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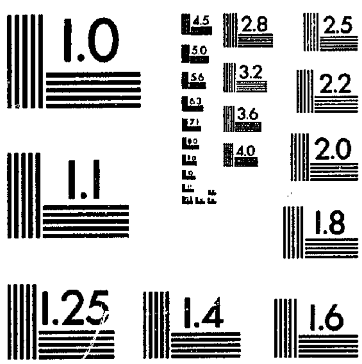

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Day, Carol A.

JEAN BURIDAN ON THE CLASSIFICATION OF THE SCIENCES

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JEAN BURIDAN ON THE CLASSIFICATION OF THE SCIENCES

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partial fulfillment of the requirements
of the degree
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in the Department of History and Philosophy of Science
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To my parents

Acknowledgements

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I am indebted to my family and friends for their assistance and moral support: to Mr. and Mrs. Hugh Day, my parents; to my sister, Mrs. Thomas Thorne, who typed an early draft and who would have done more had time and circumstances permitted; to my friend Maureen Gahan, who never ceased to encourage me; to Mrs. Michael McLean, who taught me to use the wordprocessor, and to Mrs. William Salka for additional help with recalcitrant machines; and finally, to my former colleague and friend at Thomas Aquinas College, Dr. Norman DeSilva, whose charity and fortitude in the face of suffering was an inspiration to all who knew him. Requiem aeternum dona ei, Domine.

Prefatory Note on the Meaning of Classification

This dissertation treats the classification of the sciences in the middle ages and, particularly, in the writings of Jean Buridan, the fourteenth century Parisian master. It is not inappropriate to clarify at the very beginning what is meant by "classification." The fact that this word is not to be found in the medieval vocabulary makes the task all the more desirable. One might wonder whether, lacking the word, the medieval philosophers lacked the thing as well.

The schoolmen engaged in an activity which modern scholars have called the classification of the sciences. I shall retain the phrase. A more accurate description however, is the one used by the medieval philosophers themselves: the division of knowledge or of philosophy (*divisio scientiae seu philosophiae*). Science, or philosophy, is looked upon as a genus falling under the more general genus called intellectual virtue, or habit, and under it are numerous species.

A species is a unified whole, and so each science must have something to unify it. The unifying principle is generally taken to be the subject of the science. The subject also gives the science its distinctive character. The division of sciences, then, is equivalent to the distinction of the species of science by means of their subjects.

This activity, which involves a certain amount of philosophical expertise, I shall call the classification of the sciences. Even though a mere enumeration is not a classification in the strictest sense, I shall sometimes give it the name, for it does at least contain the raw materials from which one can be made.

ABSTRACT

Since antiquity, educators and philosophers have been interested in the classifications of the arts and sciences. The three major classificatory traditions of antiquity (Stoic, Boethian-Aristotelian, and the Seven Liberal Arts) were adopted, combined and modified by the medieval classifiers.

Students of the history of the classification of the sciences have tended to ignore the later middle ages. Some have suggested that the schoolmen of the fourteenth century were not interested in the problem. I have shown that the discussion continued into the fourteenth century and that its fundamental character did not change from the thirteenth century.

The late medieval classifiers were concerned primarily with the philosophical principles of classification. Aristotle's writings, recovered in the twelfth century, posed many questions for the medieval classifiers. A major problem was to find the proper means to unify a science and to distinguish it from others. The logical method of terminism and the nominalist philosophy posed deep difficulties for the resolution of this issue. Some fourteenth century nominalists, among them William of Ockham, saw the Aristotelian method of division by formal subjects as no more than a convenience, lacking objective validity.

Jean Buridan, the Parisian Master of Arts and prominent nominalist, objected to the Ockhamist critique of the Aristotelian division.

Desiring to save the Philosopher's doctrine, he proposed a solution based upon terminist principles and compatible with nominalism. Each science, which he regarded as a collection of propositions, was unified by a single "subject of attribution," to which every subject and predicate term used in the science reduced in some way. In this dissertation I explain Buridan's solution and argue that, despite its shortcomings, it is probably the best nominalist resolution of the difficulty. I conclude by showing how Buridan incorporates much of the earlier classificatory doctrine into his scheme of the sciences.

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ABBREVIATIONS

BW = The Basic Works of Aristotle, ed. R. McKeon.

PL = Patrologiae Cursus Completus, Series Latina, ed. J. P. Migne.

QCM = Iohannis Buridani Quaestiones super Libris Quattuor De Caelo et Mundo, ed. E. A. Moody.

QDA = Questiones Buridani in Tres Libros De Anima, ed. G. Lockert.

QM = In Metaphysicen Aristotelis Questiones (Paris, 1588), Jean Buridan.

QP = Subtilissime Questiones super Octo Phisicorum Libros Aristotelis (Paris, 1509), Jean Buridan.

QNE = Super Decem Libros Ethicorum (Paris, 1513), Jean Buridan

INTRODUCTION

C. S. Lewis suggests in his lectures to students about to take up the study of medieval thought that, of all modern inventions, the men of that era might have been most pleased with the card index.[1] This is certainly an amusing way of indicating the love of order and system which characterizes so much of medieval thought. At its best, this desire led the medieval philosophers to divide, distinguish and relate. At its worst, the same impulse was satisfied with drawing up lists.

To classify knowledge is to attempt to understand the structure of reality as intelligible. What things are knowable? In what ways are they knowable? How does knowledge of one thing lead to knowledge of another? Medieval philosophers had a great interest in these questions, as did Aristotle before them. Nor did this interest die with the passing of the middle ages.[2]

Educators as well as philosophers have long been interested in the classification of the sciences. They were in fact the originators of the project. The education of youth, if it is not to be haphazard and rambling, must be grounded on firm principles of the order of knowledge and of learning. Without a curriculum there may be instruction, but there will be no professional pedagogy. And what is a curriculum but a primitive classification of knowledge?

A considerable literature exists on the classifications of knowledge proposed by the ancient Greek and Roman philosophers and educators. The liberal arts tradition, for example, has been treated extensively by students of late Roman and early medieval thought. They have shown how ancient pedagogy, adopted and adapted by Cassiodorus and others, influenced medieval thought and educational practices.

Boethius, as is well known, introduced another major element of the ancient classificatory traditon to the middle ages by passing on, in however incomplete and misleading a form, Aristotle's division of knowledge. The "Boethian-Aristotelian" tradition has also received its share of attention, although the interaction of this primarily philosophical and speculative approach with the liberal arts tradition needs to be considered more fully.

A comprehensive study of the history of the classification of the sciences has yet to be written. The standard treatments, Robert Flint's A History of the Classifications of the Sciences and Joseph Mariétan's Problème de la classification des sciences d'Aristote à s. Thomas are incomplete and out of date. Many of the primary sources are readily available, however, and in recent times several scholars have made a valuable contribution towards our understanding of this history.[3]

Although the "didascalic" writers of the twelfth century have recently been considered, and the thirteenth century authors have not been overlooked by modern scholars, we still have no general understanding of the development of the discussion in the later middle ages, or of the range of solutions proposed. St. Thomas' thought on the matter has been studied extensively, and one may find briefer treatments of St. Albert the Great, Robert Grosseteste, Roger Bacon, and St. Bonaventure. Many scholastic discussions of the division of knowledge have not yet been examined. Even the De Ortu Scientiarum of Robert Kilwardby, a treatise of major importance now available in a modern edition, has not yet been closely examined.

If the classification of the sciences in the thirteenth century is imperfectly understood, the same may be said even more insistently of the fourteenth century. Not long ago, the extent of the later schoolmen's interest in the problem of classifying knowledge was hardly realized. This is not suprising, due to the scarcity of relevant texts and the tendency, more noticable in the fourteenth than in the thirteenth century, to discuss the division of knowledge in the context of other problems rather than in its own right. As a result, many discussions of the division of knowledge have been buried out of sight. Little wonder no one realized for so long that the problem had lost none of its interest for the schoolmen of the fourteenth century.

We are now in a much better position to appreciate the extent and the intensity of this interest. Students of the later middle ages have discovered a lively debate over the problem of the unity of a science. A considerable number of texts are now available, and some have been studied. But many texts remain unexamined, and few exist in critical editions. Nicholas Steneck,[4] who has taken an interest in the divison of knowledge, has pointed out the need for a more systematic study of the dispute about the unity of a science and of the problem of classification in general in the later middle ages. If we consider the fact that just about every thirteenth and fourteenth century commentary on Aristotle and on the *Sentences* of Peter Lombard contains a discussion of one or more questions bearing on the division of knowledge, we will see what a formidable task lies before us.

