ILL: 165949133	BAYLOR UNIVERSITY LIBRARIES	TN: 905273	Borrower: PNX Group: LVIS

Source Title: A companion to Albert the Great : theology, philosophy, and the sciences / Vol: Issue: Year/Month: 2013/ Pages: 507-540	Location: Moody General Collection AVAILABLE Call #: B765.A44 C66 2013
Article/Chapter Title: Michael W. Tkacz: Albert the Great on Logic, Knowledge, and Science Author: Patron:	Print session: **4/12/2016 3:27:12 PM** Lender String: *IYU,OCA,TUT,PRK,PVU,VLB,WUG,MNT,ICW,EXW Borrowing Notes: Borrowing Notes: AZNET, AMIGOS/BCR, LVIS, AMINET (maxCost: 0.00)
Borrowing Library: ILL-PHOENIX PUBLIC LIBRARY **Odyssey: 206.107.42.120** **E-Mail: pnx@lib.ci.phoenix.az.us** **FAX: (602) 256-4350**	Comments: Supplied by Baylor University Contact us: Ph: 254-710-3054 E-Mail: BU_ILS@baylor.edu

ALBERT THE GREAT ON LOGIC, KNOWLEDGE, AND SCIENCE

Michael W. Tkacz

There can be little doubt that Albert the Great was among the most prolific of medieval scholars. No less a historian than Étienne Gilson remarked on Albert's "gigantic literary production that defies analysis" and expressed amazement at the large "amount of philosophical and scientific information heaped up in [Albert's] writings".[1] Albert's Aristotelian commentaries alone—that is, his strictly philosophical as opposed to theological works—comprise one of the most ambitious attempts in the history of the Western intellectual tradition to set out systematically the whole of human knowledge.[2] One would expect that such a scholar would have a great deal to say on logic, human knowledge, and the nature of scientific research. Indeed, even a cursory investigation of his works reveals that his contributions are so extensive that they can hardly be discussed adequately in a single brief essay. The present study, therefore, will be limited to a series of interrelated topics that especially engaged Albert in his lifelong pursuit of learning.

While the limitations of this study necessitate the exclusion of many of Albert's significant contributions to logic and epistemology, the focus on those issues most closely related to Albert's research in the natural sciences is not without textual warrant. When Albert announced at the beginning of his commentary on Aristotle's *Physics* his intention to make the whole of the new learning of Aristotle intelligible to the Latins,[3] he realized that this would be largely a matter of learning in the special sciences of nature and the method of the natural sciences.[4] Following Aristotle, Albert considered the study of the soul and its operations as part of

---

[1] Étienne Gilson, *History of Christian Philosophy in the Middle Ages* (London: 1955; repr. 1980), 277.

[2] On this point, see James A. Weisheipl, "The Life and Works of St. Albert the Great," in *Albertus Magnus and the Sciences: Commemorative Essays 1980* (Toronto: 1980), 13–51.

[3] *Phys.* 1.1.1, Ed Colon. 4/1, 1.

[4] On the nature and contents of the Aristotelian commentaries see Weisheipl, "The Life and Works of St. Albert the Great," 28–32; in the same volume also see "Albert's Work on Natural Science (*libri naturales*) in Probable Chronological Order," 565–577.

natural philosophy,[5] mathematics as derived from natural philosophy,[6] and metaphysics as foundational to a knowledge of nature.[7] Even the study of ethics and politics, deriving as it does from the study of the soul, is related to the natural sciences. Again following Aristotle, Albert considered logic primarily an instrument for scientific research. While he did admit that the discipline may be studied as a science in its own right, most of his logical writings are focused on logic as the practical art of discourse common to the specialized sciences. A consideration of Albert's logic and epistemology in relation to the natural sciences, as will be given here, certainly does not exhaust what can be said of his contribution to these disciplines. Nonetheless, this approach to his conception of human knowledge and scientific method will provide an overview of his position on a series of related philosophical issues that Albert himself considered especially significant.

The first five sections of this study are devoted to Albert's conception of logic and its use in scientific research. Albert commented not only on all of Aristotle's logical works, but also on those of Porphyry, Boethius, and Cicero. This work is too vast to survey with any degree of comprehensiveness here and, therefore, only selected elements of his contribution to the subject will be considered. In particular, because of Albert's focus on the use of logic in research, the present treatment will not detail his contributions to strictly formal logic.[8] Rather, this survey will be devoted to his general conception of logic and its application to various forms of scientific investigation. The following three sections of this study treat a series of epistemological issues that received repeated attention throughout Albert's works. While the focus is on Albert's conception of human knowledge of nature, his notions of mathematical and metaphysical knowledge are treated as well.

---

[5] *Phys.* 1.1.4, Ed. Colon. 4/1, 6–8.

[6] *Metaph.* 1.1.1, Ed. Colon. 16/1, 2.

[7] *Metaph.* 1.2.3, Ed. Colon. 16/1, 20–21; Benedict M. Ashley, "Albert the Great on Aristotle's *Metaphysics*," *American Catholic Philosophical Quarterly* 70 (1996), 137–155.

[8] On Albert's formal logic see Antonino Stagnitta, *La logica formale in Alberto Magno* (Palermo: 1984); J.M. Hubbard, "Albert the Great and the Notion of the Syllogistic Middle Term," *Thomist* 54 (1990), 115–122; Richard Francis Washell, "Aristotle's Syllogistic: A Medieval View," *Vivarium* 12 (1974), 18–29. For Albert's contributions to modal logic see Simo Knuuttila, "Modal Logic," in *The Cambridge History of Later Medieval Philosophy*, ed. Norman Kretzmann, Anthony Kenny, and Jan Pinborg (Cambridge: 1982), 342–357, esp. 352–353 and Mario Mignucci, "Albert the Great's Approach to Aristotelian Modal Syllogistic," in *Actes du IV Congrès internationale de philosophie médiévale, Montréal 1967* (Paris: 1969), 901–911.

1. The Subject of Logic

At a certain point in his commentary on Porphyry's little introduction to Aristotle's *Categories*, Albert provides a direct and explicit statement concerning the subject of logic: the subject of logic is argument.[9] He follows this with a brief division of the elements to be considered within logic so understood, thus delineating the discipline. Argument is composed of propositions, making their analysis part of the subject of logic. Propositions are themselves composed of terms and, consequently, the definition of terms is included in the discipline as well. In another discussion,[10] Albert refers to the same division in terms of Aristotle's works. Logic concerns argument as discussed in the *Analytics* and the *Topics*. This presupposes the treatment of the proposition in *On Interpretation* and of terms in the *Categories*.

This way of characterizing the subject of logic, however, leaves unanswered many questions about the nature of the discipline and its relationship to the more specialized sciences. For this reason, Albert provides a more extensive treatment of the subject of logic beginning, not with a topical division of the discipline into its parts, but with a functional definition. In the opening tract of his commentary on Porphyry, he sets out to show that logic is a science distinct from other sciences by considering its *intentio*: logic is the common mode of the sciences as they proceed from the known to the unknown.[11] That there can be a science of this common mode of reasoning is clear from the fact that abstractive reasoning is necessary for movement from the known to the unknown and such reasoning has parts which can be defined, proceeds from principles, and possesses characteristic properties.[12] This definition, however, shows that logic is unique among the sciences, for the principles and conclusions of logic take the form of rules for proper reasoning in the other sciences and in this way constitute the common mode of the sciences.[13] Because of its *intentio*, then, logic can be understood as an art as well as a science.[14]

---

[9] *De V univ.* 1.4, Borgn. 1, 7b.

[10] *Peri hermeneias* 1.1.1, Borgn. 1, 373–376.

[11] *De V univ.* 1.1 and 3, Borgn. 1, 2a and 5a–b; *De praedic.* 2.1, Borgn. 1, 149a.

[12] *De V univ.* 1.1, Borgn. 1, 2a–b.

[13] *De V univ.* 1.1 and 4, Borgn. 1, 2b and 6b–8b.

[14] *De V univ.* 1.1, Borgn. 1, 3b where Albert calls logic a *scientia contemplativa*; see also *De V univ.* 1.4, Borgn. 1, 6b and *Top.* 1.2, *Proaemium operis*, Borgn. 2, 235b–237b.

This is why Albert, following Aristotle, insists that logic be learned before any of the other sciences.[15]

These two ways of characterizing the subject of logic are clearly related, for Albert argues that the division of logic into its parts arises out of its functional definition.[16] Because the intention of logic is to provide a procedure for advancing from the known to the unknown, it is necessary that it consider the various kinds of unknowns to be known as a result of scientific investigation. First of all is the uncomplex object of simple apprehension. The intellect apprehends the nature of the object when it possesses an answer to the question of what the object of knowledge is (*quid sit?*). Second, there is the complex object of composition or division. Such an unknown complex becomes known when the intellect possesses an answer to the question of whether the object truly is the way it is thought to be composed (*an verum vel falsum sit?*).[17] Given that the unknowns are of two kinds, logic must be divided into two parts, each concerning the mode necessary for arriving at knowledge of its proper type of unknown. Simple objects are known when their definition is known, so logic must be concerned with the definition of terms. Complexes are known when the enunciation signifying their composition is known to be true, so logic must be concerned with propositional enunciations. An enunciation is known to be true when its terms are known to be related in a certain manner through some third term. Thus, logic must also concern itself with argumentation by means of which such relations are made manifest. Albert makes it clear, then, that the division of logic is grounded in the functional definition of logic.[18]

If the function of logic is to serve as the common mode of the special sciences, then the principles of the discipline are oriented to this end. It is in this sense that Albert understands logic to articulate rules of reason, for such rules are the necessary conditions for attaining knowledge of any subject. Taken together with the division of logic into its disciplinary parts of terms, enunciations, and arguments, the functional definition provides

---

[15] *De V univ.* 1.3, Borgn. 1, 5b; *Metaph.* 1.1.1, Ed. Colon. 16/1, 3.

