo ceterae differentiae loci, cum non fuerint <u>secundum naturam</u> erunt <u>quoad nos</u> , quod est contra ipsum in <i>Physics</i> .	Sed, ut dictum est in <i>Coelo et Mundo</i> , <b>loca naturalia sunt duo tantum</b> , scilicet superius et inferius, et ipse expressit hic quod istae differentiae <u>sunt naturaliter, non positione</u> .

Table no. 2

<sup>19</sup> Simplicius, *Commentary*, Heiberg, 366: "Secundo de localibus ipsius distantii et his qui secundum ipsas terminis et eo quod sursum et deorsum et dextro et sinistro et ante et retro."

<sup>20</sup> OSD, 85, ll. 1-4: "Item dicit Aristoteles in libro *de caelo et mundo* quod tantum duo sunt loca naturalia scilicet medium et horizonta. Ergo ceterae differentiae loci, cum non fuerint secundum naturam erunt quoad nos, quod est contra ipsum in *Physics*."

<sup>21</sup> See note 4.

<sup>22</sup> It also corroborates the idea that the Latin translation of Averroes' *Long Commentary on the Physics* was available in the West from the first third of the 13<sup>th</sup> century. See Ruth Glasner, *Averroes' Physics. A Turning Point in Medieval Natural Philosophy* (Oxford: University Press, 2009), 12.

However, it appears that Grosseteste directly draws on *On the Heavens* when explaining that a light body, for instance, moves naturally upwards, that is, towards a precise part of the circumference and along a specific straight trajectory.<sup>23</sup> In *On the Heavens* book 2, Aristotle wonders about the position of earth and whether it is at rest or in motion: it rests at the center of the spheric universe, but it does still have some natural motion towards the center determined precisely by its heaviness. Contrarily, light elements tend towards the outer surface or circumference of the universe. From this point of view, the basic structure of the universe is determined accordingly to the fundamental motions of heavy and light elements downwards and upwards with respect to the center of the universe.<sup>24</sup> While agreeing on that, Grosseteste's explanation goes beyond Aristotle's statement, as he puts forward a geometric example, aimed at showing that nature acts in the most economical way, that is, by taking the shortest perpendicular path towards its intended, natural place. The example is the following (see Figure no. 1). Let us take a point (A) drawn within a circle and not coinciding with the latter's center (O) as the starting point of a line. If said line is intended to reach the circumference, it will do so not by passing through the center of the circle (hence forming the line AC) but rather aiming directly at the circumference itself (i.e., forming the line AB). Nature, according to Grosseteste, operates in this way when it comes to the up- and downward movement of light and heavy things.

If within a circle, a point is drawn outside from the center, the line that starts from that point and ends on the circumference via the center, is the longest of all; whereas that [line] which is drawn from that point towards the circumference and brings the diameter to completion, is the shortest one. Thus, it is along the latter that nature moves when it aims at the circumference. Therefore, for each region on the surface of the Earth there is no more than one part of the horizon upwards, but all [parts of the horizon] correspond to the center [of the Earth]. Therefore, there will not be other [spatial] differences according to our position, but according to the place of the single regions on the Earth.<sup>25</sup>

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<sup>23</sup> OSD, 85, ll. 5-10: "Huius solutio patet ex appositione: hoc solum sursum est, in quod movetur leve non prohibitum. Sed leve extra medium existens non ad quamcumque partem horizontis movetur, sed ad unam tantum. Ergo termino distante extra medio sumpto solum, una pars horizontis sursum est respectu istius, et aliae partes aliis differentiis relinquuntur."

<sup>24</sup> Aristotle, *On the Heavens*, II, 13, 295b1-30.

<sup>25</sup> OSD, 85, ll. 12-19: "Si in circulo extra centrum signetur punctus, linea, quae ab isto puncto inchoatur et per centrum transiens ad circumferentiam terminatur, omnium longissima est, quae vero ab illo puncto ad circumferentiam trahitur et quae cum ea perficit diametrum, est omnium brevissima. Ergo per eam movebit natura, si intendat ad circumferentiam. Ergo respectu singularum habitationum in superficie terrae sunt singulae partes horizontis sursum et non plures, respectu vero medii omnes. Non ergo erunt reliquae differentiae secundum positionem nostram, sed secundum situm singularum habitationum terrae."