With so much material available but not analyzed, it is not yet possible to write a complete and definitive history of the classification of the sciences in the middle ages. Many studies of individual authors must be carried out before the general picture can emerge with clarity and probability. The present dissertation is intended as a contribution toward that goal.

One figure who should stand out prominently in any treatment of the division of knowledge in the fourteenth century is Jean Buridan. There are several reasons to expect to find something interesting in his writings. Buridan is unique in his century as a philosopher of the first rank who was not a professional theologian. His perspective as a Master of the Arts and as Rector of the University of Paris on the organization of knowledge should provide an interesting contrast to the views of his colleagues in the Faculty of Theology.

Furthermore, Buridan not only composed commentaries and questions on Aristotle's *Physics* and *Metaphysics*, which provide the standard occasions for the discussion of our problem, he also wrote on the *De Caelo*, the *De Generatione et Corruptione*, the *Meteorology*, the *De Anima*, and even on the *Ethics*, the *Politics* and the *Rhetoric*[5] of Aristotle. Commentaries on the last three works are particularly rare. In all of these works we may expect to find something of interest.

Students of Buridan have lately been concerned to point out the differences--and many are significant--between his doctrines and those of Ockham. Far from being a faithful and routine follower of the Venerable Inceptor, as once was thought, he is now appreciated for his originality and independence. It is clear that medieval nominalism is not a uniform body of doctrine. Buridan's nominalism is not exactly Ockham's. A comparison of the two philosophers' views on the classification of the sciences reveals a fundamental difference in temperament as well as of philosophical principle. For this reason alone, a study of Buridan's doctrine of classification is worth while.

Finally, the profound and widespread influence of Buridan's writings during the fourteenth and fifteenth centuries suggest that his doctrine may be an important link between the middle ages and the renaissance in the history of classification, at least in scholastic circles.

Since Buridan's doctrine of classification cannot be properly understood or appreciated apart from the ancient and medieval traditions, a large portion of this dissertation is devoted to the history of the classification of the sciences prior to the fourteenth century. The task may appear unnecessary, since so much of the material on the earlier history is available elsewhere. One looks in vain, however, for a reasonably thorough outline of the history of classification in any one book. Certain elements, notably the writings of the twelfth century "Platonists," have been largely ignored. More generally, the development and modifications of classificatory goals and principles have not received adequate attention. A certain shift of interest in the later middle ages has been noticed, but no one has described in detail the trends in the history of classification in the middle ages.

In ancient times three distinct classificatory doctrines stand out: the Stoic (sometimes called Platonic), the Aristotelian and the Seven Liberal Arts. All three were passed on to the middle ages as part of their legacy. The Fathers handed them on, attempting at times to integrate them into one schema, but never with much success. The complexities of Aristotle's discussion of the nature of scientific knowledge and of the principles of classification were unknown to the Latins for centuries.

The twelfth century saw two interesting developments in the history of classification. Most important was the genre known as the _introductio ad artes_, which became popular in pedagogical circles. These _introductiones_, of which Hugh of St. Victor's _Didascalicon_ and Dominicus Gundissalinus' _De Divisione Philosophiae_ stand out as the most important, developed and popularized the classificatory doctrines of the early middle ages. These authors not only proposed classificatory schemes, they discussed the origins, subjects, contents and roles of the various arts and sciences. Gundissalinus further enlarged the scope of the medieval tradition by translating the treatises on the division of knowledge written by the Moslem philosopher al-Farabi.

Less influential, but no less interesting, were the "Platonic" commentaries on Boethius's _De Trinitate_ of Gilbert of Poitiers, Thierry of Chartres, and Clarenbald of Arras, and the _Philosophia Mundi_ and _Glosses on Plato_ of Wiliam of Conches.[6] We find in these works an interpretation of the Boethian-Aristotelian classification based upon a hierarchy of Platonic forms. In these works mathematics is usually exalted over natural philosophy, a reversal of the Aristotelian estimation of their worth.

In the flurry of intellectual activity which followed the recovery of Aristotle's works in the later twelfth and early thirteenth centuries, a reexamination of the received classifications of the sciences in light of the new learning became an important desideratum. We see in this period a shift in interest away from the encyclopedic and pedagogical concerns of the earlier middle ages. Gradually, a greater interest in the theoretical questions of principle came to the fore. What is a science? How is it unified? What distinguishes it from other sciences? These questions above all occupied the minds of the thirteenth and fourteenth century classifiers. The result was that the schemes themselves became less important than their philosophical bases.

The transition from educational to philosophical interest was gradual. Gundissalinus in the twelfth century made the philosophical basis of his detailed scheme reasonably clear. In the thirteenth century, Thomas Aquinas treated the division of knowledge primarily as a theoretical problem, with only a brief glance now and then at its educational implications. Kilwardby, his contemporary, represents the most thorough mixture of educational, encyclopedic and philosophical interest in the middle ages. Philosophical concerns dominate in the fourteenth century, yet we find Henry of Hesse providing a detailed and quite original scheme.

No doubt there were several reasons for this gradual and never quite complete shift of interest. On the negative side, some may have felt that no more treatises after the fashion of the Didascalicon or of Kilwardby's De Ortu Scientiarum were needed. On the positive side, Aristotle's texts called for an account of the parts of knowledge and of their relationship to the world of being. Differing interpretations of the Philosopher's metaphysics and epistemology necessitated different explanations and justifications of his division of knowledge.

The thirteenth and fourteenth century debate over the principles of classification was only one part of a larger dispute about the proper interpretation of Aristotle's philosophy. Terminism in logic, and nominalism in metaphysics--the "via modernorum"[7] of the fourteenth century--forced a reevaluation of the Aristotelian conception of scientific knowledge.[8]

The terminist logic was congenial to the view that the object of scientific knowledge is a proposition existing in the mind of the knower. When combined with nominalism, which denies common natures, the terminist conception of knowledge precludes the moderately realistic explanation of the unity of a science that we find in the writings of St. Thomas Aquinas and Henry of Ghent. These philosophers understood a science to be a single habit or intellectual power, unified by its "formal object" or "ratio," and capable of being possessed to a greater or lesser degree. Among the nominalists, science came to be seen as a collection of mental propositions, each one composed of terms signifying and standing for individuals, and individuals only.

Rejecting the formal object (ratio) of St. Thomas and Henry as a meaningless "essence," they had to find another way to explain the unity of a "whole" science such as physics.

Ockham responded to the problem by denying that the unification of a science can be accomplished by assigning to it a single subject. A whole science, according to Ockham, is merely an aggregate of propositions having no natural unity and no rigorously assignable bounds.

To this view of science Buridan took exception. Agreeing with Ockham that a science is first of all the possession of a mental proposition conveying a truth about individual beings, he thought that a way could be found to assign a single subject to each whole science and to provide a criterion for assigning every proposition to a single science. Buridan's method, which was based upon the principles of terminist logic, will be explained in the third and fourth chapters of this work.

Fortunately, Buridan's interest in the problems of classification went beyond these general philosophical concerns. As a Master of the Faculty of Arts at the University of Paris, his academic career was devoted to the teaching of the "three philosophies"--natural, moral and metaphysical--and the logical disciplines that were ancillary to them. As one who gave himself entirely to teaching in the Faculty of Arts, Buridan provides us with a much more thorough and complete discussion of the nature and role of the various Aristotelian sciences than do most other fourteenth century scholastics. The number of commentaries and questions he left us is without rival.

Buridan had much time and many occasions to reflect on the parts of knowledge and how they are related to one another. We see in his writings an interest that we may properly call pedagogical. Buridan frequently had to deal with beginners, who needed to be told where the science they were about to learn fit into the scheme of knowledge as a whole. He indicates that it was a custom in the Faculty of Arts to teach the students these things. An informal survey of fourteenth century texts on the three philosophies and on the arts tends to confirm his statement.