[16] *De V univ.* 1.5, Borgn. 1, 8b.

[17] The types of *ignota* are related to the four scientific questions; see *Anal. Post.* 2.2.10, Borgn. 2, 188a–190b.

[18] For a comparison of Albert's division of logic to later Scholastic treatments see Thomas McGovern, "The Division of Logic," *Laval Théologique et Philosophique* 11 (1955), 157–181. On the extent to which Albert's treatment differs from that of Porphyry see James Donaldson, "Aristotle's Categories and the Organon," *Proceedings and Addresses of the American Philosophical Association* 46 (1972), 149–156.

an indication of the place of logic among the sciences. The functional definition also indicates a priority among the parts of logic: terms are for the sake of enunciations which are, in turn, for the sake of arguments. This is why the subject of logic may be said to concern the principles of argument, the whole being designated by its most inclusive part. Yet, arguments and their terminal and enunciative parts are articulated in language. Thus, logic is also a *scientia sermocinalis*.[19] Albert, however, is careful to point out that logic is concerned with language only accidentally.[20] Essentially, logic is concerned with what is in the intellect of the one who proceeds to knowledge of the unknown from the known. Strictly speaking, then, logic is primarily concerned with second intentions rather than language as such.[21]

Albert presents an argument for the accidental relation of language to the subject of logic by drawing attention to a distinction between simple and complex discourse.[22] Simple language (*sermo incomplexus*) cannot by itself be the means by which knowledge of the unknown is attained. This is because, while such language does signify something, it cannot signify that something is or is not. Thus, the logician does not consider simple language except insofar as it is a functional part of complex language (*sermo complexus*). Complex language, specifically that sort of complex language Albert calls an "enuntiatio", does signify that something is or is not. Yet it too cannot by itself be the means of knowing the unknown, for knowledge not only requires a signification of something, but assent in the knower that something is the case. While enunciations are necessary for attaining knowledge of the unknown, they are not sufficient. Albert argues that enunciations, with their simple components, must be brought into the form of an argument (*quod ad formam argumenti collectivus est*) in order to constitute the means by which the knower proceeds from the known to knowledge of the unknown. This is why argument is, properly

---

[19] *De V univ.* 1.2, Borgn. 1, 4a–b; *Peri hermenias* 1.1.1, Borgn. 1, 375b; *Anal. Post.* 1.1.1, Borgn. 2, 2b. See also *De V univ.* 1.4, Borgn. 1, 7a–b.

[20] See *De V univ.* 1.4, Borgn. 1, 7a where Albert compares logic to grammar, poetry, and rhetoric.

[21] *De V univ.* 1.4, Borgn. 1, 9a; see also *Metaph.* 1.1.1., Ed. Colon. 16/1, 3 where Albert uses the term *intentiones secundas*. This interpretation, put forward by Norman Kretzmann in his entry on the "History of Semantics" for *The Encyclopedia of Philosophy*, ed. Paul Edwards (New York: 1967), 371, has been challenged by Richard F. Washell, "Logic, Language, and Albert the Great," *Journal of the History of Ideas* 34 (1973), 445–50. On this debate see the remarks of Ralph McInerny, "Albert on Universals," *The Southwestern Journal of Philosophy* 10 (1980), 3–18, esp. 4–11 and note 9.

[22] *De V univ.* 1.4., Borgn. 1, 9b–10a.

speaking, the subject of logic and the discipline is a *scientia sermocinalis* only *per accidens*.

Understood in this way, argument constitutes the subject of logic insofar as it is an instrument—that is, insofar as it is productive of an intentional state of knowledge in the knower. Yet, language is necessarily involved in this production. Simple terms and complex enunciations are used in the process of attaining knowledge of the unknown and this is accomplished in the form or context of argumentation. This contextual instrumentality of terms and enunciations determines their *per accidens* relation to the function of logic. The instrumentality of argumentation, however, is related to the purpose of logic in a per se manner, for argument is used in a non-contextual way to bring the knower to knowledge of the unknown.[23]

Making use of simple and complex instruments in the process of knowing demands that the logician must attend to the features of terms, enunciations, and arguments as those features are manifested in language. Yet Albert insists that the simples and complexes that engage the logician do not belong to the signified thing insofar as it is a thing, but only insofar as the thing is known. He notes that the known through which knowledge of the unknown is attained can be considered in two ways: as existing apart from the mind or as a certain concept in the mind of the knower. It is only insofar as it exists as a known concept that the known is productive of knowledge of the unknown.[24] While logic is in a significant sense a *scientia sermocinalis*, its proper concern is not with language per se, but with second intentions. At the same time, logic is not concerned with things in themselves (*res ipsas*), but with the common mode of those sciences that are directly concerned with things in themselves.[25]

2. The Logic of Universals

Given Albert's understanding of the subject of logic, both in terms of its divisions and of its function, the study of universal concepts falls well within the province of the logician. Because argument is the subject of logic, whatever pertains to the terms and enunciations composing arguments is relevant to the principles governing the common mode of the

---

23 Washell, "Logic, Language, and Albert the Great," 448–449.

24 *De V univ.* 1.4, Borgn. 1, 9b.

25 *De V univ.* 2.1, Borgn. 1, 17b–18a.

special sciences. Among those principles are those pertaining to predication, especially universal predication. Universality, predicability of many, attaches to natures as abstracted by the intellect from the individuating conditions of matter. Every abstracted nature, as known, is related to the many in which it exists. Thus, the knower proceeding to knowledge of the unknown is proceeding from a universal concept to another universal concept. The relation, properties, and accidents of things as known must be the concern of the logician in the effort to understand and articulate the principles constituting the common mode of the sciences.

Consequently, Albert follows his treatment of the nature of logic with an extended discussion of the three Porphyrean questions concerning the nature of universals. The dependent relationship between these questions, such that the second arises only given a certain answer to the first and the third only given a certain answer to the second, determines Albert's focus on the first question of whether genera and species subsist in reality or exist only conceptually. He provides a careful analysis, considering a series of arguments on both sides of the issue.[26] In the end, he decides that the arguments for the subsistent reality of genera and species are the stronger. This determination of the first question provides the grounds for consideration of the other two issues of whether universals as subsistent are corporeal and, if not, whether they exist in sensible individuals.

Setting out his own solution, he begins with a distinction of the three ways in which universals can be considered: as a simple and invariable nature in itself, as existing in this or that, and as referred to the intellect.[27] Taken as a nature in itself, the universal is that which gives a common being, definition, and a name to many things. This nature exists in the most perfect manner, having no other natures mixed with it nor varied in its nature through some other nature. Taken as existing in this or that, the universal is individuated, multiplied, and incorporated. As such, it is subject to an infinity of diverse characteristics, because an infinity of characteristics can inhere in matter. As referred to the intellect, the universal can either be in the First Intelligence or be abstracted. The First Intelligence knows and causes the universal to be in itself simple, pure, immobile, incorporeal, and in relation to the possible intellect as perfectible and mobile. With respect to the abstractive intellect, the nature is

---

[26] *De V univ.* 2.3, Borgn. 1, 20b–24a. For a critical evaluation of these arguments see McInerny, "Albert on Universals," 16–17.

[27] *De V univ.* 2.3, Borgn. 1, 24a.

not caused to exist in itself by the act of intellection, but has universality conferred on it by the intellect's act of separating it from individuating matter. In human knowledge, then, the nature is universal relative to the act of abstraction, having restored to it the universality that it possessed in itself apart from its being individuated in matter.[28]

Albert makes the same distinction in another way. A form can be considered apart from a thing (*ante rem*) as when it is considered in itself as the cause of things. A form can also be considered in a thing (*in re*) as when it is considered with respect to the thing in which it is individuated. Finally, a form can be considered derived from a thing (*post rem*) as when it is considered as abstracted from the particularizing conditions of matter. A generic or specific form *ante rem* is a universal cause of the common being of many generically or specifically similar things. A generic or specific form *in re* is a universal essence of an individual thing making it generically or specifically like other individuals. A generic or specific form *post rem* is a universal abstracted by the knower of the generically or specifically similar individuals. Albert goes on to explain that universal natures themselves subsist as ingenerable, incorruptible, and invariable. As such they subsist apart from concepts, as he had already argued. Yet in some significant sense universal natures subsist in things and are individuated. Yet again, universal natures exist in the intellect as concepts, either in the intellect that causes and produces them or in the intellect that knows them by abstraction, producing and educing them as universalities.[29]

Albert's solution to the traditional problem of universals, then, is that genera and species can be considered in three distinct ways and will be said to exist differently according to each of these considerations. Considered in themselves, universals exist as stable and eternal forms that cannot be reduced to concepts. Considered in individuals, universals exist as particularized. Considered in relation to the intellect, universals exist as abstracted from individuating matter. This, in effect, not only provides an answer to the first of Porphyry's questions, but at least the beginning of a response to the others as well. Universals taken in themselves are incorporeal and this is also true of universals as abstracted by the intellect. Even as individuated, however, universals cannot simply be reduced to the individuating material conditions, although they stand in strong

---

[28] *De V univ.* 2.3, Borgn. 1, 24b: "quam de natura sua ante habuit..."; see McInerny, "Albert on Universals," 12–13.