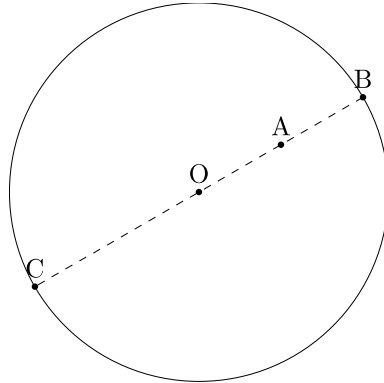


Figure no. 1

The geometric example can of course be applied to a spheric setting like the cosmos, as Figure no. 2 shows. Let us imagine two concentric spheres, one corresponding to the surface of the Earth and the other to the outer surface of the universe. A point  $x$  on the rounded surface of the Earth can aim straightly only towards a corresponding point  $y$  on the horizon, that is, a point  $y$  on the circumference of the universe. From the perspective of point  $x$ , the movement will be upwards, that is, from the center of the sphere to point  $y$  on the circumference and along the radius of the sphere. In this case, therefore, 'up' and 'down' appear to be the only spatial differences, no matter what point on the Earth we choose.

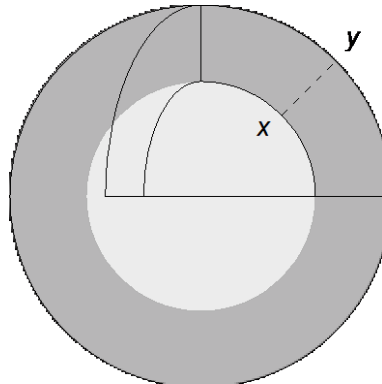


Figure no. 2

Beyond this doctrinal reconstruction, another thing worth noticing is the specific terminology that Grosseteste shares with both Gerard's and Michael's Latin versions,

that is, the words *medium* and *horizon*, which stand respectively for the center and the outer surface of the spheric universe, and which are defined as *loca naturalia* by all of them.<sup>26</sup> Even more clear, though, is the resemblance between Grosseteste and Simplicius when dealing with spatial differences applied to bodies, as we can see from Table no. 3.<sup>27</sup>

OSD, p. 85, ll. 24-27	Simplicius' <i>Commentary</i> , transl. by Grosseteste (Heiberg 383)	<i>De caelo</i> , transl. by Grosseteste (284b20)
<p><u>Corporis</u> tres sunt dimensiones, scilicet longitudo, latitudo et spissitudo. <u>Termini longitudinis</u> sunt <u>sursum et deorsum</u>, <u>latitudinis dextrum et sinistrum</u>, <u>spissitudinis ante et retro</u>, ut dicit Aristoteles in libro <i>de caelo et mundo</i>.</p>	<p>Tribus enim existentibus corporis distantis, longitudine, latitudine, profunditate, [...] tres fiunt coniugatum differentiae <u>in animalium corporibus</u>. <u>Longitudinis</u> quidem enim <u>termini sursum et deorsum</u>, <u>latitudinis autem dextrum et sinistrum</u>, <u>profunditatis vero ante et retro</u>.</p>	<p>Est autem superius quidem longitudinis principium, dextrum latitudinis, ante autem <b>profunditatis</b>.</p>

Table no. 3

Spatial differences mark the dimensions of bodies: ‘up’ and ‘down’ are the limits of their length, ‘right’ and ‘left’ of their width, ‘before’ and ‘behind’ of their depth. As explained by Aristotle himself in his *On the Heavens*, spatial differences are ‘principles’ of such dimensions – e.g., ‘up’ is the principle of length, that is, bodies can develop in length starting from their upside –, whereas Simplicius and Grosseteste stress that spatial differences are ‘limits’ of such dimensions – e.g., ‘up’ and ‘down’ contain the longitudinal dimension. As much as close Grosseteste and Simplicius are, they show a remarkable divergence concerning depth, for in OSD it is called *spissitudo*, while Simplicius calls it *profunditas*, consistently with Grosseteste’s translation of *On the*

