THE COMMENTARY OF ST. THOMAS ON THE *De caelo* OF ARISTOTLE

The "commentary" or *Sententia de caelo et mundo* of St. Thomas is a work of great maturity and profundity. It is one of Thomas's last writings, and it reveals a breadth of scholarship and achievement wanting, for the most part, in his earlier Aristotelian comentaries, such as those on the *Ethics, Physics, De anima,* and early parts of the *Metaphysics;* but it comes to grips with profound problems of Aristotelian philosophy inherent in the conflicting views of Greek and Arab commentators. I. T. Eschmann rightly noted that "it represents the high water-mark of St. Thomas's expository skill".[1] In long subtle digressions, Thomas discusses and evaluates the views of other commentators reported by Simplicius, as well as the views of Simplicius himself, who is a primary source in this commentary. As in earlier commentaries, Thomas was also concerned with the teaching of Averroes, which deeply influenced the masters in arts at Paris in the late 1260s and throughout the 1270s. The excessive adoption of Averroes by masters in arts resulted in the condemnation of 13 Averroist theses on Dec. 10, 1270, by the bishop of Paris, Etienne Tempier, and in the more sweeping condemnation by the same bishop on March 7, 1277. Simplicius and Averroes are in fact the two basic sources for Thomas's commentary on *De caelo.*

Thomas did not comment on *De caelo* until he had the full text in hand, together with the commentary of Simplicius. Although there were a number of translations of Aristotle's *De caelo* available from the Arabic, Thomas insisted on having a good translation from the Greek corrected by his friend and confrère William of Moerbeke. Wherever translations existed from the Greek, Moerbeke did not translate anew, but rather revised specific readings of words and phrases according to a Greek exemplar. The first translation of *De caelo* from the Greek was made by the bishop of Lincoln, Robert Grosseteste, between 1247 and 1253, the date of his death. Grossetes-

1 "A Catalogue of St. Thomas's Works: Bibliographical Notes", in E. GILSON, *The Christian Philosophy of St. Thomas Aquinas,* Random House, New York, 1956, item 31, p. 402.

te's translation went only as far as Book III, c. 1, 299a11; but he also translated the corresponding commentary of Simplicius. We do not know how much influence this translation had, for it has not yet been found intact in any manuscript. Moerbeke, it would seem, used the Grosseteste translation for his own revision of Books I and II, before proceeding with an original translation of Books III and IV, together with the full commentary of Simplicius. Moerbeke completed his revision and translation on June 15, 1271, at Viterbo, where the papal court of Pope Gregory X resided. Within a relatively short time, Moerbeke's translation of *De caelo* became the "common", or "vulgate" text used in the schools as part of the *Corpus recentior* of Aristotle's writings.

Moerbeke's translation was not the only one available to Latin scholastics. In fact, they had five versions in whole or in part from which to study the thought of Aristotle's *De caelo:*

1) A *summary* in sixteen chapters by Avicenna as the "second book" of the *libri naturales,* translated from the Arabic, probably by Dominic Gundissalinus and John Avendehut around 1150.

   Incipit: "Collectiones exposicionum ab antiquis Graecis in libro Aristotilis qui dicitur liber celi et mundi... Differentia inter corpus et quamlibet aliam magnitudinem hec est..."

   Remarks: Undoubtedly this summary was included in the general condemnation of Aristotle's works in 1210 ("nec commenta") and in 1215 ("nec summe de eisdem") because it taught the eternity of the world. It exists in several MSS, and a much emended text was published at Venice in 1508.

2) *De caelo veteris translationis,* translated from the Arabic by Gerard of Cremona (d. 1187).

   Incipit: "Summa cognicionis nature et scientie ipsam demonstrantis..."

   Remarks: This version was the common one used in the schools before being replaced by the new version of Moerbeke. Without doubt this version is the one intended by the statutes of the arts faculty in Paris, March 19, 1255. *(Chart. U. P.,* I, 277-79, n. 246) Albertus Magnus used this version for his own commentary, and it is printed in the new edition of Albert's works, *Opera Omnia* V, Cologne 1971.

3) *De caelo cum commentario magno Averrois,* translated from Arabic by Michael Scot, *c.* 1231-35.

Incipit: "Maxima cognicio nature et scientia demonstrans ipsam..."

Remarks: This version was frequently published with the commentary of Averroes, e. g., the italic type in the Venice edition of 1574. Michael Scot dedicated this work to Stephen de Pruvino, who with two other masters was commissioned by Pope Gregory IX in 1231 to examine Aristotle's writings on natural philosophy and to report on their contents. *(Chart. U. P.,* I, 143-44, n. 87, see fn. 2 by Denifle, ibid., p. 144).

4) *De caelo translationis Lincolniensis,* incomplete, covers Books I-III, 1, 299a11 ("huc usque d. R." MS Vat. lat. 2088), translated from the Greek together with the corresponding commentary of Simplicius by Robert Grosseteste in England between 1247 and 1253. Cf. *Aristoteles Latinus,* I, 53.

Incipit: un certain because "no complete MS of Grosseteste's translation has yet been identified". (S. H. Thomson, *The Writings of Robert Grosseteste,* Cambridge: Univ. Press 1940, p. 66)

Remarks: D. J. Allan has shown that Book II of this version is to be found in full in Oxford, Balliol Coll. MS 99; see "Mediaeval Versions of Aristotle, *De caelo,* and of the Com. of Simplicius", *Mediaeval and Renaissance Studies,* 2 (1950), 82-120. D. A. Callus remarks that "the *De caelo,* left incomplete, was his [Grosseteste's] last work" - *Robert Grosseteste,* Oxford 1955, p. 67.

5) *De caelo novae translationis,* I-II revised, III-IV translated from the Greek by William Moerbeke with the commentary of Simplicius, completed in Viterbo, June 15, 1271.

Incipit: "De natura scientia ferre plurima videtur circa corpora et magnitudines et horum existens passiones et motus..."

Remarks: This new version, the common text used in the schools in the late 13th century, replacing the translation of Gerard of Cremona, was the base text used by St. Thomas for his commentary on *De caelo;* the commentary of Simplicius was throughly exploited in Thomas's work on the heavens, and he had partially used it earlier, without sufficient comprehension, in his commentary on the *Metaphysics,* Book

XII (Lambda). A contaminated form of this version is generally printed with the works of Thomas; it was also published at Venice in bold Roman type with the commentary of Averroes, *De caelo,* 1574. The Moerbeke version of Aristetle's *De caelo,* with the full commentary of Simplicius, was published in Venice by Heronymus Scotus in 1548.