From his many writings it is possible to form a reasonably clear picture of Buridan's classificatory scheme. All the major features of the Aristotelian division are present in Buridan's *arbor scientiarum*. He was familiar with at least some of the didascalic works of the twelfth century, and had read Albert the Great and St. Thomas. In his synthesis of the elements of the medieval classificatory tradition, Buridan includes certain ideas which seem to be his own. His treatment of the moral sciences in particular is fuller than usual, and in some respects unusual if not unique. In the final chapter of this dissertation, I will describe and evaluate Buridan's *arbor scientiarum*. I hope that others will be encouraged to look into the writings of the schoolmen of the fourteenth century for more examples of late medieval classifications of the sciences.

[1] The Discarded Image: An Introduction to Medieval and Renaissance Literature (Cambridge: The University Press, 1967), p. 10.

[2] Discussions of classification by well-known scientists and philosophers include Ampère, Essai sur la philosophie, ou exposition analytique d'une classification naturelle de toutes les connaissances humanines (Paris, 1885); Comte, The Positive Philosophy of Auguste Comte, Vol. 2 (London, 1893); D'Alembert, "Preliminary Discourse to the French Encyclopedia," in Denis Diderot's The French Encyclopedia: Selections (New York, 1967).

[3] Recent studies include papers by Maurer ("Ockham's Conception of the Unity of Science" and "The Unity of a Science: St. Thomas and the Nominalists"), Palma ("Grosseteste's Ordering of Scientia"), Spade ("The Unity of a Science According to Peter Auriol"), Steneck ("A Late Medieval Arbor Scientiarum"), and Weisheipl ("Classification of the Sciences in Medieval Thought" and "The Nature, Scope and Classification of the Sciences"). See the "List of Works Consulted" at the end of this dissertation.

[4] See the work cited above, "A Late Medieval Arbor Scientiarum."

[5] I have not been able to obtain a copy of the Questions on the Rhetoric, so I will not discuss its contents. A description of the text may be found in Karin Fredborg's article, "Buridan's Quaestiones Super Rhetoricam Aristotelis." See the "List of Works Consulted."

[6] I shall not treat the "Platonic" authors at length in my survey of the history of classification, although I shall occasionally refer to their doctrines. This omission is necessary in the interests of brevity and justifiable, because they seem to have had no effect on Buridan's treatment of classification.

[7] My understanding of terminism and of nominalism, which I do not equate, is set out on pp. 198-199, n. 3, and pp. 216-217.

[8] Of all the recent writers on the classification of the sciences only Maurer has paid attention to this point. See "The Unity of a Science: St. Thomas and the Nominalists."

Biographical Note on Buridan

The biography of Jean Buridan, as it has come down to us, is a curious mixture of fact and fable. He was highly reputed in his day, a "vir venerabilis et discretus,"[1] who was twice Rector of the University of Paris. Duing his long years at Paris as a Master of Arts, he mediated disputes, defended the interests of the university before the secular powers, and lent his weight to the condemnation of intellectual abuses.[2] But he, like St. Albert the Great before him, acquired in the popular imagination a reputation quite out of keeping with the character revealed in his writings and attested to by his contemporaries.[3]

The date and place of Buridan's birth are uncertain. From his _Questions on the Meteorology_ we learn that he was very familiar with the Picard region and dialect. He is designated in documents as a cleric of Arras. Since the sixteenth century, most of his biographers claim that he was from Bethune, although this information rests solely on Jean Dullaert's preface to the 1509 edition of his _Questions on the Physics_.[4]

We know from Buridan himself that he entered the College of Cardinal Lemoine, which was founded in 1302 in the _rue Saint Victor_. This would have been sometime after August, 1308.[5] At a later date he entered the college of Navarre.

Unlike most of his distinguished contemporary Aristotelians, Buridan was a secular cleric. He received _gratia expectativa_ a benefice in the diocese or village of Arras in 1330 from Pope John XXII. Later we find that he received an appointment as a canon of Arras, expectative of a prebend, and other benefices as well.[6] His visit to the papal court at Avignon, mentioned in the Questions on the De Sensu et Sensato and referred to by Dullaert as an official mission, may have been, at least in part, to solicit a benefice.[7]

Buridan died at Paris, ca. 1358. He established a foundation in the Picard nation to celebrate mass on the anniversary of his death.[8] It is not known where he is buried.

Buridan's reputation and influence lasted beyond his death and increased with the passing of time. Although his writings were prohibited during the years 1474-1481, because of their "nominalist tendencies," during the next generation they were frequently reprinted and widely circulated. Buridan's reputation in the century following his death can hardly be exaggerated. "A document in the archives of the University of Cologne, dated 24 December 1425, speaks of the preceding century as 'the age of Buridan,'" writes Ernest Moody.[9]

[1] Buridan is so described in a document of 1328 reprimanding the abuses of certain philosophers in the citation of texts. He was at this time Rector of the university. See E. Faral, "Jean Buridan, maître ès arts de l'Université de Paris," Hist. litt. de la France, XXXVIII (1949), 462-605. Faral's article contains the most complete account available of Buridan's life and legend.

[2] In 1358, he is mentioned in a document as a witness to an agreement between the Picard and English nations. This is the last reference to Buridan as an active member of the Faculty of the University of Paris. (E. A. Moody, "John Buridan," Dictionary of Scientific Biography (New York, 1970), II, 603.) In 1344, we hear of Buridan defending the interests of the University of Paris before Philip of Valois in Rome. (Faral, "Jean Buridan," p. 476; we have no contemporary evidence for this report, however.)

[3] The legends concerning Buridan, which include the claim that he founded the University of Vienna, are recounted and discussed at considerable length by Faral. They picture Buridan as a sharp dialectician (a reputation clearly deserved), a wit, and rather a rascal.

[4] Faral, "Jean Buridan," p. 465.

[5] Buridan writes (Faral, "Jean Buridan," p. 469): "Sic etiam ego quondam, commorans in domo Cardinalis Monachi vidi cum pluribus aliis sociis cadere fulmen super capellam . . ." He goes on to mention some particulars about the chapel. The authorization for the chapel to be built was given on 30 August 1308.

[6] Concerning Buridan's benefices and appointments, see Faral, "Jean Buridan," pp. 470-74. Documents relating to these benefices describe Buridan as a "very distinguished man," "celebrated philosopher," "lecturing at Paris on the books of natural, metaphysical and moral philosophy." (Moody, "John Buridan," p. 603.)

[7] Faral, "Jean Buridan," p. 471. In question 3, Buridan tells of a blind cleric who had come to Avignon to request a benefice from John XXII. Even if he was at Avignon on official business, it is likely that he did not neglect his own affairs, as Faral points out.

[8] Faral, "Jean Buridan," p. 479.

[9] Moody, "John Buridan," p. 603.

Chapter One: The Elements of the Medieval Classifications of the Arts and Sciences

The middle ages inherited from antiquity several distinct classifications of knowledge. The most important and influential of these were the seven liberal arts and the version of Aristotle's classification preserved in Boethius' De Trinitate. The Stoic classification was also influential, though less so than the other two schemes. These three classifications (summarized in Fig. 1) guided and shaped the early medieval tradition. Without a thorough understanding of its ancient elements, the later scholastic discussions cannot be appreciated. Each of these ancient classificatory schemes, therefore, will be taken up and described in turn.