<sup>26</sup> Gerard, *Translatio De caelo* (295b25), 190; and Michael, *Translatio De celo* (295b25), 446. See Panti, “Il *De caelo* nel medioevo”, 99. In my opinion, in OSD Grosseteste refers to the horizon as the outermost spheric part of the universe, in this respect aligning himself to the generic meaning given by the Latin translators. However, in his *De sphaera* the account of the horizon is astronomically more accurate, for it is the earth’s circumference that a person is able to see all around her if she turns by 360°. See Robert Grosseteste, *De sphaera*, edited by C. Panti, *Moti, virtù, motori celesti nella cosmologia di Roberto Grossatesta* (Florence: SISMEL-Edizioni Del Galluzzo, 2001), 297, ll. 150-151: “Orizon vero est circulus qui dividit medietatem celi visam a medietate non visa, et interpretatur orizon finitor visus.”

<sup>27</sup> See Panti, “Il *De caelo* nel medioevo”, 99-100.

*Heavens*. The term *spissitudo* is to be found only in what Oliver Gutman defines as the version  $\beta$  of the *Liber caeli et mundi*.<sup>28</sup> However, *spissitudo* is all but a rare term to refer to depth in medieval astronomical texts, an example being Sacrobosco's *De sphaera*, a scientific work well known to Grosseteste himself.<sup>29</sup>

## 2. Mathematical and Natural Dimensions

We have seen that, according to Grosseteste, absolute spatial differences stand as limits for distances, and they are six in number- although it might seem that 'up' and 'down' have some sort of priority over the others, given the rectilinear movement of the light and heavy elements towards their natural places, that is, the center and the outer surface of the universe. In accordance with *On the Heavens*, in OSD, Grosseteste also explains why not all beings exhibit absolute spatial differences and why some of them exhibit only some. This leads him to articulate an interesting distinction between mathematical and natural dimensions that we can read in the passage below.

Some things have only 'right', for they do not have 'before' and 'beyond'. This truth depends on the following division: these [spatial] differences are distinguished on the basis of the limits either of mathematical dimensions or of natural dimensions, that is, dimensions which are distinguished by natural powers. If the former [option holds], the distinction of natural differences will be only by reason and name – but [in this case] there will be a disorder on the level of things [...]. If the latter, then the distinction will be according to things, as in the case of an animated being.<sup>30</sup>

As far as I can see, Grosseteste means that one can identify all spatial differences in *all* bodies, included those that do not have any soul and do not show movement of any sort. In other words, one can distinguish three dimensions (i.e., length, width, and depth) in *all* bodies, whether they are able to move by themselves or not. In doing so, one would identify spatial differences only according to reason (*secundum rationem*) but, as a result, she would obtain something that may not correspond to the natural state of affairs. To understand this passage, it is worth reminding us that spatial differences are always linked to the concept of motion of all sorts – not just locomotion –

<sup>28</sup> See Olivier Gutman, introduction to Pseudo-Avicenna, *Liber celi et mundi*, edited by Gutman, xxxi-xxxiii.

<sup>29</sup> When it comes to talk about the diameter of the sphere, Sacrobosco uses the word 'thickness' (*spissitudo*), hence comparing the diameter itself to 'thickness' (*orbis diameter sive spissitudo*). John of Holywood, *De sphaera*, I, in *The 'Sphere' of Johannes de Sacrobosco and Its Commentators*, edited by L. Thorndike (Chicago: University Press, 1949), 85.

<sup>30</sup> OSD, 86, ll. 5-11: "Quaedam enim habent tantum dextrum, cum non habeant ante et retro. Huius veritas dependet ex hac divisione: istae differentiae aut habent distinctionem ex terminis dimensionum mathematicarum, aut dimensionum naturalium, id est dimensionum, quae distinguuntur per potentias naturales. Si primo modo, solum erit naturam differentiarum distinctio secundum rationem et secundum nomen et confusio secundum rem [...]. Si autem secundo modo, tunc erit distinctio secundum rem, ut est in animato."

pertaining to ensouled bodies.<sup>31</sup> Let us think, for instance, of a rock. It is surely provided with length, width, and depth but, since it does not have any kind of movement by itself, we cannot ascribe any absolute ‘up’ or ‘down’ to it. If one regards spatial differences only according to mathematical dimensions, she bumps into such a confusion, precisely because she does not consider the *natural* dimensions of things in accordance with the diverse powers or functions of the soul within moving bodies.