Aristotle's treatise *De caelo* was written in four books after completion of the *Physics,* as is proved by the numerous cross-references Aristotle himself makes to the *Physics* (e, g., *De caelo,* 270a18; 273a 13; 275b18; 305a21; 311a13, etc.). All Arab and Latin commentators refer to *De caelo* as the "second book" of natural philosophy, and Thomas notes that it is the first treatise after the *Physics.*[2] In the first two books, Aristotle discusses the constitution and simple movements of the universe as a whole; in the third and fourth books, he discusses the simple motions of the sublunar elements. In Thomas's view, the first two books discuss "bodies which move with circular motion", whereas the last two discuss "bodies which move with rectilinear motion".[3]

Thomas did not comment on all four books, but stopped abruptly at III, 3, 302b9 (III, lect. 8, n. 9), as all of Thomas's bibliographers acknowledge. The so-called "official catalogue" drawn up by Reginald of Piperno for the canonization process lists the work as "super libros de Caelo tres".[4] Nicholas Trevet lists it as "caeli et mundi, primum, secundum et tertium".[5] Tolomeo of Lucca simply notes that the commentary is not complete: "De caelo et De generatione, sed non complevit".[6] Bernard Gui lists the work as "super tres libros de caelo et mundo".[7] The second Prague catalogue lists it as "glosas super 3 libros celi et mundi".[8] After Tolomeo of Lucca noted that *De caelo* and *De generatione* were left incomplete, he stated that "these books were completed by master Peter of Alvernia (Auvergne), his most faithful disciple, master in theology, and a great philosopher, later bishop of Clermont". Grabmann notes that at least two MSS (Paris, Bibl. Mazarine 3484 and Oxford, Balliol College 321) explicitly state at the end of the composite commentary: "In hoc completur expositio magistri Petri de Alvenia in tertium et quartum Caeli et Mundi Aristotelis, ubi praeventus morte venerabilis vir frater Tho-

2 THOMAS, *In I De caelo,* prooem. 3.
3 THOMAS, *In III De caelo,* lect. 1, n. 1.
4 P. MANDONNET, *Des Écrits Authentiques de S. Thomas D'Aquin,* ed. 2 revue et corrigée, Saint-Paul, Fribourg, 1910, p. 31.
5 *Ibid.,* p. 49.
6 *Ibid.,* p. 61.
7 *Ibid.,* p. 69.
8 M. GRABMANN, *Die Werke des hl. Thomas von Aquin,* 3rd ed., Aschendorff, Münster Westf., 1949, p. 97.

mas de Aquino omisit".[9] At the commentary on III, 3, 302b9, in Vatican MS Vat. lat. 2181, fol. 111v, the scribe wrote "Usque huc frater Thomas. Incipit magister Petrus de Alvenia usque in finem quarti celi et mundi". There can be no doubt that the authentic commentary of Thomas breaks off in chapter three at the words "Itaque palam et quod sunt elementa, et propter quid sunt" (302b) in the version of Moerbeke.

One basic question is, why did Thomas not finish his commentary? All the traditional sources say that he was prevented by death. I. T. Eschmann, howerer, claims that the commentary is not "unfinished": "Whether it is an unfinished work, as is commonly asserted, seems doubtful".[10] He gives no arguments in support of this view, but he says, "The beginning of Aquinas's exposition of *De generatione et corruptione* gives us to understand that he [Thomas] knew no more Aristotelian text of *De caelo* than [that] which he explained". A study of the text, however, renders such a view most implausible.

Thomas certainly knew two versions of the complete text translated from the Arabic; in earlier works, such as the *Summa theologiae* I, Thomas knew and referred to all four books in these versions. The question is whether Thomas had more text of the Moerbeke version than that which he commented upon. Moerbeke, as we know, translated Books III and IV directly from the Greek, and Thomas obviously knew this translation, for he commented on III, 1-3, well beyond the version of Robert Grosseteste, and well into the versions from the Arabic. Therefore Thomas had at least chapters 1-3 in the version of Moerbeke. The force of this argument will become clear when the Latin versions of *De caelo* are published in the *Aristoteles Latinus.*

Further, in the commentary itself, Thomas indicates that he knew the existence of the part not commented upon by him: e. g., at III, lect. 2, n. 1: "in quarto libro ibi *De gravi autem et levi* (= IV, 1, 307b29); and at III, lect. 3, n. 2: "Partim autem inferius in hoc eodem libro" (= III, 5). These references seem to indicate the portion of the Moerbeke text not commented upon by Thomas.

Also, the opening passage of *De generatione* does not sustain Eschmann's argument. The passage reads:

> First he [Aristotle] expresses what he principally intends; and this continues to the end of the book *De caelo,* where he says: *De gravi quidem igitur et levi determinandum sit hoc modo.* And there then follows: *De generatione autem et corruptione natura generatorum et corruptorum,* that is, of those things which naturally are generated and corrupted.

[9] GRABMANN, *ibid.*, p. 276.
[10] ESCHMANN, "Catalogue", item 31, p. 402.

In this passage, the first lemma is the concluding sentence of *De caelo,* and the second lemma is the opening sentence of *De generatione.* Withoud further study, it is difficult to say what version of *De generatione* Thomas had in mind, but it was probably that of Moerbeke. The important point is that Thomas had at hand the concluding sentence of Books IV of *De caelo,* and there is no reason why Thomas could not have completed his commentary on *De caelo* had he lived. The traditional view that Thomas's commentary on *De caelo* is "unfinished" must stand. He was undoubteddly unable to finish the work when he was unexpectedly afflicted by a stroke or breakdown on Dec. 6, 1273. Scribes, unaware of what happened to Thomas on Dec. 6, would naturally think that he was prevented by death —"praeventus morte".

From what has been said, it is clear that Thomas's *Sententia de caelo et mundo* must be dated late in his life. It was composed after Moerbeke finished his translation of the text and of the commentary by Simplicius, on June 15, 1271. Thomas obtained this translation while he was still in Paris (Jan. 1269 to spring 1272), as is confirmed by the letter of the Parisian faculty of arts sent to the general chapter of the Order of Preachers meeting in Lyons in 1274 after the death of Thomas. In the letter, dated May 3, the faculty of arts asked for four favors, the third of which was a request for the books that Thomas himself had promised to send them:

> And permit us also to mention the commentary of Simplicius on the *De caelo et mundo,* and an exposition of Plato's *Timaeus,* and a work entitled *De aquarum conductibus et ingeniis erigendis;* for these books in particular he himself promised would be sent to us.[11]

Moerbeke's translation arrived in Paris while Thomas was commeting on Book Lambda (XII) of the *Metaphysics* in 1271, for in certain passages Thomas made use of Simplicius's commentary. Whether or not Thomas's commentary on *De caelo* was begun in Paris and continued in Naples cannot yet be determined. The masters in arts of Paris in their second petition asked the Dominican chapter to send them "some writings of a philosophical nature, begun by him [Thomas] at Paris, left unfinished at his departure, but completed, we have reason to think, in the place to which he was transferred".[12] Thomas could have begun his commentary on *De caelo* at Paris after June 1271 and continued it in Naples, where he was assigned in September 1272; or he could have begun it in Naples. What is certain is that Thomas took Moerbeke's text with him to Naples.

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[11] A. BIRKENMAJER, "Vermischte Untersuchungen", *Beiträge z. Gesch. d. Phil. d. Mittelalters,* 20/5, pp. 6ff.