I A: The Stoic Division of Philosophy

The least important element in the classificatory tradition received from antiquity was the Stoic division of philosophy. The ultimate source of this division may be Aristotle's Topics (I, 14, 105bff); ethical, natural and physical problems are distinguished in this passage. The early classifiers adopted a three-fold division of philosophy into ethics, physics and logic on the authority of Cicero and of St. Augustine. The saint referred to this classification as Plato's division,[1] which is puzzling, since Plato seems to have had nothing to do with it. More recently,[2] the division of philosophy

FIGURE 1.1 a: The Stoic Division

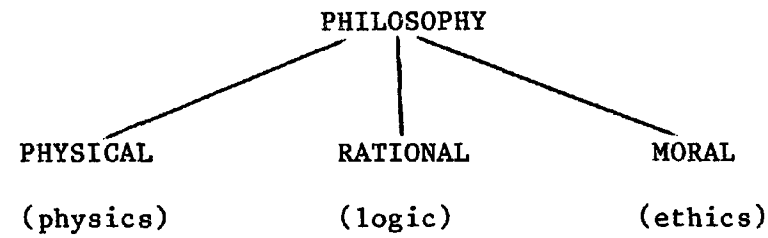


FIGURE 1.1 b: The Liberal Arts

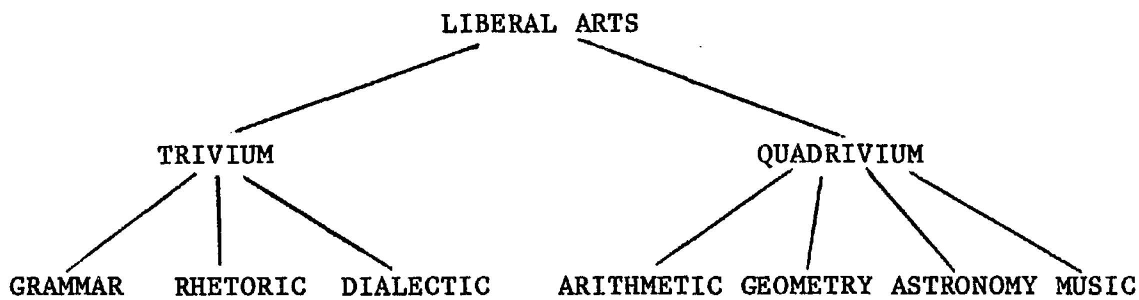
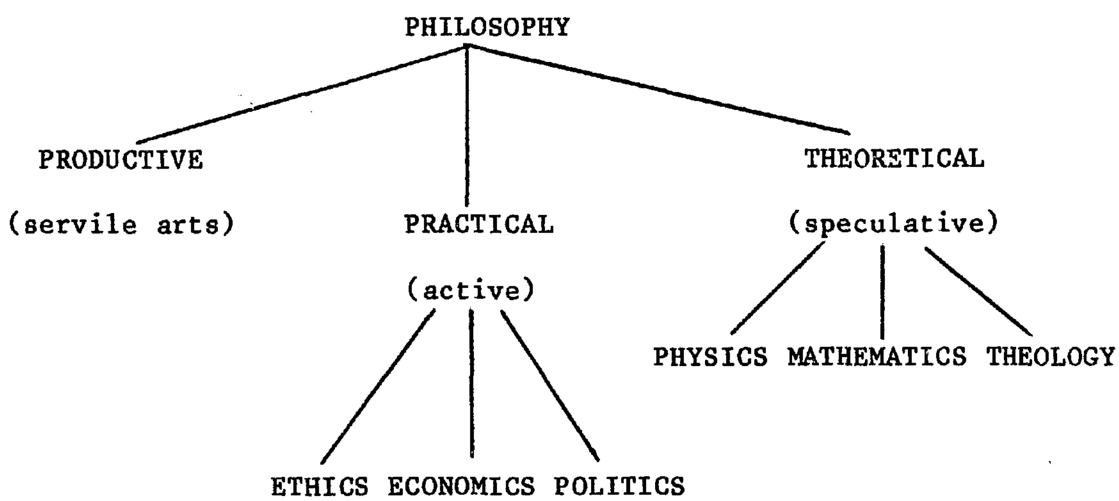


FIGURE 1.1 c: The Boethian-Aristotelian Division



into physics, ethics and logic has been called "Stoic," a name which is appropriate in virtue of its most numerable and notable proponents in antiquity, not because it was exclusively Stoic doctrine. According to the Skeptic Sextus Empiricus (A.D. 160-210), "those who divide [philosophy] into three parts are all agreed on the division into physics, logic, and ethics."[3] Sextus also tells us that some did not divide philosophy at all, and others supposed it to have only two parts. In every case the whole of philosophy or the two parts were drawn from the given list of three. Thus Thales and Anaximines and Anaximander thought that physics was philosophy. Concerning the other Pre-Socratic philosophers, Empedocles, Parmenides and Heraclitus, it is disputed whether the first two were dialecticians as well as physicists, and the last named was perhaps an ethical as well as a natural philosopher.[4] Sextus goes on to describe the opinions of many other philosophers.

In keeping with his own skeptical views, Sextus does not settle the question, but thinks that those who divide philosophy into three branches have a more satisfactory classification than the others. Such, he tells us, are Xenocrates, the Peripatetics and the Stoics.[5] He recounts three images of the three-fold division of philosophy, and these are worth repeating here. Philosophy is likened to a garden, rich in fruits. Physics is the height of the plants, ethics the richness of the fruits, logic the strength of the walls. Or, philosophy is like an egg; ethics is the yolk (or the chick), physics the white, and logic the shell. Finally, philosophy resembles an animal, physics being the flesh and blood, logic the bones and sinews, ethics the soul. It is interesting to note that in each metaphor logic is associated with the element of strength and firmness, ethics with the lively and spirited, and physics with the earthy. Posidonius, Sextus tells us, preferred the third comparison because philosophy is really an indivisible whole.[6]

Seneca, who may be taken as a witness to the acceptance of this classification by the Roman Stoics, was also a firm believer in the unity of philosophy. The subject of his 89th epistle is the division of philosophy. Seneca speaks as a true lover of wisdom when he says, "I wish, indeed, that the whole of philosophy--a spectacle very like the world itself--were able to present itself to us, even as the face of the world as a whole comes into sight."[7] To fulfill his correspondent's request, however, he agrees to divide philosophy into parts, but "not into scraps." Seneca has no use for elaborate sub-divisions of philosophy.

Most authors, writes Seneca, and the most important ones at that, have accepted the division of philosophy into moral, natural and rational (that is, logical). He goes on to say that some Peripatetics add civil philosophy and others also add economics; but these really are parts of moral philosophy. The Epicureans held that philosophy included only the natural and the moral. When forced to admit a "forensic and regulative" art, they assigned it to the natural branch. The Cyreniacs (the followers of Aristippus) accepted only the moral branch, but Seneca thinks that they really included the rational and the natural as parts of ethics. It seems that the division of philosophy into these three parts is inevitable, however they may be arranged.

One striking omission in both Sextus' and Seneca's discussion of the history of the divisions of philosophy is Aristotle's classification. The *Metaphysics* apparently was not available to them, and the Peripatetics had not maintained their master's doctrine on this point. The Aristotelian classification did not reemerge until well into the Christian era, when it was adopted by Boethius. Eventually it overturned the Stoic classification and almost eliminated it. For a long time after Boethius, however, the two existed side by side. The history of the classifications of science in the middle ages can to a great extent be seen as an attempt to integrate these two classifications and a third, the seven liberal arts. We turn now to the latter scheme.

[1] De Civitate Dei, 8.4. The source of this mistake may be Sextus Empiricus, who seems to attribute this division to Plato, although he is not clear about it. See the work cited in n. 2 below.

[2] Fr. Weisheipl so refers to it in "Classification of the Sciences in Medieval Thought," Med. Stud., 27 (1965), 63-64; 65.

[3] Against the Logicians, trans. R. G. Bury (1967), pp. 3-5.

[4] Against the Logicians, p. 5.

[5] Against the Logicians, p. 9. The Peripatetics could have learned this scheme from Aristotle himself. See below, p. 95, n. 1.

[6] Against the Logicians, p. 11. Presumably Posidonius thought of an egg as something constructed from two or more substances, not as a unified whole.

[7] Ad Lucillum Epistulae Morales, ed. R. M. Gummere (Cambridge, Mass., 1970), II, 378: "Utinam quidem quemadmodum universa mundi facies in conspectum venit, ita philosophia tota nobis posset occurrere, similimum mundo spectaculum." The translation is mine.

I B: The Seven Liberal Arts

The seven liberal arts were a late Roman distillation of the essence of ancient liberal education.[1] Although they included what were at one time advanced mathematical disciplines, the liberal arts had come to be seen and indeed to be a preparatory course of study. As a gateway to the higher sciences, the liberal arts were the foundation of medieval education, at least in theory.

The trivium, which comprised grammar, rhetoric and dialectic (or logic), provided the backbone of elementary studies. The quadrivium included four areas of more advanced study: arithmetic, geometry, music and astronomy (or astrology). This seven-fold way was envisioned as a preparation for the pursuit of the highest knowledge, philosophy. The fortunes of the seven liberal arts varied throughout the middle ages, but never were they forgotten as the necessary basis of a liberal education.