To grasp Grosseteste’s reasoning, Aristotle’s *Physics* and Averroes’ *Commentary* come to our aid. In *Physics* 4 (208b9), after remarking that differences of place are absolute, that is, by nature and do not vary according to someone’s perspective, Aristotle compares them to mathematical objects, which in turn have no absolute spatial differences but only relative ones.<sup>32</sup> Averroes closely follows Aristotle in defining spatial differences in natural bodies as absolute (they are *distincta naturaliter*) but he also delves into the diversity that characterizes spatial differences of natural bodies and spatial differences of mathematical objects. In Averroes’ view, one can speak, for instance, of an ‘up’ and ‘down’ of a mathematical object only by means of a judgment or estimation (*per existimationem*), that is, from someone’s own perspective.<sup>33</sup> This implies that spatial differences of mathematical objects are not given to us ‘naturally’, that is, regardless of any cognitive process, but rather, we can detect them after having conceived of such objects.<sup>34</sup> It seems to me that Averroes’ ‘estimating’ parallels Grosseteste’s ‘conceiving’ of mathematical dimensions (respectively, *per existimationem* and *secundum rationem*), for they express the same point: mathematical dimensions of, say, a triangle are set on the basis of the one who considers the geometric item. Not only does this imply that they are relative, but also that they require a cognitive step for one to become aware of them. Both their relativity and conceivability are what marks their differentiation from natural dimensions.

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<sup>31</sup> As Claudia Zatta explains in his study of Aristotelian zoology, movement in this case is intended as “a key phenomenon of nature and in an array of manifestations. Indeed, movement for Aristotle encompasses a range of changes that systematizes his predecessors’ reflections on animals, subsuming under the same metaphenomenon a diversity of affections, from physical growth, or conversely, decay, to the bodily alteration that accompanies the phenomenon of sensation to the specific ability to move from one place to another”; Claudia Zatta, *Aristotle and the Animals. The Logos of Life Itself* (New York: Routledge, 2022), 16.

<sup>32</sup> Iacobus Venetus translator Aristotelis, *Physica*, ed. Bossier and Brams (208b), 136: “Ostendunt autem et mathematica; cum non enim sint in loco, tamen secundum positionem ad nos habent dextra et sinistra, quare solum est intelligere ipsorum positionem, non habentia naturam horum unumquodque.”

<sup>33</sup> For ‘estimation’ in Arabic philosophy of mathematics, see Mohammad S. Zarepour, “Avicenna on Grasping Mathematical Concepts”, in *Arabic Sciences and Philosophy*, 31/1 (2021): 95-126.

<sup>34</sup> *Aristotelis De physico audito cum Averrois Cordubensis commentariis*, 123G-H: “Et significat hic dispositio mathematicorum, id est differentia, quae videtur inter partes, quae sunt in rebus naturalibus, et in rebus mathematicis, quoniam mathematica non habent potentiam ad partem, et naturalia habent hoc, scilicet significat quod partes rerum naturalium non sunt secundum positionem, nec loca eorum sunt per existimationem, sicut est dispositio in rebus mathematicis.”

Contrarily to mathematical items, animated bodies have instead absolute, natural dimensions. In this case, though, our understanding of them must be grounded in the diverse powers or functions of the soul of bodies. Grosseteste's view stems directly from *On the Heavens*, where Aristotle maintains that not all spatial differences are to be found in all bodies, because not all of them contain a principle of motion and those that do have such principle, that is, the organic substances, have different spatial differences. In fact, the most basic principle bodies is growth, pertaining to all living beings: 'up' is the starting point of growth, and it represents a precondition for all other principles of motion (i.e., locomotion and sensation), which in turn have their starting points in the other spatial differences (i.e., right and before).<sup>35</sup> Grosseteste wholly accepts this Aristotelian theory, stating that 'up' is where the principle of growth of all animated beings is located, 'right' is the side where locomotion originates, and 'before' is where the power of sensation is situated. He details this setting by referring to specific parts of organic substances endowed with growth: animals (both human and non-human) have such a principle placed in their head, whereas plants have it in their roots; therefore, these parts of their bodies are to be regarded as their absolute 'up'. Growth, locomotion, and sensation are functions of the soul, and are considered as natural dimensions that allow us to locate and order objective spatial differences.