[12] *Ibid.*

At Naples, William of Tocco saw Thomas writing his commentary on Aristotle's *De generatione et corruptione,* which he believed to have been Thomas's "last work in philosophy".[13] It is unfinished, ending abruptly in I, 5, 322a33 (I, lect. 17), and exists in only four manuscripts; it was unknown to the Parisian stationers even as late as 1304. When Thomas wrote his commentary on *De generatione* I, lect. 7, n. 1, he used the phrase "as we have made clear [*manifestavimus*] in VIII *Physic.* and in I *De caelo*", thus signifying that at least the first book of *De caelo* was completed before *De generatione* I, lect. 7, which was written in Naples. Therefore Thomas must have written his commentary on *De caelo* between June 1271 (París) and Dec. 6, 1273 (Naples). It is accordingly one of Thomas's last works in philosophy, and one of considerable maturity and reflection. The influence of Simplicius is clear on almost every page; it seems to have aroused Thomas's critical acumen to the utmost. It can be considered the profundest of all his commentaries on Aristotle. It has no equal. Even Albert's scholarly commentary on the *De caelo* fades in comparison with Thomas's. For this we have to thank the genius of Thomas and the stimulus of Simplicius, the celebrated 6th-century Greek commentator on Aristotle.

In this brief study it is impossible to do justice to Thomas's commentary. But perhaps certain highlights can be pointed out for further study.

THE SUBJECT MATTER OF *DE CAELO*

Every scholastic introduction to a new book to be discussed examines first the location of this book in the ensemble of the whole science, and its unique and proper subject-matter distinct from other treatises. All of Aristotle's *libri naturales* were universally thought to belong to the unique science of the philosophy of nature. The unique character of natural science or the philosophy of nature, is derived from the manner of defining concepts in that science, as Thomas shows in his *In Boethium De trinitate,* q. 5, aa. 1-2. Every concept in the philosophy of nature, no matter how analogous it may be, is defined in terms of sensate matter, *materia sensibilis.* These definitions leave out of consideration, or abstract from, individual matter. That is to say, the natural philosopher is not primarily concerned with individual instances of his encounter with nature, but rather wiht the species, or common nature as such. In reality, the species (or common nature) does not exist as such outside the mind; there

[13] "Processus canonizationis s. Thomae Aquinatis, Neapoli", n. 58, *S. Thomae Aquinatis Vitae Fontes Praecipuae,* ed. A. Ferrua, Ed. Domenicane, Alba, 1968, p. 287.

are only individual instances. But those species and common natures do exist as individuals. Individuals, as such, come into being and pass away, and there can be no speculative science of such individuals, except history. Therefore the philosopher who wishes to study nature must abstract the universal elements of his concern from the individual instances of his experience and experimentation. This kind of abstraction was called "total abstraction" *(abstractio totalis)* by the scholastics, for it temporarily leaves out of consideration the "parts" or existent individuals of which the species, or common nature, can be predicated. Without individual instances existing in nature, the natural philosopher could never comprehend the universal whole; but the truth he seeks must be formulated in terms of universal definitions, statements, laws, and hypotheses. Whatever is retained necessarily involves *materia sensiblis,* i. e., definitions formulated in terms of what can be sensed by touch, sight, sound, taste, and smell, as well as magnitude and number. All such tangible characteristics are needed to define concepts and laws in natural philosophy. Thus if the natural philosopher wants to talk about gravitation, he does not limit his concern to the free fall of this particular body at this particular instants of history, but formulates statements and laws about all heavy bodies in various circumstances that are of universal validity.

The kind of abstraction used in natural science can be grasped more easily by comparing its subject to that of the mathematical sciences. Mathematics, to get anywhere, must leave out of consideration all aspects that are properly sensible like apples and pears, and consider only the quantitative "form", namely number and magnitude, which are "common sensibles". Every degree of mathematical abstraction retains a quantitative "form"; this abstraction is called, in scholastic language inherited from the Arabs, *abstractio formalis,* or *abstractio partis,* because a part of reality, namely sensible matter, is left out of consideration. This kind of abstracting a formal part from whole is legitimate, as Aristotle says, and does not result in any falsity,[14] because the mathematician does not assert that such a separation really exists in nature. If the mathematician asserted that "surfaces and volume, lines and points" exists in nature as separated from sensible matter, he would be in error.[15] Nevertheless, a certain kind of matter is still retained in mathematical abstraction; it is called *materia intelligibilis,* because mathematical entities can be imagined distinctly by the mind, so that we can speak of parallel lines, variously plotted points, different kinds of circles, and the like. Intelligible matter allows for infinite multiplicity in mathematical reasoning.

[14] ARISTOTLE, *Phys.*, II, 2, 193b34.
[15] *Ibid.*, 193b24.

Like individual matter in sensible objects, intelligible matter is the principle of individuality in mathematics. On a more superficial level, one must also admit that the mathematician leaves out of consideration the individual instances of an imagined quantity; for this reason, some of the later scholastics maintained that total abstraction is common to all the speculative sciences. This is no more than a consequence of intellectual behavior, which cannot know the individual as such but must deal with the intelligible, which is universal.

Consequently, all the concepts and statements in natural philosophy are in terms of sensible matter in general, so that an animal is defined in terms of "blood and bone", and not "this blood and these bones".

In a science as vast as natural philosophy, there must be an orderly procedure whereby one progresses from the more general to the particular. The general principle of all human study is that the mind must proceed from the more common and general aspects, better known to us, to the more special and particular aspects, less known to us but better knowable in themselves. Consequently, the study of natural science should progress from the general aspects considered in the *Physics* to the more detailed considerations of the other *libri naturales.* The eight books of the *Physics* are an over-all consideration of problems basic to the study of nature itself, that is, of the concept of nature as the principle of motion and rest in all natural things, and include a consideration of all the physical aspects of motion, such as causality, place, time, space, kinds of motion, continuity, and the necessity of a first mover of the universe. After such general considerations of nature and motion, required for an understanding the whole of natural science, the philosopher should progress to a consideration of the particular species of motions and natures. This scientific progression is explained simply by St. Thomas when he says:

> Scientific knowledge which is possessed of things only in general is not a complete science in its ultimate actuality, but stands midway between pure potentiality and ultimate fulfillment... Hence it is clear that the fullness of scientific knowledge requires that it not remain simply in generalities, but proceed even to its species.[16]

In his commentary on the *Physics,* one of Thomas's earliest commentaries on Aristotle, he describes the contents of the *libri naturales* subsequent to the *Physics.*[17] *De caelo* analyzes natural bodies as mobile according to local motion, "which is the first species of motion". *De generatione* analyzes motion toward form and the basic changes in elementary bodies precisely as mutable in general. The *Meteoro-*

[16] THOMAS, *In I Meteorol.,* lect. 1, n. 1.
[17] THOMAS, *In I Phys.,* lect. 1, n. 4.

rum discusses specific types of transmutation in nature. The pseudo-Aristotelian Book *De mineralibus* discusses inanimate mobile bodies whose motions are composite, while the motion of composite animate bodies is discussed in the Book *De anima* and in books subsequent to it.