B 1: Liberal Arts and Liberal Education

To speak of the liberal arts is to speak of the education of a free (<u>liber</u>) man. Although the word is Latin, the idea is Greek. To the Greeks, liberal education was an enterprise altogether different from learning a manual art or trade. Like a trade, however, liberal education was not to be had in a school. The most ancient, though never wholly outdated, mode of liberal education was the instruction of a youth by a man of experience whom the boy accompanied, observed and imitated. A father or other elder guided and formed the youth and initiated him into adult society. This is the picture of education we see in the poetry of Homer.[2]

Even in Homeric times, of course, specialized bodies of knowledge existed.[3] There were manual and decorative arts whose origins were long forgotten. Training in certain specialized skills were part of the general education of the young warrior--such were attributed to legendary masters or even to the gods.[4] Finally, the medical art, which Homer represents as a body of skills and secret knowledge handed on from father to son,[5] was highly esteemed.

The aim of education in the Homeric era, as opposed to mere training, was the formation of the perfect warrior, who should know how "to give good counsel and perform great deeds."[6] Homeric education comprised instruction in the manly arts of warfare and the hunt and training in "knightly" virtue and practical wisdom.[7]

The distinction between education and mere training was recognized by Plato in the Laws, but his ideal was the perfect citizen, not the perfect warrior. Training directed toward acquiring money, a good physique, or even intellectual facility was coarse and illiberal, according to Plato. When we call a man educated, he writes, we have in mind education in virtue, "a training which produces a keen desire to become a perfect citizen who knows how to rule and be ruled as justice demands."[8] Although the ideal has changed, the notion of education as learning a way of life is the same. Education for life cannot be gained by following a course of study in a school.

Although apprenticeships of some sort in the various arts and trades must have existed in the Homeric era, there were no schools in which a young man could be formally educated.[9] Nor were there any classifications of the arts and sciences. The specialization of instruction in the arts is a sine qua non for their classification, but more is required. A certain pedagogical sophistication--the formation of a philosophy of education--is also a necessary condition.[10]

The earliest division of education in Greece was extremely simple, but it was based upon a rational principle dear to the Athenians, the two-fold nature of man, soul and body. The "Old Athenian" education (originating in the mid-sixth century B.C.) consisted of music and gymnastics.[11]

Music included not only the study of harmony and the art of playing instruments but also grammar and literature, which were taught primarily from the Homeric poems.[12] There is some reason to think that music was not restricted to grammar, literary studies and music as we think of it. Before specialized instructors in literature appeared, the citharist taught the elements of arithmetic as well as letters and the art of the lute.[13] Music, it seems, was the complete education of the soul, the complement of the training of the body in the gymnasium. If we recall that "music" is named for the Muses, this broad usage of the word will not surprise us.

The theory that the liberal arts arose from one source, which we may call "musical education," has a great deal of plausibility. But it is certain that education was changing in the direction of greater specialization in the fourth century B.C.[14] The knowledge of letters, "reading and writing," was becoming distinct from the knowledge of singing and melody. Mathematics began to be taught at an elementary level as an independent part of the curriculum. Higher studies could be pursued under special teachers by those who were so inclined.

According to Marrou, the revolution began with Isocrates.[15] His was the sophist's ideal of education: to produce an effective rhetorician. Isocrates' student would have undergone the usual elementary education in gymnastics and "philosophy." The basis of philosophy, according to Isocrates, was grammar, the study of the classics. To this was added history and mathematics. A new element mentioned by Isocrates was "intellectual gymnastics," the art called "eristics," which was training in argument and debate. Eristics was the immediate preparation for the "higher culture," attained only by the few. The art of arts, reserved for the most advanced disciples, was oratory. All other arts were preliminaries to it.

Isocrates was perhaps more responsible than anyone for the literary bent of the late classical education.[16] But the eventual absorption of rhetoric into the number of the liberal arts represents the triumph of the Platonic and Aristotelian ideal of higher education, according to which speculative philosophy was the ultimate goal.[17]

The Academy and the Lycaeum, outstanding examples of the new institutions of higher learning, embodied this ideal. Since our concern here is with the liberal arts, not higher education, we must consider what Plato and Aristotle expected a young man to know before he took up advanced studies.

Aristotle and Plato did not disagree about the ultimate aim of education, as Burnet has so aptly explained: "They both agree that the training of character must come first and that it must have in mind the practical requirements of the community. On the other hand, they are both equally clear that the highest function of education goes beyond the practical life."[18] The liberal subjects,[19] Aristotle claims, are the proper study of the free man because they serve these two ends: the acquiring of virtue (above all, civic virtue) and the pursuit of speculative knowledge.

Plato recommended the traditional course of study, music and gymnastics, as the most suitable elementary education.[20] Music represented primarily the grammatical and literary aspects of Greek education. Such studies were to occupy the youth until he reached the age of twenty. During the next two years he was to pursue what we may call a secondary education in the mathematical disciplines,[21] arithmetic, geometry, astronomy and harmony. Only then was he ready to advance through the use of the art of dialectic to the "highest music," philosophy. Philosophy, of course, was not a subject. It was a way of life.

In none of his extant works does Aristotle outline an ideal course of studies. We are able to make a reasonable conjecture, however, based upon the little textual evidence we have together with a general understanding of his philosophical doctrines. Our major source for Aristotle's ideas about elementary education is Politics VII and VIII, in which he describes education in an ideal state. He describes the customary course of studies with approval as embracing those arts which "we must study merely with a view to leisure spent in intellectual activity" and which "are to be valued for their own sake."[22] He lists as the usual branches of education reading and writing, gymnastic exercises, music (in the restricted sense) and, optionally, drawing. The emphasis is upon physical training and the fine arts.

We find nothing here or elsewhere in Aristotle's writings which resembles the list of the seven liberal arts.[23] The mathematical disciplines and logic are noticable by their absence. This is not to be wondered at, since Aristotle is concerned in this text with the most elementary education given to all. Unfortunately, he never tells us when logic (which in a sense he invented) and mathematics ought to be studied. It is not difficult, however, to form a reasonable conjecture.

As the instrument (organon) of all the arts and sciences, logic would have to be studied early in the course of the youth's "secondary" education. Mathematics, too, would be studied before the more difficult sciences. We know from the Metaphysics that Aristotle regarded mathematics as one of the theoretical sciences. It could hardly have been studied as such before the youth reached the age of eighteen or nineteen.[24] (No doubt he would already have learned the rudiments of measurement and calculation in the course of his "primary" education.)

Aristotle divides the life of the young man into two periods with respect to his education (Politics, VII, 17, 1336b38ff): age seven to puberty and puberty to the age of twenty-one. It seems reasonable to assign his education in logic and mathematics to the latter period. Only after the age of twenty-one would he take up advanced studies, and then only if he chose to live the life of a philosopher.[25]

Did Aristotle agree with Plato that mathematics is a preparation for the pursuit of the highest wisdom? It is clear that for Aristotle mathematics was inferior to physics and the natural sciences and, to a limited degree, useful to them. No doubt mathematics constituted a remote preparation for metaphysics, at least in the sense of providing intellectual discipline. But the Philosopher showed no sympathy for the kind of metaphysical mathematics we find in the Platonic tradition.[26] The study of mathematics most probably was intended to precede the study of natural philosophy.

Although it is impossible to know exactly what place mathematics and logic held in Aristotle's conception of the ideal curriculum, he probably did not disagree with Plato about the normal course of study of the free Greek. This curriculum assumed its "classical and definitive form" in the generation following Aristotle.[27] This was the enkyklios paideia,[28] or cyclical instruction, which was sometimes conceived as general intellectual culture and at others as basic learning preparing the mind for more advanced studies.[29]

The notion finally prevailed that the enkyklios paideia, embodied in the seven liberal arts, was the beginning rather than the end of education. While Europe remained pagan, rhetoric and philosophy vied for the pinnacle of education.[30] When Europe became Christian, Sacred Theology assumed the place of honor. The idea of the liberal arts as the necessary foundation for the study of Holy Scripture was firmly established. All that remained was to establish the number and contents of these arts.

B 2: The Establishment of the Seven Liberal Arts

The seven arts which medieval tradition established as _the_ liberal arts were all of ancient origin. Each one had been taught before Plato wrote his first dialogue or Aristotle gave his first lecture. The arts of rhetoric and of dialectic originated in the fifth century before Christ, if Aristotle's testimony may be accepted. According to Diogenes Laertius, Aristotle attributed the origin of rhetoric to Empedocles (ca.493-ca.433) and of dialectic to Zeno (b.ca.490).[31] Although it seems unlikely that one man invented any art singlehandedly, there is no doubt that each art had its first teacher. Empedocles and Zeno may indeed have been the first to teach these arts. It is clear, in any event, that they existed as disciplines in Aristotle's day.