For 'up' is the part of an animated being, where the principle of growth is placed, like the head for animals and the roots for plants. In those beings that have a principle of moving by place, the part through which the power of locomotion exits is 'right'. 'Before' is that part where the senses are located. Therefore, according to the order of these powers, the six differences will be ordered too.<sup>36</sup>

As already said, this stance traces back to Aristotle's *On the Heavens*. However, determining which version Grosseteste had at hand when writing OSD would prove to be quite arbitrary. For, even if we compare the passage from OSD to the respective ones from Gerard's, Michael's, and Grosseteste's own translations of *On the Heavens* (Table no. 4), there are no distinctive and definitive links among them that allow us to point to a specific version.<sup>37</sup>

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<sup>35</sup> Aristotle, *On the Heavens*, II, 2, 284b32-34 and 285a15-19. This is also addressed in Aristotle's *Progression of Animals*; see James Lennox, "On the Heavens 2.2 and Its Debt to the *De incesso animalium*", in *New Perspectives on Aristotle's On the Heavens*, edited by A. C. Bowen and C. Wildberg (Leiden and Boston: Brill, 2009), 187-214, esp. 199.

<sup>36</sup> OSD, 86, ll. 11-18: "Quoniam pars animati, unde est principium augmentandi, est sursum, ut caput in animalibus et in arboribus radix. In habentibus autem principium movendi secundum locum pars, per quam exit virtus motiva secundum locum, dextra est. Ante autem est pars ipsa, in qua siti sunt sensus. Igitur secundum ordinationem illarum potentiarum ordinabuntur istae sex differentiae."

<sup>37</sup> See Panti, "Il *De caelo* nel medioevo", 99.

OSD, p. 86, ll. 11-18	<i>De caelo</i> , transl. by Gerard (284b), p. 110	<i>De caelo</i> , transl. by Michael (284b), p. 280	<i>De caelo</i> , transl. by Grosseteste (284b)
Quoniam pars animati, unde est principium augmentandi, est sursum [...]. In habentibus autem principium movendi secundum locum pars, per quam exit virtus motiva secundum locum, dextra est. Ante autem est pars ipsa, in qua siti sunt sensus.	Nam principium motus augmenti est sursum et principium motus localis est dextra et principium motus sensibilis est ante, et non significamus per ante, nisi ubi sunt sensus.	Principium enim motus crementi est superius, et principium motus localis est dextrum, et principium motuum sensibilis corporalis est ante; et est dicere ante ubi sunt sensus.	Principia enim haec dico unde incipiunt motus primum habentibus. Est autem superiori quidem augmentatio, a dextris autem qui secundm locum, ab ante autem qui secundum sensum; ante enim dico in quo <sensus>.

Table no. 4

It is worth noticing that in his commentary on *On the Heavens*, Simplicius himself stresses that the natural upside of animals and plants would be their head and roots respectively, even in the event an animal ducked or buried its head in the ground. And although it might sound counterintuitive that the upside of plants be their roots it is nevertheless so by nature, because plants take in nutriment and grow from that part.