In the prooemium to *De caelo,* therefore, Thomas again follows the general pedagogical method of proceeding from the general to the particular.[18] Aspects common to all of nature are seen a treated in the *Physics.* Thus "what remains in the other books of natural science is to apply these common aspects to their proper subjects". In this application, the more simple and general are discussed before the complex and specific. In this view, Book I of *De caelo* considers the entire corporeal universe prior to considering its parts; Book II considers simple bodies prior to the mixed; and Books III and IV consider elemental bodies prior to the complex and compound bodies. Since one aspect common to all the books of *De caelo* is body, "the first topic of discussion in the very beginning of this book is body, to which must be applied all that was set forth about motion in the *Physics*".

Aristotle's *De caelo* is a complicated treatise in four books, and is is difficult to find the unifying thread. But commentators and scholastics had a penchant for discovering unity before proceeding to dissect it. Even though the *De caelo* discusses "bodies" throughout, this fact does not sufficiently identify the precise subject-matter of the four books. Even though "the first topic of discussion in the very beginning of this books is body, to which must be applied all that was set forth about motion in the *Physics*", this topic does not sufficiently unify the treatise, since there are many kinds of bodies in the heavens and on the earth.

The title, *De caelo,* can be understood in three senses. It can mean (1) the outermost sphere that moves with diurnal motion; (2) all the heavenly bodies that move circularly; and (3) the entire universe. According to Simplicius in his proemium, Alexander of Aphrodisias "believed that the subject primarly treated therein is the universe". Alexander assumed that Aristotle restricted himself to discussing general characteristics of the heaven and the earth—its eternity, finiteness, uniqueness, and the like. However, Iamblicus and Syrianus, according to Simplicius, thought the term "heaven" to apply to the heavenly bodies that move circularly. Iamblicus maintained that other bodies in the universe are discussed in *De caelo* "consequentially, insofar as they are contained by the heavens and influenced by them", whereas Syrianus held that other bodies are discussed "inci-

[18] THOMAS, *In I De caelo,* lect. 1, n. 3.

dentally [*per accidens*] insofar as a knowledge of other bodies is assumed in order to explain what is being said of the heavens". But one might object that the consideration of elementary bodies and their motions cannot be called "incidental", or *per accidens*. The heavens and the four elements are simple bodies; and after Aristotle discusses the heavenly bodies in Book Two, he proceeds to discuss the four terrestrial elements of earth, water, fire, and air as a principal consideration in Books Three and Four. "The Philosopher is not wont to assign a principal part in some science to things that are brought up only incidentally".[19]

Therefore Simplicius argued that the subject matter of *De caelo* has to be "simple bodies", and since among all simple bodies the heavens predominate, it is reasonable to entitle the whole book *De caelo*.[20] If Aristotle had in fact intended to talk about the universe as such, Aristotle would have had to discuss all the parts of the world, even plants and animals, as Plato does in the *Timaeus*.

But Thomas argues against Simplicius, saying that if Aristotle were talking only about simple bodies, he would have had to discuss everything pertaining to simple bodies. In fact, Aristotle discusses only one aspect, that of their being light and heavy, leaving out of discussion their qualitative aspects, such as their being cold or hot, reserving this for the subsequent book *De generatione*.

Thomas prefers to follow the view of Alexander in saying that the subject of this book is the universe itself, and that simple bodies are discussed insofar as they are parts of the universe. Parts of the universe constitute the whole insofar as they have a determined position *(situs)* in the whole. That is, the heavenly bodies and the four terrestrial elements primarily and *per se* have a determined position by reason of their basic motions, which are simple. Since it is a question of position, Aristotle does not discuss the terrestrial elements in terms of hot and cold, dry and moist, and so forth, but only in terms of their lightness and heaviness, which determine their position in the whole. For this reason, continues St. Thomas, there is no need to discuss other parts of the universe, such a stones, plants, and animals, according to their proper natures, but only insofar as their movements are dominated by heavy and light elements, which constitute them in their being. This proper, or specific, consideration of such compound bodies belongs to other bookes of the *libri naturales*.

Thomas goes on to conclude that this view agrees with what is usually said among the Latins, that "this book discusses mobile body with respect to position, or place, which motion indeed is common

[19] THOMAS, *In I De caelo*, prooem. n. 4.
[20] SIMPLICIUS, *op. cit.*, prooem., fol. 2rb.

to all parts of the universe".[21] By "Latins", Thomas certainly included himself and Albertus Magnus. In his earlier work on the *Physics,* Thomas specifies the subject matter of *De caelo* as being "mobile [body] according to local motion, which is the first species of motion".[22] In his paraphrase of *De caelo,* Albert, writing around 1251, says, "There is a single science about those mobile bodies, not because here we discuss them precisely as moved by different natures, but rather precisely as they have a singular potentiality in general and a singular act, which is local motion".[23]

Later Thomists, with only partial justification, classified the *libri naturales* according to their generic motions. Thus the books of the *Physics* were said to discuss motion in general, while *De caelo* considers bodies in simple local motion, *De generatione* considers alterations leading to substantial changes, and *De anima* with its subsequent books consider augmentation of animals. Such mental gymnastics are oversimplifications of the contents of the Aristotelian books as understood by Albert and Thomas. It is true enough, however, that *De caelo* is concerned with simple bodies that move with local motion. It is not concerned with the local motion of animals precisely as living beings who are the cause of their own voluntary motions, for this subject is discussed in *De motibus animalium;* rather it is concerned with their rectilinear motion resulting from the predominance of certain elements, as when an animal loses balance and falls to the ground or when a bird in flight is shot down.

Thus, in Thomas's view, *De caelo et mundo* is concerned with the universe and the place of simple bodies in it. The place of these bodies in the universe is determined by their local motion, namely, the motion of celestial bodies circularly and the motion of the elements upward and downward, depending on their natural heaviness and lightness. Whatever is scientifically determined in *De caelo* is to be applied to other books in the *libri naturales.*

CELESTIAL MOTIONS

For Thomas, there are two basically distinct sciences that study the movements of the heavenly bodies: natural science, meaning the philosophy of nature, and astronomy. Both of these sciences have a common subject matter, the motions of the heavens. But the principles used in studying these motions are formally different. That is, natural philosophy uses the principles of nature outlined in the eight books of the *Physics,* with "nature" *(phúsis)* regarded as an active or passive principle of specific activity. Nature as an active principle is the

21 THOMAS, *In I De caelo,* prooem., n. 5.
22 THOMAS, *In I Phys.,* lect. 1, n. 4.
23 ALBERT, *I De caelo,* tr. 1, c. 1, ed. cit., 1, 60-63.

innate form of the body that spontaneously and dynamically determines both the motion and the goal, unless some other body impedes its natural activity. Nature as a passive principle is the innate receptivity of the matter for actions performed on it by natural agencies. These principles will be discusses again shortly. For the present it is sufficient to see that natural philosophy discusses the physical and natural motions of the heavens from the viewpoint of "nature" *(phúsis)*. It is also concerned with natural magnitudes, distances, velocity, and natural causes of those movements seen in the heavens in terms of nature, sensible matter, and motion.