[29] *De V univ.* 2.3, Borgn. 1, 24b–25a.

relation to such material conditions. Universals considered in themselves and in the intellect clearly exist apart from the sensible individuals from which they were abstracted. As the common nature of an individual, of course, a universal exists in the individual in some significant sense. Albert's approach to these issues in his commentary on Porphyry has a strongly Platonic flavor that is difficult to reconcile with some of his later work. While this treatment is not without its ambiguities and hardly constitutes the final word on the problem of universals, it does provide a series of important distinctions.

In fact, this discussion was not Albert's final word on the subject. Later in his *De intellectu et intelligibili*, he again addresses the first Porphyrean question. Considering a series of arguments on both sides of the question of whether universals exist outside of concepts, he appeals to a number of distinctions by way of his own solution. The essential nature of a thing can be considered in two ways: in the first, a nature is considered distinct from the material subject in which it is found, and in the second it is considered insofar as it is individuated in matter. When a nature is considered apart from matter, it is being considered in one of two possible ways. It may be considered insofar as it is a certain essential nature absolute in itself (*essentia quaedam absolute in seipsa*) and it is in this sense that it is called "essence". Alternatively, it may be considered with respect to its capacity (*secundum aptitudinem*) to be realized in many and in this sense it is called "universal".[30] When known, however, the nature is in many actually and not simply by way of a capacity and this is why, explains Albert, the Peripatetics claim that the universal exists only in the intellect, for they are referring to what is actually in many and not simply an aptitude.[31] Albert's account in this later work, then, provides some advance beyond his earlier treatment, for he is able to distinguish more clearly the universality of a nature as conferred by knowing and the universality a nature has in itself.

Albert also addresses the question of universals in his commentary on the *Metaphysics* in the context of a discussion of the Aristotelian doctrine of substance.[32] Identification of a substance by way of a definition may be done in two ways: in itself and with respect to its attributes. When one considers substance respectively, one is considering substance by

---

[30] *De intell. et intellig.* 1.2.2, Borgn. 9, 492a–493a.

[31] *De intell. et intellig.* 1.2.2, Borgn. 9, 493b.

[32] *Metaph.* 7.5.1, Ed. Colon. 16/2, 372–373.

comparison with something other than itself. It follows that considering substance insofar as it exists in the intellect or as it exists individuated in matter is to consider it with respect to accidents that are not essential to it taken in itself. Considering the universal nature as existing in one respect or another is in no way to assert that the universal exists through itself.[33]

3. The Method of Division

Genera and species come to be known through a process of division, a part of logic to which Albert devoted a great deal of attention. In fact, Albert is the first scholar since antiquity to manifest detailed knowledge of the Aristotelian reform of the Platonic method of division and its application to scientific research.[34] The original purpose of division as established by Plato was not classification, but definition. The Aristotelians agreed, considering division a dialectical means by which the scientific researcher proceeds from observation to definition through the study of what does and does not belong to or inheres in the subject under investigation. Albert notes that inherence may be as an accident, genus, property, or definition. Because inhering as a differentia is reducible to a genus and inhering as a likeness is reducible to a definition, the kind of thing the subject is comes to be known through a process of division by differentiae.[35] Albert realized, however, that the dichotomous method of division used by the Platonists produced false and accidental divisions, thus failing to provide useful definitions. He followed Aristotle in rejecting such divisions and articulated rules for proper division that would insure valid definitions.[36]

In his commentary on Aristotle's *Topics*, Albert discusses division very generally in relation to the dialectical or topical syllogism. His actual rules for division, however, are to be found in his treatment of zoological

---

[33] For a more detailed comparison of Albert's several treatments of universals see McInerny, "Albert on Universals," 3–18, esp. 11–16.

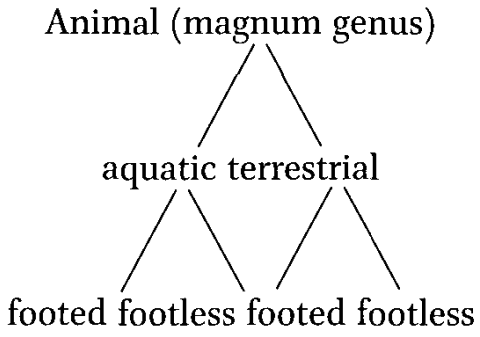
[34] This is related to the point argued by James G. Lennox, "The Disappearance of Aristotle's Biology: A Hellenistic Mystery," in *Aristotle's Philosophy of Biology: Studies in the Origins of Life Science* (Cambridge, 2001), 110–25, esp. 123–24; for textual evidence see Michael W. Tkacz, "Albert the Great and the Revival of Aristotle's Zoological Research Program," *Vivarium* 45 (2007), 30–68, esp. 54–63.

[35] *Top.* 1.2, *Proaemium operis*, Borgn. 2, 236a.

[36] *De animal.* 11.2.1, ed. Stadler, 1: 780; see also *Metaph.* 7.4.3, Ed. Colon. 16/2, 370–372 and *Quaest. super de animal.* 11.7, Ed. Colon. 12, 221.

method in his *De animalibus*.[37] There he characterizes Platonic division as the attempt to define a species by dividing a genus into two by a single differentia at a time. This dichotomous splitting is done at each successive stage of division until the species is identical with the form to be defined. Reading back through the divisions is, then, supposed to provide the definition through the identification of the successively greater genera in which the species participates. By means of this method, for example, squirrel is defined by dividing the genus animal into aquatic and terrestrial, terrestrial into footed and footless, footed into biped and quadruped, and quadruped into toe-footed and hoofed. Reading back through these dichotomous divisions, then, squirrel is defined as a toe-footed quadrupedic terrestrial animal.

Albert argues[38] that such a division will either be invalid or incomplete—that is, the division will either be accidental or it will fail to include sufficient characteristics to constitute a useful definition. There are at least two problems with dichotomous division. The first is that dichotomy divides natural kinds. As a result, the same sub-kind could appear on both sides of a supposedly exclusive division. Given a division of animal into aquatic and terrestrial, the next division cannot be into footed and footless, because each of the species will appear in each division of the magnum genus. Thus, we would have:



The division would fail to show that being footed is a terrestrial trait, because footed does not imply an inclusion in a particular genus. The division, therefore, fails to show the reason for the possession of the trait in terms of the genus to which the subject belongs. Second, dichotomy cannot make use of negative differentiae. Differentiae that indicate privations, such as footless or invertebrate, cannot be further divided in a way

[37] *De animal.* 11.2.1–2, ed. Stadler, 1: 780–792.
[38] *De animal.* 11.2.1, ed. Stadler, 1: 780–782.

providing useful definitions. A division of featherless into fish and insects will not allow for further divisions, despite the fact that there are many species of fish and of insects. The reason is that what is actually being divided is not featherless, but the genus animal-lacking-feathers. While there are many ways of being feathered, there are not infimae species of featherless. As a result, dichotomy cannot use privative differentiae to establish definitions that can be "read back" from an infima species to the genus divided by the privation.

These difficulties with dichotomous division indicate that useful definition will only result from division by multiple differentiae applied together. Albert identifies four rules governing the proper division of a genus.[39] The first three of these regulations are aimed at avoiding the accidental divisions of the dichotomists. The final rule provides an alternative to Platonic dichotomy. First of all, the differentiae dividing the genus must be part of the definition or essential nature of the species and not accidental. It is especially important to avoid dividing by proper accidents, for these may seem to yield useful definitions, but will in fact be misleading. A division of the genus plane figure into the species possessing two right angles/possessing many right angles is not valid. While it is necessary that triangles have two right angles, this is an accident of triangles and does not indicate its proper definition. The second rule is that division must always be into proper opposites, ensuring that the definiendum will fall exclusively on one side of the division. Dividing by differentiae belonging to non-opposed genera, such as locomotion and coloration, is invalid. The dichotomous division of animal into swimming and unpigmented results in a false division, as the proper division is of fish into pigmented and unpigmented. The third rule is that division must be by a differentia that will not appear as a characteristic in both infimae species. The genus animal can validly be divided into sighted and non-sighted, but not into walking animals and flying animals. Some species are capable of both walking and flying and will thus appear on both sides of the division.