For, even if some particular animal buried its head and raised its feet up high, its feet would not be up and its head down by nature; and plants, for whom up is by nature around the roots because they take in nutriment and grow there first, are thought to have their branches up relative to us.<sup>38</sup>

However, one cannot rule out that the examples chosen by Grosseteste about the objective ‘up’ of animals and plants might as well be derived from other works by Aristotle, such as, *On the Soul* (416a). We cannot assume, therefore, that Simplicius

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<sup>38</sup> Simplicius, *On Aristotle's On the Heavens*, II, 2 (Herberg 391), translated by I. Mueller (London and New York: Bloomsbury, 2004), 38. See Grosseteste's Latin translation, in Simplicius, *Commentary*, Herberg, 391: "Neque enim in particularibus animalibus, utique deorsum vertens quis caput pedes suspendat, propter hoc pedes quidem sursum secundum naturam erant, caput autem deorsum; sed et arbores secundum naturam ad radices sursum habentes, quia inde nutrimentum et prima augmentatio, ut ad nos ramos habere sursum videntur."

oriented Grosseteste's reading in this case, nor can we identify the version of *On the Heavens* Grosseteste read. What such an analysis reveals is merely that OSD presents an abridged account of what Aristotle exposes in *On the Heavens* about objective spatial differences of organic substances.

### 3. Celestial Spatial Differences

All animated beings have their natural spatial differences according to their growth, moving, and sensation. To each of these operations there corresponds a precise spatial difference, namely, 'up', 'right', and 'before'. In line with Aristotle, Grosseteste maintains that this stands as long as ensouled bodies are concerned. And since heavens, too, are provided with a soul, such natural dimensions are to be found in the superlunary regions too. But where exactly are we to locate such spatial differences in the heavens? Answering this question requires us to briefly recall Grosseteste's cosmology, which is based on his metaphysics of light.<sup>39</sup> First matter and first form are metaphysical constituents structuring all physical bodies, including the heavenly ones. First form provides matter with spatial extension and stretches it into three-dimensions, generating a finite *quantum*. This happens because first form can expand in all directions along with first matter. It is light that turns out to be able to do so, and more precisely, to diffuse itself spherically. In fact, Grosseteste has light coinciding with first form. Starting from a self-multiplying point of light, the first matter of the universe was informed and thus extended into a spheric shape. The farther from the original point of light, the more rarefied the matter. Having expanded matter as far outwards as possible (i.e., up to the firmament), light started drawing itself from the outermost sphere towards the center of the universe. Thus, the nine celestial spheres were generated by this inwards movement of light, for their matter was gradually more rarefied at this new passing of light.<sup>40</sup> The circular motion of the heavenly spheres is determined by the impossibility of matter to be further dispersed and stretched either towards or away from the center of the universe, that is, to move upwards or downwards. Moreover, such circular motion is linked to separated substances: each sphere is assigned an intelligent celestial mover, which, as it is stated in OSD, acts on the heavenly body by means of light (*lux*) itself.<sup>41</sup> It is within such cosmological

<sup>39</sup> For an overview of Grosseteste's metaphysics of light, see the comprehensive study by James McEvoy, *The philosophy of Robert Grosseteste* (Oxford: University Press, 1982, reprint 1986).

<sup>40</sup> Things are more complicated than this. It is not just light that moves inwards after reaching the outermost sphere, but it is also the *lumen*, which is light plus the spirituality of matter, that rarefies more and more matter as it passes through the celestial spheres. This inwards movement of light (and *lumen*) halts at the lunar sphere, where matter is no longer able to be completely dispersed. See Roberto Grossatesta, *La luce*, edited by C. Panti (Pisa: University Press, 2016), 80-81, ll. 133-139, and 139-144 for the commentary; see also Cecilia Panti, "L'incorporazione della luce secondo Roberto Grossatesta", *Medioevo e Rinascimento* 13 (1999): 45-102, esp. 51-58.

<sup>41</sup> Reference is at note 42. Concerning the way light makes the separated substance move the heaven, OSD diverges from what Grosseteste maintains, for instance, in his *De motu supercelestium*,

structure that one has to identify the functions and hence the absolute spatial differences of the heavens, which Grosseteste introduces as follows:

Consistently, these differences are to be found in the heaven. For the growth of the circle comes about as [this circle] occupies a greater space, which corresponds to the distance between the center and the circumference. Therefore, as length consists in this distance, its limits (i.e., the center and the circumference) will be ‘up’ and ‘down’. On the other hand, ‘right’ is a different part, such as Aries, where there is a stronger impression of light, by which the separate substance moves the heaven. Indeed, the north part, where the fixed stars are in their perennial appearance, is called ‘before’.<sup>42</sup>