Astronomy, on the other hand, is a science radically dependent on mathematical principles, such as those proved in geometry and in the higher branches of mathematics. Since both natural science and astronomy deal with the same celestial phenomena, they are said to share in the same material object *(obiectum materiale)*. But since they differ profundly and radically in their medium of demonstration, they constitute two separate and distinct sciences, each having its own identity and validity by reason of its formal object, its *ratio formalis obiecti*.[24]

The distinction between natural science and astronomy does not mean that they are mutually exclusive. On the contrary, they are of mutual interest and concern. The conclusions of the one can provoke the other to further inquiry and possible corroboration as in the earth's sphericity, center of movement, the meaning of time, and so forth. Both approaches are useful and even necessary. Both construct hypotheses to account for the phenomena perceived by sense. However, the hypotheses postulated by the naturalist involve natural causes and natural mathematical devices to account for the phenomena, even if those devices cannot be verified in nature.

The basic problem faced by early astronomers was the obvious irregularity of planetary motion. These planets, or "wandering stars", sometimes seem to move faster, sometimes slower; sometimes they seem to be stationary, and at other times they seem to move backward with a retrograde motion.[25] Such irregularity is not only unbecoming celestial motions, thought to be the domain of the gods, but it is impossible to study these motions scientifically without some reference to rational regularity. According to Simplicius:

> Eudoxus of Cnidos was the first Greek to concern himself with hypotheses of this sort, Plato having, as Sosigens says, set it as a problem to all earnest students of this subject to find what are the uniform and ordered movements by the assumption of which the phenomena in relation to the movements of the planets can be saved.[26]

[24] THOMAS, *Sum. theol.*, II-II, q. 1, a. 1.
[25] THOMAS, *In II De caelo*, lect. 17, n. 2.
[26] SIMPLICIUS, *In II De caelo*, 12, comm. 43, fol. 74r-v.

Eudoxus started with the assumption that all planetary movements must be regular and homocentric, i. e., having the same center around which to revolve, namely, the center of the earth. For Eudoxus the phenomena of celestial movements could be saved by postulating a number of regular spheres for each planet, each rotating around different axes at different speeds. For him each of the planets, including the sun and moon, has three basic motions: in respect to the sphere of the fixed stars moving from east to west; second, in respect to the middle of the zodiac through which the planets move; and third, in respect to the breadth or longitude of the zodiac.[27] All told, Eudoxus postulated 27 spheres and motions to account for the phenomena rationally.[28]

Callippus, a younger contemporary of Eudoxus, postulated a far greater number of spheres, amounting to fifty-five in all (or forty-seven, if one did not postulate the additional eigh for the rotation of the sun and moon).[29] Aristotle himself could not decide on the exact number of spheres (and consequently movers) needed "to save the appearances". In fact, Aristotle was not particularly concerned about the exact number of movers, and decided to leave this question open "to more powerful thinkers".[30] For Aristotle the important issue was that celestial bodies cannot move themselves, but must be moved by something else that is not physical.

Aristotle and the astronomers of his day assumed that all celestial motion had to be regular, circular, and homocentric. Pedestrian observation indicates that the earth and its center are the stationary point around which all the celestial bodies rotate. But this simplistic explanation involves many difficulties and does not account for all the phenomena. Because of these difficulties, "Hipparchus and Ptolemy hit upon eccentric and epicyclic motions to save what appears to the senses concerning celestial motions".[31] It is impossible, as all scholastics realized, that Aristotle and Ptolemy be both right in the domain of a single science. While Aristotle's natural philosophy made sense, it did not account for all the data accumulated by astronomers. And while Ptolemy's astronomy accounted for all the phenomena, it assumed such mathematical devices as eccentrics and epicycles that could not be physically true. For Thomas, such an escape is not a demostration, but a kind of supposition, that is, an hypothesis.[32] But even if Ptolemy's supposition were true in nature, continues Thomas,

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27 ARISTOTLE, *Metaph.*, 12, 8, 1073b18-31.
28 Cf. T. L. HEATH, *Aristarchus of Samos*, Oxford, 1913, pp. 195-196.
29 ARISTOTLE, *Metaph.*, 12, 8, 1073b31-1074a14.
30 *Ibid.*, 1074a16.
31 THOMAS, *In I De caelo*, lect. 3, n. 7.
32 *Ibid.*

"nevertheless all the celestial bodies would be moved around the center of the earth in its diurnal motion, which is the motion of the outermost sphere rotating the whole [universe] and all things within it". [33]

The status of astronomical hypotheses, such as epicycles and eccentrics, was of particular interest to Thomas, because they could not be verified physically; but their assumption in astronomey did account for the known motion of the planets within the sphere of the fixed stars. Thomas's views are clear:

> It is not necessary that the various suppositions (i. e., hypotheses) which they [the astronomers] hit upon be true. For although these suppositions save the appearances, we are nevertheless not forced to say that these suppositions are true, because perhaps there is some other way men have not yet discovered by which the appearance of things may be saved concerning the stars.[34]

This same view was also expressed by Thomas some six years earlier in his *Summa theologiae:*

> There are two kinds of argument put forward to prove something. The first goes to the root of the matter and fully demonstrates some point; for instance, in natural philosophy there is a conclusive argument to prove that celestial movements are of constant speed. The other kind does not prove a point conclusively but shows that its acceptance fits in with the observed effects; for instance, an astronomical argument about eccentric and epicyclic motions is put forward on the ground that by this hypothesis one can show how celestial movements appear as they do to observation. Such an argument is not fully conclusive, since an explanation might be possible even on another hypothesis.[35]

In other words, the hypotheses of astronomy are significant in that they may account for all the phenomena without forcing the mind to acknowledge their physical certainty. As in the case of the movement of the earth, the appearances could be saved either by holding that the earth is stationary and the heavens are moving about it, or that the heavens are stationary and the earth is moving within the heavens, or that both the earth and the heavens are moving.[36]

In the first part of Aristotle's *De caelo* there are two main issues: the nature of celestial bodies, and the nature of celestial motion. From the nature of the motion, one can argue to the nature of the body-not vice versa. The celestial body is said to be incorruptible, different from terrestrial bodies, eternal, and perfect, and their motions is said to be uniform, regular, and circular. The celestial body

[33] *Ibid.*
[34] THOMAS, *In II De caelo,* lect. 17, n. 2.
[35] THOMAS, *Sum. theol.,* I, q. 32, a. 1, ad 2.
[36] THOMAS, *In II De caelo,* lect. 11, n. 2.