The reason why dichotomy is invalid, according to Albert, is that its differentiae are not continuous. For example, the dichotomous division of animal into winged and non-winged, winged into multi-colored and solid-colored, and multi-colored into domesticated and wild fails in this way. Being multi-colored is not a way of being winged, but of being colored. Being domesticated is an accidental determination of being

[39] *De animal.* 11.2.1, ed. Stadler, 1: 786.

multi-colored, for nothing about being determined as domesticated prevents the determination of the same infima species by the opposite genus, wild. Albert, therefore, defines a fourth rule stating that division must be polychotomous. All the relevant differentiae must be applied to the genus together. Through the use of several coordinated series of dichotomous divisions, each of which divides with continuous differentiae, valid and useful definitions will result. Non-accidental division begins with magna genera immediately identifiable by known generic properties. Bird, for example, is immediately identified as winged, biped, beaked, and so on. These differentiae can then be divided according to the various ways they appear in the genus. First-level generic differentiae are divided, not by new differentiae, but by the degree in which they appear in the various sub-kinds. Such a division, then, will be by a combination of morphological and quantitative differentiae. All birds are beaked, but not in the same way: some have short, strongly curved beaks such as the hawk, and some have large, flat beaks such as the shoveler duck, and some have long, thin, pointed beaks, such as the curlew.[40]

The proper method of division, according to Albert, is not simply a matter of making a series of dichotomous divisions and then gathering them together into a hierarchy of formal features in the Platonic manner. Useful definition by division proceeds by dividing off a kind by its specific features and then differentiating the features according to the degree they exist in the morphological variants. In this way, the final differentia will be convertible with the species and the division will provide an intelligible account of the subject.[41] The avoidance of accidental division is crucial to ensuring that the final differentia will have precisely the same extension as the species being defined. In a valid division, all the differentiae other than the final one will be superfluous in the sense that each is a determination of its predecessor and will imply it. This is why non-accidental divisions are useful: they function dialectically as a means of sorting out what is known of a subject in such a way that the convertibility of the final differentia with the species defines the species rigorously.

Albert realized that Aristotle's rejection of the Platonic method of division by dichotomy was not a rejection of the method of division itself. At the same time, he clearly understood Aristotle's critique of dichotomy as a reform of division as a dialectical tool. Moreover, Albert follows Aristotle

[40] *De animal.* 11.2.2, ed. Stadler, 1: 789.
[41] *Quaest. super de animal.* 11.7, Ed. Colon. 12, 221.

in using division as means of providing rigorous definitions for the purpose of scientific explanation rather than as a scheme of classification. When applying division to the study of animals, for example, Albert has no interest in developing a zoological systematics in the modern sense. He does not use division to attempt a complete taxonomy of animal species with all major and intermediate forms specified and related. Rather, he remains focused on the purpose of the Aristotelian reform of the Platonic method of division to secure non-accidental definitions for the purpose of causal explanation in the special sciences.

4. Inventive Logic

The method of division is an important part of inventive logic or dialectics which Albert distinguishes from judicative logic or demonstration.[42] Non-accidental division is one of several methods of discovery that play a crucial role in the function of logic as the common mode of the sciences. In the process of moving from the known to knowledge of the unknown, the scientific investigator cannot simply begin to produce scientific demonstrations. This is because the process of demonstrating presupposes a discovery and description of something about the subject and in terms of which the subject will be understood. Scientific investigation, therefore, is a complex two-staged procedure of description (*narrativus*) and causal explanation (*causarum assignativus*).[43] This is reflected in the division of logic into inventive and judicative parts.[44]

Albert considers the possibility that inventive logic may be unnecessary for arriving at knowledge of the unknown from the known.[45] Given that scientific explanation is knowing a subject through its causes and that causes are known when demonstrated, it seems that there is no room for discovery and description in the process of coming to know a subject. A demonstration, after all, is a syllogism producing knowledge (*syllogismus faciens scire*) and, therefore, scientific method is demonstrative and not descriptive, it is judicative and not inventive. Albert rejects this suggestion by arguing that the ultimate explanatory goal of scientific research pre-

---

42 *Top.* 1.1, *Proaemium Alberti,* Borgn. 2, 233a–b.

43 *Quaest. super de animal.* 11.1, Ed. Colon. 12, 218; *De animal.* 1.2.1, ed. Stadler, 1: 38.

44 On the distinction of these parts of logic with reference to Albert's Aristotelian commentaries see Richard L. VanderWeel, "The *Posterior Analytics* and the *Topics*," *Laval Théologique et Philosophique* 25 (1969), 130–41.

45 *Quaest. super de animal.* 11.1, Ed. Colon. 12, 218.

supposes a narrative or descriptive phase of investigation in which what has been discovered of the subject is set out in an orderly and useful way. Without such description, there is nothing to explain, for there is nothing demanding to be understood in terms of its causes. While causal explanation is a judicative process of demonstrating, there can be no demonstration without invention.

The distinction between the inventive and the judicative arises out of a consideration of the possible kinds of rational discourse. These kinds, Albert argues, may be designated according to whether discourse is directed to the necessary, the probable, or the merely apparent.[46] Insofar as logic concerns discourse productive of the certain judgment of scientific knowledge, it is a judicative method (*logica iudicativa*). Such certain judgment results from analyzing or resolving the subject into its principles or causes and is, therefore, a *via analytica* or *via resolutiva*. The formal means by which this certitude is attained by the intellect is the syllogism. This, Albert contends, provides the subject matter of Aristotle's *Analytics*—the *Prior Analytics* being concerned with the mode and figure of the syllogism considered abstractly and the *Posterior Analytics* being concerned with the demonstrative syllogism that produces scientific knowledge. While properly scientific reasoning aims at the certitude of scientific demonstration, not all rational discourse directly produces certain judgments. Insofar as logic concerns discourse productive of probabilities, it is concerned with discovery and is an inventive method (*logica inventiva*). The syllogism remains the instrument of discourse, but now as the means of probable rather than demonstrated knowledge. Albert notes that probabilistic reasoning is the subject of Aristotle's *Topics*, a treatise on the dialectical syllogism. Albert adds that the study of logic may also be directed to sophisms (*logica sophistica*)—that is, to fallacies and arguments that altogether fail to produce knowledge of the unknown from the known, even probable knowledge. Discourse that is only apparently rational provides the subject of Aristotle's *Sophistical Refutations*.[47]

In his paraphrastic commentary on Aristotle's *Topics*, Albert notes that the purpose of inventive logic is to provide a method for terminating discussions that would otherwise continue without reaching some sort of useful stopping point.[48] This is obviously necessary if logic is to provide a

---

[46] *Soph. El.* 1.1.1, Borgn. 2, 526a.

[47] On Albert's coordination of the divisions of logic with the books of Aristotle see *De V univ.* 1.2–3, Borgn. 1, 4a–7a and *Top.* 1.1, *Proaemium Alberti*, Borgn. 2, 233a–234a.

[48] *Top.* 1.2, *Proaemium operis*, Borgn. 2, 236a.

means for coming to knowledge of the unknown. Discourse and investigation must be ordered and even if the means by which it is ordered do not themselves produce complete understanding of the subject, these means are necessary for eventually reaching such understanding. It is possible to do this for any problem that may arise in discourse, because all problems are problems of inherence (*inesse*). Whether it is inherence as an accident, genus, property, or definition, inventive logic teaches us how to syllogize in such a way that we arrive at useful description and definition. Discourse thereby attains a certain goal: that is, either the definition of the subject or the removal of any impediment to definition.[49] The utility of the definitions are respective to the demonstrations that are the concern of judicative logic, making the task of the dialectician that of preparing the way for scientific explanation.

The bulk of Albert's work on the *Topics* is devoted to setting out and explaining the various dialectical methods by which definitions are established and discourse properly ordered to what is needed for scientific demonstration.[50] Demonstration involves inference to a necessary conclusion that is not known as necessary independently of being demonstrated. The only way in which an investigator could be in a position to demonstrate like this is by already knowing that it is possible to show the necessity of the conclusion. A conclusion cannot be known as demonstrable unless it is known to be probable—that is, if a reason can be given dialectically to accept it and there is no reason to doubt it. In an ongoing investigation of a subject, some conclusions that seem probable may come to have doubt cast on them. When this happens there must be a dialectical means by which this doubt is either laid to rest or a substitute probable conclusion suggested. Such procedures continue in the investigation until the conclusion is known to be probably demonstrable. Thus, dialectical methods stabilize the conclusions of demonstrations in a way that show them to be capable of being established as necessary.[51] As there are different modes of definition, so there are different dialectical methods providing the ingredients for the demonstrations of the judicative stage of the knowing process.

---

[49] *Top.* 1.2, *Proaemium operis*, Borgn. 2, 236b–237a.

[50] On the order and content of Albert's *Topica* see William A. Wallace, "Albert the Great's Inventive Logic: His Exposition of the *Topics* of Aristotle," *American Catholic Philosophical Quarterly* 70 (1996), 11–39.

[51] *Top.* 1.1.5, Borgn. 2, 245b–249b.