That the quadrivial subjects were taught during Socrates' lifetime is clear from the _Protagoras_. In this dialogue Protagoras claims that he teaches a young man to manage his personal and household affairs and the affairs of state. He must go to the other sophists--Hippias is indicated here--to learn the special sciences, arithmetic, astronomy, geometry and music.[32] The quadrivium, then, was taught in the schools of some of the sophists. A fragment[33] from the works of Archytas of Tarentum (fl. early 4th c. BC) indicates that the four-fold division of mathematics was familiar to him. It may well go back to Pythagoras.[34]

Although the seven liberal arts were all in existence by the fourth century, they had by no means been established as a generally agreed upon curriculum of preparatory study. Such agreement was highly unlikely in the absence of public support and control of education. Yet there were certain constants. The study of grammar and literature was agreed to be the foundation of liberal education, and dialectics, rhetoric and mathematics were generally thought to have a place in intellectual culture. Such differences of opinion as existed among philosophers primarily concerned the proper contents of these arts and their order of dignity. The possibility of establishing a definitive list of the liberal arts was not remote, but its actual establishment was not to come for a long time.

During the Hellenistic period, education came under the regulation of the state, and this development contributed to the standardization of the curriculum. The preparatory education of a young Greek in the third century included gymnastics, grammar, music, and drawing for the younger boys and arithmetic and geometry for the older.[35] Rhetoric and dialectic, later to be included among the arts of the trivium, were still advanced studies. So, too, was astronomy, perhaps the most difficult of all the mathematical disciplines. As time went on, all the mathematical arts were pushed out of secondary education and turned into advanced studies. General education became ever more literary in the Hellenistic period.[36]

Following Friedrich Marx, Marrou argues that the list of the seven liberal arts was "finally and definitively formulated" around the middle of the first century B.C., between the times of the grammarian Dionysius Thrax (ca.170-ca.90 BC) and of the Roman encyclopedist Varro (116-27 B.C.).[37] If the claim amounts to no more than this, that grammar, rhetoric, dialectic, arithmetic, geometry, astronomy and music were sometimes proposed as the arts suitable for the education of a free man, it can perhaps be sustained. But taken literally, the claim that the list of the seven liberal arts was definitively formulated during this period cannot be admitted.[38]

The Greek and Roman authors disagreed among themselves about the contents of the *enkyklios paideia*,[39] but the definitive list of the liberal arts was well on its way to being established by the time of St. Augustine. From the time of Cicero, no one among Latin authors had named grammar, rhetoric, dialectic, arithmetic, geometry, astronomy and music as the liberal arts until St. Augustine proposed this list in *De Ordine*. The Bishop of Hippo did not always enumerate the same arts, but he did always draw them from this list of seven.[40] Perhaps the Saint's authority had a great deal to do with the eventual acceptance of the definitive list of the liberal arts.

In the fifth century we reach a milestone in the history of the seven liberal arts. We may point without hesitation to the book which established the tradition of the seven liberal arts once and for all in medieval thought--*De Nuptiis Philologiae et Mercurii* of Martianus Capella (fl.ca.420 A.D.)[41] It may be doubted whether Martianus intended his seven liberal arts as a thorough and definitive classification. If the number were of any significance, one might expect Martianus to comment upon it in this allegorical poem, but he does not. A more likely hypothesis is that he was commiting to writing the actual educational practice of his day.[42] However that may be, Martianus' book, which remained popular throughout the middle ages, canonized grammar, dialectic, rhetoric, geometry, arithmetic, astronomy and harmony as the seven liberal arts.

The modern reader finds it difficult to account for the immense popularity which De Nuptiis enjoyed in the middle ages. Critics agree that it is a literary failure, and not a minor one. But as Stahl has pointed out, Martianus read the taste of his readers aright; we can hardly demand that he meet ours.[43] The fact is that this book was one of the most important channels through which the intellectual life of the ancients flowed into the early middle ages. Only Boethius, Cassiodorus and Isidore of Seville rival him as a transmitter of the Greek and Roman traditions of learning to the early middle ages.[44]

De Nuptiis does not merely name the seven liberal arts, it transmits, or purports to transmit, their contents as well.[45] Martianus desired to avoid the dry format of a textbook, however. The discourses on the arts are woven into a story meant to delight as well as to instruct.[46] This is the scenario: Philology (representing learning) and Mercury (representing eloquence) appear before the council of the Olympian deities to solemnize their marriage, first suggested by Apollo. Before the rites begin, seven women called feminae dotales (women of the dowry) appear. The first is called Grammar, the second Dialectic, and so on. Each one delivers a learned discourse summarizing her art and then is extolled by the wedding guests, which include the great philosophers of old.

The setting of the allegory occupies books I and II. Martianus' Latin style is so difficult in this part of the work that his medieval scribes could not easily read it. As a result, the text is often corrupt. Each of the following books (III-IX) contains the discourse of one of the dowry women together with further allegorical presentations. In contrast with the allegorical settings, the discourses are plain and straightforward in style, although like the rest of the book they abound in neologisms and confusing constructions.[47]

The matter of the discourses is, for the most part, a rehashing of various Greek and Roman sources. A long tradition of handbook-writing lies behind De Nuptiis. Such handbooks--always a poor but pedgogically useful substitute for the original writings of men of genius--suffered a decline in the passage from the Greek to the Roman writers. Martianus' compilation is one of several end products of this decline, but, according to Stahl, it is far from being the worst.[48]

There is no evidence that Martianus knew at first hand the Greek authors who were the ultimate sources of his doctrine. It is far more likely that he worked from Latin sources only. Varro (whose Menippean Satires anticipated the alternating prose and verse style of De Nuptiis) may have been Martianus' principal source. That he was indebted to Varro seems clear, but the nature of his debt is a matter for conjecture. He may not have had direct access to Varro's encyclopedia, at least in its entirety.[49] This is a question of little importance. We have to do here with a body of learning that was the common inheritance of all the Latins. Varro himself was only a transmitter.

The only aspect of Martianus' treatment of the arts worthy of special notice here[50] is the content of Geometry's discourse. The other discourses contain much what one would expect from the names of the arts. The primary subject of the geometrical book, however, is geography. The treatment of geometry proper is extremely brief. Martianus presents a short compendium of part of Euclid's Elements (with some Heronian material[51]), including a few definitions and axioms, the first five postulates, the division of a proposition and the classification of plane and solid figures. The great bulk of the discourse is devoted to a description of the world and a naming of places excerpted from Solinus' condensation of Pliny.[52]

Geography was never regarded as a distinct art during antiquity or the middle ages. The word "geography," in fact, was rarely used. J. K. Wright mentions only one example of the use of this term in his valuable study, The Georgaphical Lore of the Time of the Crusades.[53] The name "geometry" suggests the appropriateness of including geographical lore in this art. An old and often repeated story had geometry invented for the purpose of surveying the boundaries of countrys and regions.[54] Though it may surprise us, who consider geography a distinct science, Martianus' inclusion of it in geometry is easily understood. The only reason for regret is that for a time geometry proper was understood and appreciated less than this minor and subordinate branch.

A reading of De Nuptiis Philologiae et Mercurii provides a good picture of the state of learning at the end of the classical era and the beginning of the middle ages. This is the work of a pagan[55] to whom the remnants of the arts and sciences were treasures to be shown off and to be passed on. Little did he realize that his book would help establish the framework within which human knowledge would be organized in the Christian middle ages.

Two further questions remain in this brief survey of the establishment of the seven liberal arts. What is the origin of the names "trivium" and "quadrivium" and, more importantly, was this list ever made into a true classification? That is, was a rationale ever given why the liberal arts were exactly these and no others? I will suggest an answer to the lesser question now; the greater may not be settled until we have considered the later history of classificatory systems.