is said to be incorruptible because no corruption or even alteration was seen to occur in the heavens despite long centuries of observation by astronomers. Had Aristotle noted the sun-spots observed by Galileo, he undoubtedly would have acknowledged corruption, or at least alteration, in the sun. But the fact was that neither Aristotle nor any of the ancient astronomers before the 17th century ever observed any change incelestial bodies. From this it follows that the matter in celestial bodies must be different from terrestrial matter; for on earth, matter is the root of corruptibility. Hence celestial matter was designated as the "fifth element", different from the prime matter of earth and having no "privation" for change. Further, if there is no "privation" in celestial matter, it must be "perfect", since in it there is nothing wanting. Furthermore, it follows that celestial bodies and the whole universe must be eternal, for there can be no "before" before time and motion, as Aristotle proved in the *Physics* and assumed in *De caelo*. Thomas knew perfectly well that Aristotle maintained the eternity of the universe. But on this point, Thomas argued that there is no conclusive argument one way or the other with regard to the eternity or temporality of the universe. The only basic issue for Thomas was that the universe had to be created by God either in time or in eternity.[37]

Similarly, the only kind of motion observed in the heavens is local motion that is perpetual, never tending to rest, but ever flowing. While observation shows that planetary motion is irregular, this irregularity cannot be understood except in terms of regularity that is thought not to be. In other words, all irregularity must be defined in terms of regularity. The same is true of uniformity in velocity, for there can be no difform motion except in relation to that which is uniform. That is to say, there can be no denial of uniformity and regularity except in terms of uniformity and regularity. But the only local motion that can be uniform and regular is circular motion. All motions on earth (1) come to rest in some finality achieved, and (2) tend to accelerate as they approach the term of motion. Celestial motions are not like that, for it needs be that they continue forever in a state of uniform velocity. Consequently, the task of the ancient astronomer was to determine the exact number of uniform circular motions needed to account for the irregularity of planetary motion.

The important issue for Thomas, as for Aristotle, was the cause of celestial motion, i. e., the efficient cause responsible for all the motions needed in the heavens to account for the phenomena. There were many observers in antiquity and in the Middle Ages who maint-

[37] THOMAS, *In II De caelo*, lect. 1, n. 2-3; I, lect. 22, n. 1; *Sum. theol.*, I, q. 46, a. 1; *De aeternitate mundi*.

ained that it is the very nature of a spherical body to rotate with uniform circular motion. This was the view of Plato and Copernicus; but others, including Aristotle and Thomas, insisted on the radical difference between celestial and terrestrial motions. Terrestrial motions are of two kinds: natural and violent. All natural motion comes about from some internal principle that determines the body to act in a certain kind of way, while violent motion must be explained by some external force acting upon the body, the body itself contributing nothing to it.[38] Violence, like chance, happens only rarely and unpredictably, and it cannot be said that the regularity of the heavens is due to violence or chance. While violent action can be seen on earth, Aristotle totally excludes it from celestial motions. Natural motions, on the other hand, are of two kinds: animate and inanimate. Animate motions are those produced by living bodies, whose "soul" is the efficient cause of movement through its various parts. Inanimate motions are those emanating from an internal active or passive principle, but not through efficient causality. That is to say, the soul of living things is the efficient cause, the *motor,* of animate motions; whereas the "nature" of inanimate things moves spontaneously and dynamically toward a specific kind of motion and finality by the active principle within the inanimate body, provided that these motions are not impeded by some obstacle. The formal nature of a non-living body is not a *motor;* it is not an efficient cause of its own motion. The true efficient cause of such spontaneous natural activity is the "generator" of the body in the first place; it is the generator who produced the natural form. Once the form is generated by a distinct agency, the body immediately, spontaneously, and dynamically *(subito* and *statim)* manifests all its natural accidens, motions and finality.[39] Once the natural body is generated, there is no need to look for another *motor* or efficient cause to account for its natural motions.

Celestial motions, for Aristotle, cannot be explained by the nature of the physical sphere, as Plato would have it. For Aristotle, the celestial body has no intrinsic formal principle to move spontaneously in circular rotation. Nevertheless, these regular, uniform, and eternal motions are "natural" and partake of the divine. Therefore, for Aristotle, celestial bodies are animated by a soul, which is the *motor,* the efficient cause of celestial movement.[40] Thus for Aristotle, each sphere was animated by a special soul, which was the formal cause, as well as the efficient cause, of celestial motion. The number of souls (or

[38] ARISTOTLE, *Ethic.* III, 1, 1110a1-3.

[39] THOMAS, *In III De caelo,* lect. 7, nn. 5-8; J. A. WEISHEIPL, "The Concept of Nature", *New Scholasticism,* 1955, *28,* 338-408.

[40] See J. A. WEISHEIPL, "The Celestial Movers in Mediaeval Physics", *The Thomist,* 1961, *24,* 286-326.

divinities) depended on the number of motions required to explain celestial motions. Aristotle, adopting the view of Callippus, postulated fifty-two or forty-seven. Each soul of the sphere was itself a substance separate from matter, and hence were called separate substances. For Thomas it did not make much difference *(nec multum refert)* whether the sphere was moved by a soul inherent in the body or by a distinct substance, separate from matter, moving the sphere through its efficient causality.[41] What was clear to him was that a heavenly body had to be moved by something distinct from itself, and that this mover had to be a substance separate from matter. One could, therefore, conclude that each celestial sphere moves itself by reason of its animate form, so that the ultimate soul of the first sphere was the first mover of the universe. Thomas, of course, preferred to think of these separate substances not as souls animating celestial bodies, but as separate efficient causes, like an "angel" moving the body.[42]

Since, for Aristotle, there can be only one universe, the mover of the outermost sphere has to be unique and supreme for all other motions depend upon it. This ultimate mover, it would seem, was the unmoved mover. Al least this is the view many recent historians take in explaining the views of Aristotle. It would seem from Aristotle's discussion in *Metaphysics* Bk. 12, however, that the ultimate unmoved mover is a separate substance for whose sake the first mover acts, a substance which is subsistent thinking thought.[43] Already in Thomas's day there were some who maintained that God was (according to Aristotle) only the final cause of all; there were also others who maintained that Aristotle's God is only a *causa movendi* and not a *causa essendi*. Rejecting these views, Thomas says, "It should be noted that Aristotle here [*De caelo* I, 4, 271b33] posits God to be maker [i. e., the efficient cause] of the celestial bodies, and not just a cause after the manner of an end, as some have said".[44] In other words, each celestial sphere has a separate substance, either animating it or pushing it, but beyond the first "soul", the *anima mundi,* there is the creator and final cause of all, whom Aristotle, according to Thomas, calls God, who creates as well as moves the entire universe. "And so it is evident that although Aristotle postulated the eternity of the world, he did not for this reason deny that God is the *causa essendi* of the universe, as some would have it, claiming that God is only a *causa movendi*".[45]

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41 THOMAS, *In II De caelo,* lect. 3, n. 3.
42 *Ibid.*
43 ARISTOTLE, *Metaph.,* 12, 7, 1072b25-29.
44 THOMAS, *In I De caelo,* lect. 8, n. 14; Cf. *In VI Metaph.,* lect. 1, n. 1164; *In VIII Phys.,* lect. 3, n. 6.
45 THOMAS, *In VIII Phys.,* lect. 3, n. 6.