5. Judicative Logic

In his commentary on the *Posterior Analytics*, Albert cites Ptolemy's *Almagest* claiming that anyone seeking knowledge of the unknown ought not to be satisfied with probabilities and opinions.[52] These products of the various methods of inventive logic are incapable of bringing about stable concepts in the mind. Instead, the scientific investigator ought to be satisfied only with demonstrated certainties that certify and establish understanding precisely because they are certain and eternally stable. While Albert later rejects Ptolemy's conclusion that this restricts true scientific knowledge to what is mathematically demonstrated, he is here citing Ptolemy with approval.[53] Demonstration is always a revelation of necessity and what is truly known is what is manifestly necessary. Any logical procedure that results in probable conclusions alone cannot fulfill the goal of the discipline in bringing the knower to knowledge of the unknown. Thus, demonstration is necessary for science and the art of dialectics is exercised for the sake of scientific judgment made manifest in demonstrations.[54]

Following Aristotle, Albert defends the possibility of such demonstrative knowledge by considering two errors of the ancients. The first error, attributed by Albert to Heraclitus,[55] claims that, were demonstrated knowledge possible, then its premises would have to be demonstrated through prior premises ad infinitum. Given that the first premises cannot be demonstrated, nothing following from them can be demonstrated. Albert replies that not all truth is demonstrated. Some truths that may serve as the premises of demonstrations are known as self-evident independently of demonstration. Scientific investigation will have recourse to such foreknown principles and this allows for the possibility of demonstrative knowledge.

The second error, attributed by Albert to Empedocles,[56] claims that everything can be demonstrated, because all demonstration is actually circular, merely restating what is already known. Demonstration amounts

---

[52] *Anal. Post.* 1.1.1, Borgn. 2, 2b.

[53] See *Phy.*1.1.2, Ed. Colon. 4/1, 4; on the apparent inconsistency of these texts see William A. Wallace, "The Scientific Methodology of St. Albert the Great," in *Albertus Magnus. Doctor Universalis 1280/1980*, ed. Gerbert Meyer and Albert Zimmermann (Mainz: 1980), 385–407, esp. 399–400.

[54] *Anal. Post.* 1.1.4, Borgn. 2, 13b.

[55] *Anal. Post.* 1.2.6, Borgn. 2, 33b–34a.

[56] *Anal. Post.* 1.2.6, Borgn. 2, 34a.

to the tautologous claim that, given the existence of the thing, the thing exists—a trivial and meaningless exercise unproductive of true scientific knowledge. There is a distinction, Albert replies, between what is better known in its own nature and what is better known or more familiar to us in experience and common notions. A demonstration revealing the causes of what is familiar to us is not circular and represents a real advance in knowledge. Indeed, the distinction between the products of inventive and judicative logic supports this point.

These ancient controversies provide the opportunity for Albert to clarify the nature of scientific knowledge in terms of the logic of demonstration. Those who possess a *scientia* of a subject are those who know the reason why (*propter quid*) the subject is what it is in addition to knowing that (*quia*) the subject is like this. In other words, the one who knows in the best possible way, knows or demonstrates the reason why the subject is the way it is through principles that are immediate, primary, and true. Knowledge through such proper principles is the only knowledge that is fully demonstrative and scientific. Knowledge through other principles is tentative, dialectical, and probable.[57] There are, then, two types of demonstration: demonstration of the fact (*demonstratio quia est*) and demonstration of the reason for the fact (*demonstratio propter quid*). It is only in the latter that complete scientific explanation through causes is achieved.[58]

Whereas *propter quid* demonstrations are those that demonstrate through an immediate and proper cause, *quia* demonstrations are of two kinds: through an effect (*per effectum*) and through a remote cause (*per causam remotam*). Scientific investigation typically begins with the observed effect and attempts to discover and demonstrate the initially hidden cause. Such effects, however, may either be or fail to be commensurate or convertible with the cause. In arguments establishing that the fact is convertible with the cause, the *quia* demonstration can be converted into a *proper quid* demonstration by a reversal of the major and middle terms. Albert repeats Aristotle's example of the explanation for the non-scintillation of planetary light as viewed from earth.[59] The *quia* demonstration shows that the observed non-scintillating character of planetary

[57] *Anal. Post.* 1.2.6, Borgn. 2, 34a–b.

[58] *Anal. Post.* 1.3.6–7; 2.4.7, Borgn. 2, 82a–87b; 222a.

[59] *Anal. Post.* 1.3.6, Borgn. 2, 83a where Albert also provides as another example the *quia* demonstration that the moon is an externally illuminated sphere on the basis of its waxing and waning through crescent phases and the *propter quid* demonstration showing that the moon's sphericity is the reason for its exhibiting phases.

light provides the reason why planets are known to be near: things emitting non-scintillating light are known to be near; planets emit non-scintillating light; therefore, planets are near. This demonstration does show a necessary association of planetary nearness on the grounds of planetary emission of non-scintillating light. Yet, emission of non-scintillating light is not the cause of the nearness, but the result. Given that planetary nearness and non-scintillating light emission are commensurate, these terms can be converted producing a *propter quid* demonstration: near things emit non-scintillating light; planets are known to be near; therefore, planets emit non-scintillating light. This demonstration does show the cause of the non-scintillation of planetary light on the grounds of the connection of non-scintillating light emissions with planetary nearness.

Another type of *quia* demonstration that does not allow for a simple conversion into *propter quid* explanation is through an attribute of a genus. Knowing that being raptorial-footed is associated with being a bird of prey, and that the European sea eagle possesses this attribute, provides a reason for including this species of eagle in the genus. A certain necessity is made manifest through the argument, because being raptorial-footed does demonstrate the fact of genus inclusion. Yet, this cannot be converted into a *propter quid* demonstration because the middle term is not commensurate with the major term—there may be birds that prey on other animals without the use of a raptorial foot. From the fact that the European sea eagle is a bird of prey, then, it does not follow that it must be raptorial-footed. The proper cause of being raptorial-footed is the need to seize and tear at food.[60]

In scientific investigation, *quia* demonstrations provide a bridge between the strictly dialectical methods of the inventive stage of research and the attainment of causal explanation through *propter quid* demonstration. A brief look at how the method of division supplies the ingredients for *quia* demonstrations provides a good example of how Albert understood the relation of inventive to judicative logic. Definition through division is achieved by grouping differentiae under genera in order to provide a descriptive account of how attributes of the subject are associated in reality. The ultimate purpose of this is causal explanation of the associations known to exist in the species. Such explanation will be the manifestation of the causal connections among the associated features such that they are

[60] See *De animal.* 12.3.6, ed. Stadler, 1: 888.

judged necessary.[61] Albert realized, however, that the investigator cannot proceed directly from a series of divisions to demonstration of the necessity of the causal connections. Yet he makes it clear that division does give rise to demonstrations.[62] Assuming the investigator has at hand a set of divisions of a subject-genus, this can be put into the form of a demonstration: taking the genus A as the middle term, let the attribute B inhering in things of the genus A be the major term and a species C of the genus A be the minor term. It will be demonstrated, then, that the reason why the attribute B is characteristic of species C is because C belongs to genus A which is universally characterized as B. Syllogizing this, Albert provides the following example: all animals are sensory beings; all lions are animals; therefore, all lions are sensory beings. Similar syllogisms can be constructed for any other species D, E, and F falling under the genus A—that is, if the species were man or horse or another species.[63]

The scientific investigator makes the best use of the information provided by his divisions by expressing it in the form of a demonstration. In other words, the genera and species are recast in such a way that the connections among them become clear. Given a certain form being studied, the investigator begins with the most common genus relative to it. He then selects the features which belong to the genus and those features belonging to these. The magnum genus bird, for example, is one known from commonly accepted groupings of animals. The investigator, collecting all the features common to every bird, is then in a position to provide the reason why a given feature belongs to the kinds falling under the genus. This is articulated in the form of a *quia* demonstration manifesting the reason in terms of the kinds and sub-kinds revealed through the divisions. The species under study, then, has been rigorously shown to exist in terms of the associations made through the divisions.[64]

The role of *quia* demonstrations can be illustrated by Albert's own research on the various species of eagle in his *De avibus*.[65] Having established the common features of the major genus bird, he divides the various species according to common nomenclature. In each case, he provides the various differentiae of the species that mark it off from other species

---

[61] *Anal. Post.* 2.4.6, Borgn. 2, 218a–b; *De animal.* 11.2.2, ed. Stadler, 1: 789–792.

[62] *Anal. Pr.* 1.6.8, Borgn. 1, 647b–650b.

[63] *Anal. Post.* 2.4.6, Borgn. 2, 218b–219a.

[64] See Tkacz, "Albert the Great and the Revival of Aristotle's Zoological Research Program," 60–63.

[65] *De animal.* 23.1.1–15, ed. Stadler, 2: 1433–1437.

of birds as well as those that place the determined species in the same genus along with other species. The eagle, for example, belongs in the same genus as the falcon, for both in terms of morphology and behavior they are equally birds of prey. Yet they can be distinguished by, among other features, the relative shape and length of wings: since eagles are characterized by large broad wings as opposed to the falcon's narrow long wings. Albert goes on to group together under the genus eagle various other differentiated features: massive oblong beaks, large yellow feet, large broad wings, short tail feathers, and so on. These divisions provide the basis upon which he employs a *quia* demonstration to show why it is that the European sea eagle has short tail feathers: it is because this bird is a species of eagle, and in the genus eagle short tail feathers are associated with the other known features of eagle morphology, also possessed by this species of eagle, in a way they are not in every species of the larger genus, birds of prey. By similar *quia* demonstrations, Albert also shows that the golden eagle is of the same genus, for it has the short tail feathers characteristic of eagles. Further, he is able to demonstrate the fact that all species of eagle are rightly considered birds of prey in terms of their possession of the features common to all birds of prey: a strongly curved and pointed beak, taloned feet, and so on.