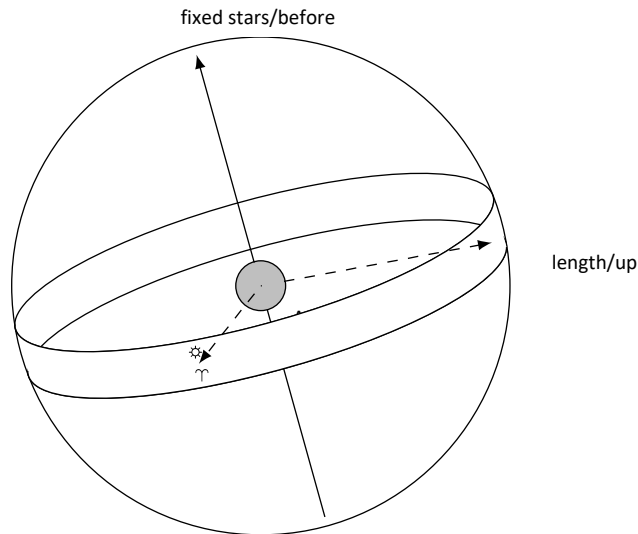


Figure no. 3

Growth of heavenly concentric spheres is evident if one considers the space each of them occupies, being greater than the space of the sphere it contains. In other words,

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where the motion of the heavenly sphere is explicitly said to depend only on the intellectual power of the separated substance. See Cecilia Panti, “Robert Grosseteste’s Early Cosmology”, in *Editing Robert Grosseteste*, edited by J. Goering and E. Mackie (Toronto: University Press, 2003), 135-166, esp. 153-154; and Panti, *Moti, virtù, motori celesti*, 56-59.

<sup>42</sup> OSD, 86, ll. 19-26: “Et proportionaliter sunt istae differentiae in caelo. Augmentatio enim circuli est ex maiori occupatione spatii, quod est distantia centri et circumferentiae. Ergo, cum longitudo penes hanc distantiam consistat, termini huius distantiae, scilicet centrum et circumferentia, sursum et deorsum erunt. Dextrum autem est pars alia, ut aries, in qua est fortior impressio lucis, per quam substantia separata caelum movet. Ante vero dicitur pars septentrionalis, in qua sunt luminaria fixa sempiternae apparitionis.”



growth is measured by the distance or length between the circumference of the outermost sphere and the center of the earth. Consistently with what has been said earlier, the limits of the distance that goes from the center to the circumference of all heavenly spheres represent their absolute 'down' and 'up' respectively. The explanation of 'right' as absolute celestial difference relies on the action of light, by means of which celestial intelligences are said to move the heavens. Light impresses itself in a specific heavenly region, namely, at the intersection of the equinoctial circle and the ecliptic, that is, in the first degree of the constellation of Aries. This intersection happens at the vernal or spring equinox, when the Sun's path is along the celestial equator, so that day and night hours are equal. Aries, thus, is to be considered the objective celestial 'right' or East, that is, the absolute spatial difference where the circular movement of the heavens begins.<sup>43</sup> As for 'before', Grosseteste refers to its function, namely, (visual) sensation, for it is to be located north, in correspondence of the part where fixed stars are always visible (from the arctic hemisphere). This is the absolute 'before' of the universe. Figure no. 3 might help clarify this spatial setting.

A thing worth specifying is that in identifying the three celestial absolute spatial differences, Grosseteste's account differs from Aristotle's in *On the Heavens*— and thus from Gerard's, Michael's, and Grosseteste's own translations. For instance, Aristotle (and his translators) places the absolute East of the universe simply in the part where the stars rise, and dwells very briefly on the differences 'before-behind' just to remark the superiority of forward movement over the backward one.<sup>44</sup> Moreover, as we can see from Table no. 5, in all Latin versions of *On the Heavens* the absolute 'up' and absolute 'down' of heavens correspond to the length between the poles (i.e., the endpoints of the diameter crossing the circumference of the cosmic sphere), whereas in OSD, Grosseteste conceives of them as the length between the center and the outer circumference of the cosmic sphere. The feature that draws together OSD and Grosseteste's translation of *On the Heavens* lies precisely in the definition of the length: while Gerard and Michael define it as 'space' and 'dimension', Grosseteste consistently calls it 'distance' in both his works.