THE EARTH AND TERRESTRIAL MOTIONS

Apparently in antiquity there were some who thought that the earth is flat. Aristotle mentions Anaximenes, Anaxagoras, and Democritus as giving "the flatness of the earth as the cause of its immobility".[46] To those who thought the earth flat, one might add the Jews, for whom the firmament was like an inverted bowl or upper hemisphere. No one in the age of Columbus had reason to think that the earth is flat or that if one came to the "edge" of it, one would fall off. This might have been the popular opinon of some unlearned men, but it was never the view of philosophers and scientists. Even those who postulated a cosmic fire, the sun, as the center of the universe, like the Pythagorians, maintained that the earth is a sphere or globe which moved with uniform motion around the sun. The sphericity of the earth is most readily seen in an eclipse of the moon, when the earth comes between the sun, the source of light, and the moon, upon which the shadow of the earth is cast. Aristotle frequently referred to the free fall of heavy bodies as proof of the earth's sphericity: no matter how distant the points of experiment are, heavy bodies always fall perpendicular to the earth as its center, and not parallel to each other. One could also argue, as many ancients did, from the experience of watching ships come into port: at first only the uppermost part of the mast is visible before the whole ship is seen.

The real problem in antiquity, and in the Middle Ages too, was in determining the center of the universe; or, to put the question in another way. Is the earth at rest or in motion? Heraclitus, Aristarchus of Samos, and the Pythagorians maintained that the earth revolves around the sun, or cosmic fire, which is the center of the universe. Aristotle and the great majority of thinkers opted for the experience of sense, in which the earth is stable and the heavens revolve. If the universe is finite and revolving, then its center, whatever it may be, must be immobile. The center of any revolving sphere is immobile. As far as calculations are concerned, it makes little difference whether the earth is mobile or immobile, but it makes a great deal of difference to the natural philosopher, who wants to know what things really are in their nature. In antiquity, Anaximander, Anaxagoras, Democritus, Empedocles, Platonists and Aristotelians opted for a stable earth around which all the heavens revolve.[47] If the center of the universe is taken to be the center of the spherical earth, then it necessarily follows that the cender of the earth is immobile. If that be granted,, it also follows that "up" and "down" are absolute terms, so that if a piece of terrestrial earth were to be put where the moon now is, that

[46] ARISTOTLE, *De caelo*, II, 13, 294b14-15.
[47] THOMAS, *In II De caelo*, lect. 20, n. 3.

earth would tend to move toward the center where the earth now is. Aristotle defines the terms "up" and "down" in terms of the local motion of bodies toward the center of the universe (earth) or away from it. Thus bodies are called "heavy" if they tend toward the center of the earth, and "light" if they tend away from the center and toward the celestial bodies.

Both Aristotle and Thomas considered the earth to be a "sphere of no great size".[48] Relying on the mathematicians of his day, Aristotle gave the earth's circumference as 400,000 Greek stades. Thomas calculated this as 50,000 Roman miles, since for him a Greek stade is one-eighth of a Roman mile. Hence the universe, Aristotle contends, is "of no great size". Thomas, howerer, notes that

> According to the more careful measurements of present-day astronomers, the earth's circumference is much less, i. e., 20,400 miles as Al-Fragani says; or 180,000 stades as Simplicius says, which is roughly the same, since 20,000 is one-eighth of 160,000.[49]

In explaining what Aristotle meant by "no great size", Thomas notes that astronomers of his day hold that the sun is 170 times greater in size than the earth. Today we hold that the sun's radius is 109 times greater than the earth's equatorial radius.

The method used by Thomas's sources, which he carefully explained, is based on the terrestrial length compared to one degree of difference in the heavens:

> Astronomers were able to calculate this [distance] by considering how much space of earth makes for a difference of one degree in the heavens; and they found that it was 500 stades according to Simplicius, or 56 and 2/3 miles according to Al-Fragani. Hence, multiplying this number by 360, which is the number of degrees in the heavens, they found the size of the earth's circumference.[50]

According to the calculations of modern scientists, Aristotle's estimate is twice too large, and Simplicius's and Thoma's figure not large enough; for Aristotle's measurements came to approximately 46,000 miles, and Al-Fragani's and Simplicius's come to about 20,500, whereas a rough modern calculation is 24,900 miles at the equatorial circumference. It would seem that Thomas learned the method of calculating the size of the earth from Simplicius or from Albert the Great, who claims to be following Alcemenon (whoever he was) and Ptolemy.[51] Albert's commentary was written some 20 years earlier than Thoma's.

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48 THOMAS, *In II De caelo*, lect 28, n. 3; ARISTOTLE, *De caelo*, II, 14, 298a7-8.
49 THOMAS, *In II De caelo*, lect. 28, n. 4.
50 See SIMPLICIUS, *Comm. in libros De caelo*, II, comm. 67.
51 ALBERT, *De caelo*, lib. 2, tr. 4, cap. 11, ed. Cologne 1971, V/1, p. 201, lines 26-63.

In Books III and IV, Aristotle considers the position of heavy and light bodies, but Thomas commented only as far as III, c. 3, 302b9 (lect. 8). In this brief space there are two important points to consider.

First, Thomas carefully identifies the first mover of the universe in the order of natural movers. This first mover, being made up of "soul" and "heavenly body", moves itself and in its motion moves everything in the heavens. This first mover is comparable to Plato's mover who first initiates the movement of elements into a structured universe. Such a "first mover", which moves itself in the perpetual movement of the first sphere, "should not be understood as the absolutely first, because this latter is absolutely immobile [*omnino immobile*], as proved in Phys. VIII and in Metaph. XII". Rather, such a mover is "the *primum movens* in the category of natural movers, which moves itself, as composed of a *motor* and a *motum,* as proved in Phys. VIII, 5 (lect. 10)".[52] In this passage, Thomas admits that the first physical mover could, if one wished to hold it, be considered a self-mover, i. e., a composite of celestial body and an immaterial, immortal soul, as Aristotle seems to suggest. But Thomas insists both here and elsewhere that beyond such a self-mover there is another reality, whom we call God. It would seem that this passage in the *De caelo,* written at the height of his intellectual powers, agrees satisfactorily with the position advanced when Thomas was a young master in theology composing the first book of the *Summa contra gentiles,* in which he discussed various proofs for the existence of God.[53] In the earlier *Summa,* Thomas had argued to the existence of a first mover who is not moved by anything outside itself. But, he suggests, since such a mover is not necessarily totally unmoved, Aristotle argues further, saying that this idea can be understood in one of two ways: either totally unmoved, in which case it is God, or self-moved, in which case there must be a first mover beyond, who is in no way moved, not even *per accidens,* and this mover we call God. For Thomas, movers of the spheres were not souls, but angels who move the bodies in the order of efficient causality. Beyond the highest angel who moves the outermost sphere, there is another reality who is the efficient and final cause of all. This reality he calls God, the Christian God. Never once did Thomas doubt that Aristotle had demostrated the existence of the one, true God.