Using divisions in the form of *quia* demonstrations brings the investigator knowledge of the unknown from the known in two ways. First, when the investigator is able to assign a feature to a species on the basis of inclusion of the species in the genus, he comes to know which kind possesses the feature per se. Second, as a result of his assigning features to a species on the basis of his divisions, the investigator increases his knowledge of how the kinds are related to each other and how they form a unity of kind.[66] This type of intermediate demonstration of the facts concerning the properties and differentiae of the subject under study does not constitute a true scientific demonstration insofar as it does not demonstrate the proper cause of the facts so revealed. Rather, such a *quia* demonstration together with the divisions upon which it is based provides a rigorous means by which the information gathered about the subject is organized for the sake of eventual causal explanation through *propter quid* demonstrations. This sort of preliminary stage of scientific investigation is necessary both to clarify by division and definition the subject and its relevant

[66] *Anal. Post.* 2.4.6, Borgn. 2, 219a–b; *De animal.* 11.2.2, ed. Stadler, 1: 790–791.

features as well as to direct the attention of the investigator to possible candidates for an explanatory middle term.[67]

6. Knowledge of Nature

Toward the beginning of his commentary on Aristotle's *Physics*, Albert presents an argument against those who would deny that human beings are capable of attaining direct scientific knowledge of natural subjects.[68] While he ascribes these three objections to Heraclitus, Albert is also concerned with similar objections put forward by others, including some of his contemporaries.[69] The first objection is that the proposed subjects of natural science, natural beings, exist in an infinite number and so cannot be understood by the finite human intellect. If there exists an infinity of natural subjects that must be known for the attainment of truly scientific knowledge, then such knowledge is impossible because a finite intellect cannot have as the object of its finite operation an infinite number of subjects. The second objection is that the definitions of natural subjects required for scientific demonstrations cannot be constructed. Such definitions will apply to natural individuals equivocally and, as such, cannot serve as the middle terms of explanatory demonstrations. The third objection is that the changeability of natural things prevents them from being the subject of scientific demonstration. Natural subjects are unstable and in constant motion whereas the subject of true scientific demonstration must always be the stable and the necessary.

Albert responds to the first two objections by clarifying the precise subject of natural science in terms of the goal of scientific investigation. The aim of nature is to produce a complete being (*ens completum*) as the perfection of an individual of a given kind. This completed being is finite, and it is so because it is produced by its essential causes of form and matter received through the agency of an agent cause and through the end toward which the agency is tending. The subjects of scientific investigation are not individuals in their infinite number, but rather the causes that

---

[67] *Anal. Post.* 2.4.7, Borgn. 2, 222a.

[68] *Phys.* 1.1.2, Ed. Colon. 4/1, 3–5.

[69] Later in the same text Albert cites Ptolemy, and Albert's arguments in his *Metaphysica* show his concern for answering similar views held by his contemporaries; see James A. Weisheipl, "Albert the Great and the Oxford Platonists," *Proceedings of the American Catholic Philosophical Association* 32 (1958), 124–139 and Ashley, "Albert the Great on Aristotle's *Metaphysics*," 137–155.

produce individuals as beings of this or that kind, and the variety of kinds is finite. Thus, natural science does not require that the human intellect take as its proper object of knowledge an infinite number of individuals. Instead, natural science is concerned with a finite number of species. Similarly, the definitions of natural subjects do not apply to what is true of individuals as individuals, but to individuals as belonging to species. Univocal definitions covering many individual cases are possible because, even though a great diversity of individual differences arising from the dispositions of matter may be observed, these differences are not the end at which nature aims. The function of scientific demonstration is to disclose the final form toward which nature is tending and this belongs to the individual insofar as it is an individual of its kind. Thus, proper definitions will not be equivocal and can provide the middle terms of explanatory demonstrations.

Albert remarks that Heraclitus's third objection is essentially that of Ptolemy who regarded the diversity of opinion among natural scientists as witness to the instability and non-necessity of natural beings. Ptolemy was convinced that there can never be a true science of natural subjects, as there is of mathematical subjects, but only opinion. In his *Posteriora Analytica*, Albert explains Ptolemy's reasons for rejecting the possibility of scientific knowledge of nature.[70] Apprehension of the probable and changeable beings of the natural world can never result in stable concepts in the mind. It is only the demonstration of absolutely certain things that results in understanding, because such things are eternal and stable. Scientific explanation is always a demonstration of a necessity in the subject and natural subjects are contingent. For Ptolemy, then, there can be no scientific knowledge of natural subjects as there can be of mathematical subjects which are absolutely necessary and eternal.

Albert agrees that scientific explanation is always a matter of demonstrating necessity, but he does not accept Ptolemy's claim that natural subjects lack the requisite necessity. On the contrary, Albert insists that there can be a demonstration of natural things because such things have a subject, attributes, and principles through which an attribute is proved of a subject with a certain necessity. If this were not the case, there could be no understanding or knowledge of natural things which we do, in fact, understand.[71] The changeability of natural things does not prevent them

---

[70] *Anal. Post.* 1.1.1, Borgn. 2, 2b; see also *Metaph.* 1.1.1, Ed. Colon. 16/1, 1.

[71] *Phys.* 1.1.2, Ed. Colon. 4/1, 4.

from being the subject of demonstrations revealing a necessity. Just as the essential species of the natural individual allows univocal reference, so abstraction from individuating matter allows a demonstration of necessity in the natural subject. The contingent and the unstable can be the subject of scientific investigation because such investigation seeks to explain the subject in terms of its being the kind of thing that is capable of change, rather than in terms of the change itself.[72]

7. Suppositional Demonstration

Some years before producing his commentary on the *Metaphysics*, Albert had occasion to refer to Aristotle's classification of the types of necessity in a theological work.[73] Necessity, he there explained, falls into two general categories: simple (*necessitas simplex*) and respective (*necessitas in respectu*). Simple necessity is unconditional whereas respective necessity is always relative to an end (*in respectu finis*) or the production of something (*in respectu esse efficientis*). It is clear from Albert's examples that he considers respective necessity to be found in both natural and artificial subjects. In his later commentary on this Aristotelian text,[74] Albert points out that necessity is not limited to absolute compulsion (*necessitas absoluta*) and may also be suppositional (*necessitas suppositionis*) when what is prior is inferred from what is posterior. While absolute necessity is associated with material cause, suppositional necessity concerns finality. Providing a wealth of examples from both the arts and nature, Albert argues that suppositional necessity is the same "in mechanics and in nature". If there are to be soldiers, then there must be the fabrication of arms and, if human beings are to exist, then a certain complex of humors is necessary.[75] Necessity, then, is not always a matter of force, for what is necessary can also be that required on the supposition that something else be the case.[76]

---

[72] *Phys.* 1.1.4, Ed. Colon. 4/1, 8; see also Benedict M. Ashley, "St. Albert and the Nature of Natural Science," in *Albertus Magnus and the Sciences: Commemorative Essays 1980*, ed. James A. Weisheipl (Toronto: 1980), 73–102.

[73] *Super I Sent.* 6.A.2, Borgn. 25, 198a–b.

[74] *Metaph.* 5.1.6, Ed. Colon. 16/1, 220–222.

[75] *Metaph.* 5.1.6., Ed. Colon. 16/1, 221.

[76] William A. Wallace, "Albertus Magnus on Suppositional Necessity in the Natural Sciences," in *Albertus Magnus and the Sciences*, 103–128.

Demonstrative knowledge of nature involves the disclosure of both absolute and suppositional necessity. The scientific investigator will seek to know whether the necessity of material things is absolute (*simpliciter*) or on a supposition and condition (*ex suppositione et condicione*). The reason for this is that some things in nature, such as the descending of the heavy and the ascending of the light, do not require the presupposition of anything to be necessary. Other things, however, do require a presupposition and are not necessary except on the supposition of something else, as when it is necessary for a man to be sitting, if he is to be seen sitting. Pointing out that absolute necessity is found in natural things only in the aptitude and necessity of matter (*in sola materiae aptitudine et necessitate*), Albert insists that what is necessary in nature is also, and primarily, according to a supposition (*secundum suppositionem*) and on the basis of some hypothesis (*in ordine hypothesis alicuius*). Thus, while it is not necessary that an animal be asleep, sleep is necessary if the animal's sensory powers are to be rested.[77]

Albert is concerned to distance himself from the ancient naturalists who attempted to explain nature in terms of chance and force, rather than function. Empedocles, he argues, was wrong to attempt an explanation of the morphology and arrangement of animal teeth in terms of absolutely necessary material characteristics and chance motions. While an account of the shape and hardness of an animal's molars will make reference to their material composition, their existence in the animal and position at the back of the mouth must be understood in terms of their food-grinding function.[78] An Empedoclean explanation in terms of chance and force alone must be radically incomplete. It is just as if one were to say, argues Albert, that a wall came into existence by chance through the material force and disposition (*propter materiae obligationes et aptitudinem*) of its components, the heavy stones becoming positioned at the foundation and the lighter wood above them. The positioning of the material components of the wall is inexplicable in the absence of any reference to the function of the wall. Were this not also the case in nature, the Heraclitean objection to the possibility of natural science would be telling, because an infinite variety of forms could be produced out of the available matter and nature could never be known. Natural necessity, however, does not operate in the way the ancient naturalists supposed. It is true that the wall exists