It is not clear when and how "quadrivium" and the related, but certainly later, term "trivium" came to be the accepted names for the two major branches of the liberal arts. Early Christian classifiers generally called the mathematical arts "disciplinary" (translating the Greek word literally) or "doctrinal" and the others simply "arts." Evidentally they saw no need for a special name for grammar, rhetoric and dialectics taken as a group. Indeed, they may not have considered these three as parts of a whole. Some joined together rhetoric and dialectics, giving them the name "logic," but they cheerfully left grammar, the most trivial of the arts, outside their formal classificatory schemes.

"Trivium" and "quadrivium" mean the threefold way and the fourfold way. Boethius coined the word "quadrivium" not as a name for the mathematical arts but as an expression of the metaphor of the road to knowledge. Knowledge here means theology or wisdom. The seven liberal arts were not the end of the journey but stages along the way. Indeed, they were the way.

Citing Pythagoras and the early primaeval authorities (priscae auctoritatis viros) Boethius explains in De Arithmetica that the only way to the perfection of philosophy is through a fourfold path.[56] Later on he speaks of the mathematical arts as the paths of wisdom (semites sapientiae). They are also called the steps by which the soul is led beyond the senses to the intellectual apprehension of truth.[57]

The perception of the mathematical arts as a distinct group was ancient, and it is not surprising that the four were named before the three rational or discursive arts. Although it seems natural, with the benefit of hindsight, to group the latter together and give them a name, many of the early classifiers failed to do so. The names "trivium" and "quadrivium" do not appear in the works of Isidore, Alcuin or Rabanus Maurus, or at least not prominently, for I have not been able to locate them in the most likely places in the texts.[58] There is no reason to think that these names were in common use before the ninth or tenth century.[59] Hugh of St Victor, however, uses both names as though they were well known. That this terminology was well established by the twelfth century is confirmed by Latham's

Medieval Latin Word List, according to which "trivium" occurs frequently in manuscripts dating between 1089 and 1421.

The obvious conclusion of these observations is that the early medieval classifiers did not regard the seven liberal arts as a unified and coherent scheme. It remains to be seen who, if anyone, ever did. But it _is_ true that the number of the liberal arts was interpreted at an early date as highly significant. Most of the fathers were interested in the symbolic meanings of numbers, and they realized that seven was an important number. Cassiodorus says that whatever is continuous and perpetual is represented in Scripture by this number.[60] One scriptural use of the number seven is pertinent to the liberal arts: Solomon's temple, the temple of wisdom, was supported by seven columns. Alcuin explicitly identifies these columns with the seven liberal arts.[61]

Considerations such as these no doubt helped fix the number of the liberal arts once and for all. But the integration of the liberal arts with the other two major divisions of knowledge, the Stoic and the Aristotelian, prevented them from becoming a distinct and independent classificatory scheme.

B 3: The Contents of the Seven Liberal Arts

It seems appropriate at this point briefly to describe the contents of the seven liberal arts, as they were taught during the middle ages. My account of the medieval curriculum (which was by no means one and the same in all schools or at all times) is intended as a rough sketch, not as a thorough history of the subject. Several excellent works on the liberal arts in the middle ages have been published in recent times, and the interested reader should refer to them.[62] My intention is to supply a general notion of the education in the liberal arts offered during the middle ages.

We may form a tolerably clear notion of the medieval curriculum by considering the young scholars' textbooks. These were of two kinds, encyclopedias and specialized treatises. Encyclopedic works, although not textbooks in the usual sense, were important sourcebooks of medieval education. When not used themselves, the encyclopedias provided much of the raw material for specialized treatises. A typical encyclopedia treated several, if not all seven, liberal arts.[63] In the earliest of these, Martianus' De Nuptiis, the arts are given more or less equal weight. If a trend may be observed in later encyclopedias, it was away from anything approaching an adequate coverage of arithmetic, geometry and music. Within the trivium, grammar was generally treated at greatest length. Alcuin, for example, devoted twice as many pages to grammar as to rhetoric or dialectics, and Isidore almost four times as many. While Isidore gave at least a passing glance at all the quadrivial arts, Alcuin wrote on astronomy only.[64]

One author stands outside this development and was, quite possibly, a cause of it. Boethius' actual contribution would have been more extensive had he lived to complete his project of writing on all the liberal arts. We have only two encyclopedic texts from Boethius, his compendia of arithmetical and musical doctrine. The success and popularity of these works (and of the geometrical compendium attributed to him) may explain the relative neglect of these arts in subsequent encyclopedias.

Turning to the specialized texts on the liberal arts, we find that these were often adaptations of Pagan Greek and Latin texts. The most frequently used textbooks of grammar were Donatus' Ars Grammatica Minor and Priscian's Instituto De Arte Grammatica, and the commentaries and adaptations which they inspired.[65] After the twelfth century, however, metrical grammars, for example the Doctrinale Puerorum of Alexander de Villedieu, replaced them in popularity.[66]

The Ars Grammatica Minor is a very brief work, an outline of the eight parts of speech. The medieval textbooks based upon Donatus filled in this bare skeleton. The Instituto was an altogether different kind of book, an attempt "to put the study of Latin on the same scientific basis as the study of Greek."[67] This work, which covered syntax as well as basic grammar, survives in hundreds of manuscripts.[68]

Supplementing the grammatical texts were vocabulary lists and books of proverbs and maxims, which served as readers. The young scholar not only learned the Latin language, he was also introduced to Latin and Greek literature.[69] Christian authors were also read, of course. In this way the medieval schools followed the example of the ancients, who also combined the study of language with the study of literature.

It must not be supposed that all schools attached the same importance to literary studies or to grammatical theory. There is reason to believe that the emphasis varied from school to school. Huntsman[70] points to a divergence between the approaches to grammar taken in the schools of northern and of southern Europe during the eleventh and twelfth centuries. In the south, an extremely practical approach emphasised grammar as preparatory to the writing of correct and persuasive Latin. In the southern schools, grammar tended toward the rhetorical and the literary, often combining grammar with the art of writing letters and briefs (<u>ars dictamini</u>). In the north, a more philosophical approach to grammar predominated, which tended to subordinate the grammatical art to logic. In light of this trend, it is not suprising that the speculative grammars of the thirteenth and fourteenth century were the products of the northern universities.

Rhetoric held its place as a liberal art throughout the middle ages, but it did not remain autonomous. Grammar encroached upon its boundaries from one side, and dialectic from the other. When the technical aspects of persuasion were in the forefront, rhetoric was in danger of being absorbed by dialectic. When considerations of style predominated, rhetoric and grammar tended to mingle.

For the early middle ages, classical rhetoric was summed up in Cicero's De Inventione.[71] The most influential part of the work was the general introduction, in which Cicero distinguishes the parts and kinds of rhetoric. The bulk of the work is devoted to a single part of rhetoric, the discovery of arguments. Cicero dealt mainly with forensic rhetoric in De Inventione, which limited its usefulness in the middle ages. The medieval rhetoricians had little need for a rhetoric aimed at arguing cases in Roman law.

Two other works contained the seeds of later developments. The first is the Rhetorica Ad Herennium,[72] ascribed incorrectly to Cicero. This books contains a much more complete treatment of the art than does De Inventione. The Ad Herennium, or "new rhetoric," served both as a supplement and as a corrective to the Ciceronian text. By the ninth century it was a standard text; by the mid-eleventh century, it was a serious rival to the older work.[73]

The most notable feature of the new approach to rhetoric was its emphasis upon style. Especially popular was the study of figures of speech. Donatus had distinguished grammatical figures from rhetorical figures, but the medieval rhetoricians did not maintain the distinction. In the pursuit of good style, and in the study of the classical poets, rhetoric and grammar merged.

The second seminal work was Boethius' De Topicis Differentiis, a study and comparison of rhetorical and dialectical topics (the "seeds" of arguments). Boethius distinguishes the subject matters of rhetoric and dialectic, noting that the former art deals with questions involving particular circumstances, while the latter deals with general questions. Rhetoric was for Boethius an art subordinated to dialectic, and a technique rather than a science.[74]

To the rhetorical works of antiquity, among which we must number Quintillian's Institutio Oratoria,[75] the medieval writers added encyclopedic commentary[76] and, later, specialized works on the ars dictaminis and the ars praedicandi (the art of preaching). According to Camargo, these works were long on example and short on theory. They were more important for their practical value than as contributions to the art of rhetoric.