The second point Thomas discusses at some length in his commentary on the third book of *De caelo* pertains to gravitational motion. For Aristotle, natural bodies have a natural motion which be-

[52] THOMAS, *In III De caelo,* lect. 6, n. 2.
[53] *Summa contra gentiles,* I, c. 13.

longs *per se* to that body. Bodies which naturally move with rectilinear motion have "gravity" and "levity,", the latter being a term awkward to translate. Nature, as defined by Aristotle, is a principle *(arché)* of motion and rest in those things in which it resides *per se*.[54] Bodies, therefore, are called "natural" which have such a nature and such a natural motion. But all natural rectilinear motion is either up or down, i. e., either heavy or light. Therefore all natural bodies on earth have a natural rectilinear motion. But all rectilinear motion is either up or down. Therefore all natural bodies on earth move either up or down. Among the four simple bodies on earth, namely, earth, water, air, and fire, only two can be said to move absolutely up or absolutely down, namely, earth and fire. Earth is said to move down absolutely because it always tends to fall below water, while fire always tends to move beyong air. Water and air are said to be *relatively* heavy or light because water moves downward in relation to air, but upward in relation to earth, while air moves up in relation to water, but down in relation to fire. Statements such as these are to be understood only in a broad and relative sense, for nature often shows mountains to be higher than lakes, and air higher that fire. Whatever small validity Aristotle's theory of the elements has today, the natural movement of all simple bodies must be seen strictly in a relative context, as I have tried to show elsewhere.[56]

The important point is that a heavy body, for example, has within it a formal, active, dynamic principle whereby it moves downward *secundum principium activum sive formale.* This principle is "nature" as *form.* But all bodies have "nature" also as *mater,* which is an intrinsic passive principle for being acted upon by other natural bodies; this is "nature" *secundum principium passivum, receptivum sive materiale.* This concept of "nature" *(phúsis)* as an intrinsic active or passive principle is essential to all of Aristotle's philosophy; without an understanding of it, nothing can be correctly understood in any branch of his teaching, least of all in natural philosphy.

The concept of "nature" as an intrinsic principle, both active and passive, distinguishes natural motion from violent ones. Violent motion is one forced upon the body from without; that is, the source of that motion lies in another body and the body being forced reacts contrary to its nature. "An unnatural movement presupposes a natural movement which it contravenes".[57] Thus violence presupposes nature, as the motion of a heavy body upwards presupposes its natural tendency downward. Following Aristotle, Thomas explains the mo-

54 ARISTOTLE, *Phys.*, II, 1, 192b21-23.
55 THOMAS, *In III De caelo*, lect. 7, n. 2.
56 J. A. WEISHEIPL, "Space and Gravitation", *The New Scholasticism*, 1955, 29, 175-223.
57 ARISTOTLE, *De caelo*, III, 2, 300a24-25.

vement of projectiles after they have left the hand of a thrower in terms of the medium which has the means of carrying the projectile against its nature.[58] Thus the Aristotelian explanation of violent motion requires that there be a medium, such as water or air, to allow the possibility of violent motion; in this case, the medium is a necessity, not just a convenience *ad bene esse.*[59]

But Averroes claimed that the medium is absolutely necessary not only for violent motion, but for natural motion as well.[60] As Thomas points out, Averroes gives two basic arguments for the need of resistance in natural motion.[61] The first argument is drawn from the need for an efficient cause of all natural movement. The *motor separatus,* or efficient cause of all heavy and light bodies, is the generator, which, in giving the form, gives as a consequence all the natural motions that derive from that form, just as it gives all natural accidents which flow from that form; and so the generator causes natural motion by means of that form. Natural motion, however, ought to follow immediately from its *motor,* its efficient cause. But since natural motion does not follow immediately from its efficient cause (the generator), but from the substantial form, it would seem that the substantial form is the proper *motor coniunctus,* the immediate cause of natural motion. And so it would seem, according to Averroes, that heavy and light bodies —in a certain sense— move themselves: of course, not *per se,* for things that move themselves properly *(per se)* have to be divided into "mover" and "moved", which division cannot be properly found in heavy and light bodies, which are divided only into form and matter, the latter of which is not, strictly speaking, "moved". Hence it remains that a heavy or light body moves itself *per accidens,* i. e., much as a sailor moves a ship through whose movement he himself is moved. Similarly, both the light and the heavy body, through their substantial forms, move the air, upon whose motion the heavy and the light body are moved. Hence, Averroes concludes that air is indispensable for natural motion.

The second argument Averroes gives is in his commentary on *Phys.,* IV, text. comm. 71, where he says that there must be some kind of resistance between the mover and the moved. But there is no resistance between the matter of a heavy or a light body and their substantial form, which is the principle of their motion. Therefore it is necessary that there be resistance from the medium, which is air or water. Therefore Averroes concludes that air is indispensable for natural motion.

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58 THOMAS, *In III De caelo,* lect. 7, n. 5-6.
59 *Ibid.,* n. 6.
60 AVERROES, *De caelo,* III, comm. 28.
61 THOMAS, *In III De caelo,* lect. 7, n. 8.

Thomas notes that both of these arguments are based on the same error.[62] Averroes believed that the substantial form of the heavy or light body is an active principle of motion after the manner of a *motor,* or efficient cause of motion, in such a way that there would have to be some resistance to the form's inclination, and also that the motion does not immediately proceed from the generator who produced the form in the first place. Thomas insists that this asumption is altogether false: *hoc est omnino falsum.* For Thomas, the substantial form of heavy and light bodies is not a principle of motion as an agent, a *motor coniunctus,* but as a principle, or source, *by which (quo)* the mover causes motion; it is like color, which is the principle by which we see. In all natural inanimate motion the substantial form is no more than an instrument *by which* the agent acts.

Thomas explicitly says that "the motion of heavy and light bodies does not derive from the generator by means of any other moving source". That is, there is no need to look for any resistance beyond what already obtained between generator and generated, agent and patient. Consequently, natural motions do not need a medium in which to move, whereas violent motions do. Whatever moves naturally already has everything it needs to move; it has an innate source, or power, of moving. In short, it has "nature" as an active formal principle, which is not an efficient cause. So there is absolutely no need to look for any other efficient cause to impel such bodies when they move naturally; there is no need to postulate a *motor coniuctus;* there is no need to look for any other efficient cause of motion distinct from the generator which produced the natural form in a given body. The case of violent motion is different, for in violent motions the source of movement is always outside the body being moved, impelling the projectile along. Thomas is explicit here and elsewhere: natural motions is possible even in a void, or vacuum; natural motions do not need the resistance of a medium.[63]

The commentary on Aristotle's *De caelo* by St. Thomas Aquinas is a valuable source for his mature thought on the basic principles of natural philosophy. There is no evidence of a change of teaching, but there is ample evidence to show that we have here a deeper understanding of the basic elements of his philosophy of nature.

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[62] *Ibid.,* n. 9.

[63] Cf. J. A. WEISHEIPL, "Motion in a Void: Aquinas and Averroes", *St. Thomas Aquinas, 1274-1974: Commemorative Studies,* Toronto, 1974.