[77] *Phys.* 2.3.5, Ed. Colon. 4/1, 141.
[78] *Phys.* 2.3.1, Ed. Colon. 4/1, 133.

through the "binding force of the matter" (*ex materiae obligatione*) out of which it is composed, yet it does not exist on account of this absolute necessity. The necessary forces of the materials operate in the wall in the way they do because of the purpose of the wall as a shelter for something. Without an explanation of the wall in terms of its function, whatever necessary properties its materials have are inexplicable with respect to being the properties of the components of the wall. Such is the case with natural forms which can only be fully understood in terms of their functions: the function of natural parts in terms of the natural morphologies composed of them and the function of the natural morphological wholes in terms of their proper operations.[79]

References to the materials and their absolutely necessary properties become part of the explanation of the entire given natural form only insofar as they are suppositionally necessary for the form to exist and function as observed. Suppositional necessity, then, is a principle of nature in light of which material necessities are understood. Natural forms exist for the sake of an end, but the end is not to be found in the matter and its material efficiencies. It is, as Albert puts it, *in ratione*, and this reason provides the principle of the whole being and operation of the natural entity explained through demonstration.[80]

The possibility of suppositional demonstration in the natural sciences provides Albert with an answer to Ptolemy's objection that scientific knowledge of natural things is impossible because they lack the necessity and stability of mathematical objects. Like Aristotle, Albert insists on the possibility of strict scientific knowledge of natural subjects in terms of a demonstrative disclosure of their suppositional necessity. Despite their contingency, then, natural things are not lacking a necessity allowing them to be known through demonstrations. Albert points to further parallels between the natural and mathematical sciences. In his *De animalibus*, he argues that research in the mathematical and the natural sciences proceeds in the same general way.[81] In astronomy and geometry, the investigator first posits those things into which inquiry will be made such as the eclipse of the moon or sun, or the equality of the internal angles of a triangle to two right angles. Once an accurate description is thus obtained, the investigator works out the causes of these properties

[79] *Phys.* 2.3.5, Ed. Colon. 4/1, 141; see also *De animal.* 11.1.3, ed. Stadler, 1: 776–777.
[80] *Phys.* 2.3.5, Ed. Colon. 4/1, 142; *Anal. Post.* 1.2.1, Borgn. 2, 23a.
[81] *De animal.* 11.1.2, ed. Stadler, 1: 765.

as the middle terms of demonstrations. In a similar way, the zoologist will consider the common properties of animals and then proceed to an investigation of their causes. This procedure is precisely what Albert finds in the order of Aristotle's zoological treatises: the ten books of the *Historia animalium* contain theoretical descriptions of animal morphologies and behaviors and these are followed by the treatises on the parts and generation of animals containing causal explanations through demonstrations.[82] Thus, the natural and mathematical sciences share the general two-staged structure of scientific investigation that makes use of the various dialectical and demonstrative methods of inventive and judicative logic.

Albert is quite clear, however, on the differences between mathematical knowledge and the sort of knowledge an investigator has of natural subjects. Grounded in the distinction between absolute and suppositional necessity, the mode of mathematical demonstration differs from that of demonstrations in the natural sciences. Mathematical demonstration has a twofold necessity. Because the necessity of the conclusion is on account of its formal relation to the premises, mathematical demonstration exhibits a necessity of consequence (*necessitas consequentiae*). Yet the premises themselves are absolutely necessary in their own right and it is because of their necessity that the conclusion is absolutely necessary. So, mathematical demonstration also exhibits a necessity of the consequent (*necessitas consequentis*). Demonstrations in the natural sciences, however, exhibit a necessity of consequence only, because the conclusion is never absolutely necessitated in its own right except insofar as they are the formal consequence of some premises. As the premises are contingent, they do not communicate to the conclusion itself a necessity. Yet such demonstrations do disclose a necessity insofar as they manifest the conclusion as a necessary consequence of premises presupposed to be the case. These premises will contain a middle term stating an end and the conclusion will state what is necessary on the condition that the end is realized. Demonstrations of this kind, therefore, exhibit a conditional necessity on the presupposition of an end (*necessitas conditionis ex finis suppositione*).[83]

---

[82] Albert refers to this order at *De animal.* 1.2.1, ed. Stadler, 1: 38–39.

[83] *Phys.* 2.3.6, Ed. Colon. 4/1, 143; *De animal.* 11.1.2, ed. Stadler, 1: 768; Wallace, "Albertus Magnus on Suppositional Necessity in the Natural Sciences," 119–120, 122–123. For Albert's conception of the application of mathematics to natural subjects see A.G. Molland, "Mathematics in the Thought of Albertus Magnus," in *Albertus Magnus and the Sciences*, 462–478.

The fact that the necessity proper to an eternal thing cannot be attributed to a natural subject does not prevent scientific knowledge of the contingent forms of nature. The natural scientist is able to demonstrate suppositionally, seeking a necessity of consequence such that given the natural form whatever the form presuppositionally requires is necessary, but not the converse. There need not exist birds possessing taloned feet, and strongly curved and sharply pointed beaks. However, given the supposition that there exists a bird that feeds by seizing and tearing its prey while flying, then this bird must possess such a morphology. The function is presupposed on the basis of observation, and the form, also known from observation, is understood in terms of the function by means of the suppositional demonstration. Explanation through causes in the suppositional mode is not a matter of simply deducing empirical conclusions from universal principles. It is, rather, an analysis of an observed form in light of more general principles which have also been established through observation. The investigator of animal nature will have noticed over and over again a certain relation of form to function and will use this as a theoretical principle according to which many more specific observed forms can be understood. Albert, for example, explains the taloned feet of eagles[84] and the sharp teeth of dogs[85] in terms of the fact that eagles and dogs are carnivores. Neither the morphological feature nor the carnivorous nature of the species is deduced from the principle that form follows function. Rather, the observed morphology of the species (taloned feet, sharp teeth) is associated with the species (eagle, dog) on account of the carnivorous function of the species in light of the general principle about form and function. The necessity of the association is established by demonstration on the supposition of both the function and the principle.[86]

8. The Metaphysical Foundations of Knowledge

Albert prefaces his paraphrastic commentary on Aristotle's *Metaphysics* with a treatise "On the Establishing and Nobility of this Science."[87] Here he argues that there are only three types of theoretical knowledge: knowl-

---

[84] *De animal.* 23.1.1–15, ed. Stadler, 2: 1433–1437.

[85] *De animal.* 12.3.6, ed. Stadler, 1: 883–884.

[86] Ashley, "St. Albert and the Nature of Natural Science," 77–80.

[87] *Metaph.* 1.1, Ed. Colon. 16/1, 1–17. Ashley, "Albert the Great on Aristotle's *Metaphysics*," 139f., translates Albert's *stabilire* and the associated noun *stabilitio* as "stabilizing" and "stabilization" suggesting the role of metaphysics as stabilizing or grounding the other sci-

edge of natural things, knowledge of mathematical things, and knowledge of being as being. There are, therefore, three theoretical sciences: natural science, mathematical science, and metaphysical science. These are, in fact, the only theoretical sciences of being. The moral sciences are not theoretical (*scientiae contemplativae*) for they are not studied for the sake of contemplating the truth. As already discussed, Albert did hold that logic could be considered a theoretical science and studied as such. Yet the subject of logic is the common mode of the sciences and in that capacity it does not concern any particular kind of being or part of being. Rather, logic considers second intentions (*intentiones secundas*) and is clearly to be distinguished in this respect from the natural, mathematical, and metaphysical sciences.[88] Albert goes on to argue that metaphysics provides the foundation for the other two sciences. This seems to suggest that he considered the natural and mathematical sciences as derivative from metaphysical principles and, therefore, not autonomous sciences—that is, that they are not independently productive of true knowledge. That this is not Albert's view is suggested by his insistence, following Aristotle, that metaphysics is to be studied after the mathematical and natural sciences. Further, he claims that the mathematical sciences can be taught independently from metaphysics—to the young, for example. Moreover, knowledge in the natural sciences arises out of the long accumulation of experience—again, independently of metaphysics. Most telling of all, however, is Albert's rejection of the error of Plato who held that natural science was grounded in mathematics and mathematics in metaphysics. For Albert, the sciences are autonomous in the sense that each can be studied according to its own principles. In whatever way metaphysics provides the foundation for all the other sciences, then, it cannot be such that all other kinds of knowledge are derived from or reducible to metaphysical knowledge.

Albert was especially concerned with the Platonic reduction of the sciences and was quite critical of his contemporaries whom he identified as the "friends of Plato" (*amici Platonis*).[89] According to these thinkers, natural beings are ontologically grounded and causally dependent on mathematical beings and mathematical beings, in turn, are grounded and

---

ences. Albert, however, is here equally interested in establishing (*stabiliens*) a subject for a metaphysical science as well.

[88] *Metaph.* 1.1.1, Ed. Colon. 16/1, 3.

[89] *Metaph.* 1.1.8., Ed. Colon. 16/1, 12; for identification of the *amici Platonis* see Weisheipl, "Albertus Magnus and the Oxford Platonists," 124–139, esp. 131–136.

causally dependent on divine being.[90] For the Platonists, the subject of natural science is not the material body in its changeable material being, but the eternal subsistent forms. Antecedent to these subsistent forms are the formal mathematical principles generative of them. These principles are subsistent abstract figures and numbers that originate being (*numerus principians entia*). These subsisting figures and numbers are the subject of mathematical science. Antecedent to these is unity, which is the principle of all number, and this is the eternally subsistent God from whom all being emanates. God, then, is the subject of metaphysics.