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<sup>43</sup> See also Robert Grosseteste, *De sphaera*, edited by Panti, *Moti, virtù, motori*, ll. 183-185, 299. Reference to Aries and to the equinoctial circle as the 'belt of the first movement' is given also in Sacrobosco, *De sphaera*, II, edited and translated by Thorndike, *The 'Sphere'*, 86 (and 123 for the English translation): "Et dicitur equinoctialis quia, quando sol transit per illum, quod est bis in anno, scilicet in principio Arietis et in principio Libre, est equinoctium in universa terra. Unde appellatur equator diei et noctis, quia adequate diem artificialem nocti, et dicitur cingulus primi motus."

<sup>44</sup> Aristotle, *On the Heavens*, II, 2, 285b16 and II, 5, 288a3.

OSD, p. 86, ll. 11-18	<i>De caelo</i> , transl. by Gerard (285b), p. 114	<i>De caelo</i> , transl. by Michael (285b), p. 289	<i>De caelo</i> , transl. by Grosseteste (285b)
Ergo, cum <u>longitudo</u> penes hanc <u>distantiam</u> consistat, termini huius distantiae, scilicet <b>centrum</b> <b>et</b> <b>circumferentia</b> , sursum et deorsum erunt.	Et dico iterum, quod <u>longitudo</u> orbis est spatium, in quo sunt <b>orbis</b> , et quod ex orbibus sunt, qui sunt sursum, et ex eis sunt, qui sunt deorsum.	Et dicamus etiam quod <u>longitudo</u> orbis est dimensio in qua sunt <b>orbis</b> , et quod orbium quidam sunt superius et quidam inferius.	Dico autem <u>longitudinem</u> quidem ipsius secundum <b>polos</b> <u>distantiam</u> , et polorum hunc quidem sursum hunc autem deorsum.

Table no. 5

### 3. Conclusions

*On Spatial Differences* is one of Grosseteste's early scientific works, which addresses what in modern theories of mechanics would be called spatial quantities. It is argued for the objectiveness of some reference points in space, such as, 'up' and 'down', 'right' and 'left', 'before' and 'behind'. In line with what Aristotle maintains, these three pairs of spatial differences pertain to all ensouled beings in the universe, in both the sub- and superlunary regions. This means there is an absolute 'up' and 'down' of every human animal, as well as of every heavenly sphere. Roughly put, 'up' and 'down' – and the other four differences – are natural dimensions that one shall identify based on three functions of the soul, namely, growth, locomotion, and sensation.

Scant and too weak similarities with Latin translations of *On the Heavens* and Simplicius' *Commentary* do not allow us to identify which version Grosseteste read or which text oriented his reasonings. On the other hand, we were able to observe to what extent Averroes' *Long Commentary on the Physics* angled Grosseteste's understanding of *On the Heavens*, mistakenly inducing him to spot a tension between Aristotle's account of spatial differences in the *Physics* and *On the Heavens*. But Averroes' authority has not just generated some misunderstanding, for Grosseteste relies on him to posit a distinction between mathematical and natural dimensions. Contrarily to the latter, mathematical dimensions (i.e., length, width, and depth) are to be found in all bodies, regardless of whether they are provided with a soul. This leads both Grosseteste and Averroes to stress their relativity and conceivability, looking at them like something which is not set by nature, but rather requires someone's cognitive step to be detected.

*On Spatial Differences* is a summary of what *On the Heavens* (essentially book 2) deals with, and yet it cannot be dismissed as a mere recap of Aristotle's work. For, despite the conciseness of the text, some original features can be appreciated in Grosseteste's

analysis of spatial differences. In this sense, two things can be particularly noticed: first, the ability to rework and expand Aristotle's theory by means of geometric models; and second, the enshrinement of some aspects of his metaphysics of light in his discourse on heavenly spatial differences.

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