On this Platonic view, therefore, antecedent to every material body is abstract dimensionality and this depends on the principles of figure. Antecedent to figure is abstract generative number and antecedent to number is God. There are three ascending grades of scientific knowledge corresponding to the three ascending grades of separated being. Scientific knowledge results from a sort of abstractive superduction of the subject to the higher principles from which it derives its intelligibility.[91]

Albert rejects this Platonic account as completely false and he is especially concerned to deny that the principles of the natural sciences are to be found in mathematics. He points out that dimensionality cannot be the principle of a material body according to any bodily *esse*, because the dimensions of a body follow from the way in which the matter has been formed. Thus, the proper principles of material bodies are matter and form and any quantitative accidents of a body are consequent upon these. To the extent that the scientific investigator considers the dimensionality of a material body in light of mathematical principles, the dimensionality is considered as abstracted from material body.[92] In discussing the principles according to which animals are to be understood, for example, Albert warns that the zoological investigator should be on guard against introducing forms that are not proper to matter, as did Plato. This is because explanation in the natural sciences can only be in terms of those forms that exist in matter and are brought forth from the potentiality of matter (*in materia existentes et de potentia materiae eductae*).[93] Natural science,

---

[90] *Metaph.* 1.1.1, Ed. Colon. 16/1, 2 where he directly ascribes the view to Plato.

[91] *Metaph.* 1.1.2; 1.5.5, Ed. Colon. 16/1, 4–5; 75–76. See Weisheipl, "Albertus Magnus and the Oxford Platonists," 129–30, for further references.

[92] *Metaph.* 1.1.1, Ed. Colon. 16/1, 2–3.

[93] *De animal.* 11.2.4, ed. Stadler, 1: 789.

then, is autonomous and has its own principles through which knowledge of natural subjects is attained.[94]

Albert is likewise concerned to argue that the mathematical sciences are autonomous from metaphysics. The subject of mathematics is abstracted measure and not antecedent form. The unity that is the principle of number is not identical with the unity of being studied by the metaphysician. Numerical unity is an accident derived from material being, but the unity of being is the indivisibility of the actually existing substance as substance.[95] Numerical form is consequent upon physical form. The quantitative forms considered by the mathematical investigator are attained by abstraction from the measure of bodily forms. Thus, mathematics is consequent on natural science and not metaphysics.[96] Albert did admit that *propter quid* demonstration through mathematical principles is possible in some of the natural sciences, but only for those mixed sciences concerned with purely quantitative attributes of natural subjects.[97]

Albert also denies that God is the subject of metaphysics. Rather, the subject of metaphysics is being as being and not being as this or that kind of being which provides the subjects of the special sciences. Thus, the proper concern of the metaphysician is the analogy of being that derives from the demonstration that not all being is physical. If one did not know of the existence of non-physical being, then there would be no distinction between natural and metaphysical science.[98] Yet, insofar as God is the cause of the beings from which metaphysics analogically takes its subject, being as being is known in metaphysics as related to its cause, which is necessary being.[99]

Whatever the way in which metaphysics is considered by Albert as foundational to all the sciences, then, it cannot be in the way conceived by the Platonists in terms of a superalternation of mathematics to natural science and metaphysics to mathematics. Having pointed out the error of Plato, Albert cites Ptolemy to the effect that mathematics has a certain stability and necessity that natural science lacks. The forms studied in the natural sciences are considered as they exist in changeable and temporal

---

94 *Anal. Post.* 1.5.6, Borgn. 2, 140a–b.

95 *Metaph.* 5.1.8, Ed. Colon. 16/1, 227–229.

96 *Metaph.* 1.1.2, Ed. Colon. 16/1, 4–5.

97 *Anal. Post.* 1.3.7, Borgn. 2, 85b–86a.

98 *Metaph.* 1.1.2; 6.1.3, Ed. Colon. 16/1, 3–4; 305–306.

99 See Timothy B. Noone, "Albert the Great's Conception of Metaphysical Knowledge," in *Albertus Magnus und die Anfänge der Aristoteles-Rezeption im lateinischen Mittelalter* (Münster: 2005), 685–704.

matter. As a result, knowledge of natural things is mixed with opinion and cannot be confirmed, fixed, or necessary. This is contrasted to mathematics where fixed and necessary knowledge is possible.[100] As already discussed, Albert had argued in his *Physica* that, contrary to Ptolemy, the natural sciences can arrive at fixed and necessary knowledge through causes despite the changeable nature of their subjects, because the scientific investigator is able to abstract the fixed forms from changeable matter, demonstrating them to be suppositionally necessary. The contradiction between these two citations of Ptolemy, however, is only apparent. Albert admitted that knowledge of natural subjects is often limited to the probable in contrast to mathematical knowledge.[101] Yet he defended the possibility of a true science of nature and explained in extensive detail how to demonstrate in natural science. Albert can cite Ptolemy approvingly in the *Metaphysica* because he acknowledges that a mathematical science aimed at saving the appearances, such as Ptolemy's astronomy, is more certain and necessary than a science, such as zoology, which deals with less regular processes and less certain outcomes. This is not to deny his position in the *Physica* that certain knowledge of natural subjects is possible.[102]

While the mathematical sciences are certain, they do not study ontologically independent substances as do the natural sciences. The absolutely necessary subjects of mathematics are abstractive and are derived from the natural substances upon which they are ontologically dependent. As a result, both sciences require metaphysics to establish and fix their proper subjects. Natural science presupposes the existence of its subject and this depends on the establishment of the properties of being in a foundational science. Mathematical subjects, being abstracted from the physical subjects of natural science, also require the foundation provided by the metaphysical study of being as being. This establishing or fixing of the subject is not the grounding of a science in the principles of a superior science. Rather, it is the analogical analysis of what the mathematical sciences and the specialized natural sciences have in common: that is, whatever is true of being considered as being. Metaphysics, then, has no subjects of its own in the sense of a class of being proper to metaphysics alone, for every being is the subject of the appropriate special science. Moreover, this is

---

[100] *Metaph.* 1.1.1, Ed. Colon. 16/1, 1 and Phys. 1.1.2, Ed. Colon. 4/1, 4 where Albert calls Ptolemy "vir in multis prudens".

[101] See, for example, *De animal.* 11.1.2, ed. Stadler, 1: 765.

[102] Ashley, "Albert the Great on Aristotle's *Metaphysics*," 140–141; see also Wallace, "The Scientific Methodology of St. Albert the Great," 399–400.

why metaphysics does not provide the proper principles of the other sciences, as the Platonists claimed. It draws its subject from the other sciences in the sense that it presupposes them. This is why, Albert argues, the special sciences are not reducible to metaphysics: the transcendental truths known in metaphysics are not the explanatory principles of beings because these can only be known in the special sciences.[103]

For Albert, then, metaphysics has a kind of dependency on the other sciences. This is why it is to be studied last: knowledge begins in experience, and therefore the natural sciences that study being in its diverse kinds precede metaphysics in the order of discovery. The analogical notion of being follows from the knowledge that being can be material or immaterial and this requires knowledge of being in its various kinds as known through their proper principles.[104] Yet metaphysics establishes all other sciences and, because it does, it is rightly called "divine science" and excels all the other sciences in nobility.[105]

9. Conclusion

Albert left behind a massive literary production that addressed every part of human knowledge known in his day. He not only gave his careful scholarly attention to the sciences well known and studied by his contemporaries, but he also revived long dormant scientific research programs and even invented whole new sciences as well. Throughout this work certain themes concerning human knowledge can be identified. Among these is the robust confidence in the intelligibility of nature and the efficacy of the tools provided by the logical tradition for its study. His works evince a certain care to understand the differing forms of being on their own terms and to avoid the sort of reductive tendencies that so often in the history of human thought have resulted in the devaluing of one sort of knowledge in favor of another. This is especially true regarding the study of nature. For Albert, the natures of things represent independent sources of intelligibility and the seeker of truth is obligated to respect this autonomy if knowledge is to be attained. Given his appreciation of the source of knowledge in human experience, it is not surprising that Albert gave a certain priority to the understanding of the various natural sciences.

---

[103] *Metaph.* 1.1.2, Ed. Colon. 16/1, 4; see also 7.2.1, Ed. Colon. 16/2, 338–340.
[104] *Metaph.* 4.1.6, Ed. Colon. 16/1, 167–169.
[105] *Metaph.* 1.2.3, Ed. Colon. 16/1, 20–21.

In the order of discovery, knowledge is built up from sense experience through the ordered application of a series of dialectical and demonstrative methodologies. These allow not only for the understanding of natural forms, but also for the abstraction and systematic treatment of mathematical forms. They also allow for knowledge that the natural forms so known have a source of being in the immaterial necessary existent. Finally, the methodologies allow for an analogical appreciation of being in its role as establishing the special sciences. The reverse order of teaching provides the seeker of knowledge with the reasoned confidence that the intelligibility of reality reaches through being known best in itself down to what is most familiar to human knowers in their experience.