Dialectic was the crown of the trivium, in theory if not in practice. The history of this art is rather complicated. Plato's dialectic was synonymous with philosophy. We have seen that philosophy sometimes replaced dialectic in the lists of the liberal arts. Boethius, following Aristotle, distinguished dialectical from demonstrative reasoning, separating both from philosophy. But in the early middle ages, dialectic generally was held to embrace the whole of formal and material logic, not exclusive of probable and even of rhetorical argument. Alcuin's division of dialectic illustrates this conception of the art.[77]

Alcuin's division of dialectic is based on a list of the standard texts, each of which represents one branch of the subject: the Isagoge of Porphyry is an introduction to Aristotle's Categories. Cicero's

FIGURE I.2: Alcuin's Division of Dialectic

$$\text{Dialectica dividitur} \begin{cases} \text{In Isagogas} \\ \text{In Categorias} \\ \text{Topica} \\ \text{In Perihermeneias} \\ \text{In Diffinitiones} \end{cases}$$

Topics is a work on rhetoric, Aristotle's Peri Hermeneias (or De Interpretatione) deals with the parts of speech and the formation of propositions. De Definitione is a treatise which was incorrectly attributed to Boethius. No mention is made of a treatment of the demonstrative syllogism; Aristotle's two Analytics were not yet available.

Dialectic gained a new importance in the eleventh and twelfth centuries. The reality of universals was the hottest question of the day.[78] The debate demanded great dialectical skill, and such skills were in turn developed by it. Abelard's famous Sic et Non, a radical and seemingly disrespectful juxtaposition of contrary theses from the writings of the Fathers and other venerable writers, brought about a revolution in theological method.[79] Finally, the discovery of the New Logic, which included the Prior and Posterior Analytics, the Topics (on probable syllogisms) and Sophistical Refutations, helped transform the study and teaching of logic.

One effect of the discovery of the logica nova was a return to the Boethian and Aristotelian separation of dialectic and the logic of demonstration. In demonstrative logic, two major developments should be mentioned. The first was the production of several noteworthy commentaries on the Analytics. These commentaries reveal the intense interest of the schoolmen in problems of epistemology, as well as in the technical issues of logic. The second development was the so-called logica moderna, or terminist logic. Although terminism has been traced back to the second half of the twelfth century,[80] this approach to logic began to flourish in the early thirteenth century, and it attained its greatest achievements in the fourteenth.

The most influential of the textbooks in terminist logic was the Summulae Logicales of Peter of Spain (Pope John XXI). A brief examination of this work explains the name, "terminism," since the emphasis upon the properties of terms is readily seen. The work is divided into twelve treatises. The first few treatises take up customary subjects: propositions, predicables, predicaments, syllogisms and topics. In the later treatises, new logical notions having to do with the functions of terms in propositions are introduced. These notions were essential to the logical theories of the thirteenth and fourteenth centuries: suppositions, ampliations, restrictions, distributions, and so on. This book represents a considerable development of the art of logic. Peter of Spain and his fellow terminists were preparing the ground for the sophisticated logical discussions of the fourteenth century, in which Jean Buridan took a leading part.

Terminism was for the most part a development of the logic of demonstration, but the terminists did not neglect the other part of logic, dialectic. This art also flourished in the twelfth and thirteenth centuries. Boethius' De Topicis Differentiis, on which many commentaries were written, was the standard text.[81] Aristotle's Topics was also influential. Eleonore Stump[82] notes a decided shift in this period from the Boethian understanding of the topics as means for the discovery of arguments to the understanding of them as means for completing or validating arguments. Peter of Spain regards the Boethian topics as premises to be used to complete enthymemes (incomplete syllogisms). For Boethius, the topics were a guide to the discovery of middle terms.

Dialectic completes the trivium, the arts of speech. The quadrivium comprises the mathematical, or "disciplinary" arts. Although numbered among the liberal arts, these were generally thought to have a scientific character. Unfortunately, the development of the quadrivial arts was arrested in late antiquity, toward the end of the Hellenistic era. It would be incorrect to say that men lost interest in mathematics in the "dark ages" which followed, but the level of mathematical knowledge was very low. This is indicated not only by the scarcity of original work but also by the character of the selections of mathematical doctrine included in the encyclopedias. These generally included no more than a few definitions and axioms, classifications of figures and numbers, and the enunciations of a few propositions. Only gradually did the quadrivium begin to regain some of its ancient glory.

The first mathematical art is arithmetic. Arithmetic had two aspects, as in ancient times: number mysticism and the techniques of computation. The former part, which was said to be of Pythagorean origin, was very popular. Certain Fathers of the Church delighted in the explanation of the mystical significance of numbers used in Holy Scripture. "The understanding of numbers," wrote Isidore, "is not to be scorned, for they should consider that in many places in Holy Scripture number illuminates the mystery."[83]

Each of the digits had a special significance, as did many other numbers. This doctrine did not find its way into textbooks; no doubt it was considered unsuitable for beginners. The _scientia numerorum_ also included more properly mathematical classifications of numbers, and these form a major part of the arithmetical doctrine contained in the encyclopedias and pedagogical handbooks. This aspect of arithmetic was derived in large part from the _Introduction to Arithmetic_ of Nichomachus,[84] which was the major source for Boethius' treatise _De Arithmetica_.[85] Isidore presents a brief summary of the Boethian text and Cassiodorus a briefer one still.

The classification of numbers reveals an interest in number for its own sake rather than for its practical value. Academic interest in mathematics remained theoretical in the middle ages, but practical mathematics was valued by merchants and astronomers for its usefulness. As long as Roman numerals were used, calculation was difficult and tedious. The _computus_ treatises of the ninth and tenth century (which belong more properly to astronomy than to arithmetic) indicate a certain facility with arithmetic as a practical art. From the tenth century onward, further progress in practical arithmetic may be noted.

Gerbert, who taught the quadrivium at Rheims from A.D. 972 to 982, was a great promoter of practical arithmetic, and a Regula De Abaco Computi is attributed to him.[86] The "algoristic" school introduced the Arabic numerals and the use of zero as a placeholder, and they developed a rudimentary algebra.

The first important text of Hindu-Arabic mathematics to be used in the university, according to Michael Masi,[87] was the Algorismas Vulgaris of Sacrobosco (ca.1240), which united classical number theory with the algorithms of the Arabs. Eventually, specialized treatises of theoretical mathematics appeared, but these do not seem to have had an influence upon mathematical education. One of the most remarkable of these, Jordanus' De Numeris Datis, is essentially algebraic in method. Interesting in their own right, these books of theoretical mathematics were for the most part ignored by medieval educators.[88]

The status of geometrical knowledge was no better than that of arithmetical in the early middle ages. We have already seen that Martianus understood geometry as primarily concerned with geographical lore. We find the same conception of this art in the writings of Cassiodorus and Isidore. Boethius is known to have translated Euclid's Elements,[89] but nothing is known of its fate. Various "Boethian geometries" circulated from the tenth century onward; these were mere summaries of definitions and propositions drawn from the Elements, sometimes with examples. The character of these compendia may be judged by consulting the Euclidae Megarensis Geometriae Libri Duo included in the Patrologia Latina under Boethius' name.[90] In this work simple figures and their properties are described and illustrated. After listing the five postulates and common notions of Book I, the author gives the enunciations of the propositions of Books I and II (giving proofs of the first three propositions of Book I only), and the enunciations of some of the proofs of Books III and IV. Then he adds a chapter on calculation with the abacus! Book II illustrates the computation of the areas of various figures. The scraps of ancient geometry available in the tenth century were meager indeed.

No sign of progress in geometry can be seen before the Elements were recovered in the twelfth century. The discovery of Euclid had a small but real effect on geometrical education. Geometry certainly occupied a minor place in the university curriculum, compared to logic or the study of the books of Aristotle, but some study of this art was required at Oxford, at least.[91] The recovery of the works of Euclid and of other Greek geometers did stimulate the production of original treatises in the later middle ages, but as in the other quadrivial subjects, these advanced original works were not part of the normal course of instruction.

We have already noted that astronomy outranked the rest of the quadrivium in interest during the early middle ages. Although relatively little was available in the way of solid astronomical doctrine, interest in this subject could hardly have been greater. Cassiodorus, Isidore and other encyclopedic writers were the primary sources of the students' knowledge of the nature of astronomy and of some of its contents. From these books the student learned the definition of the science, the names of the great circles and reference points in the heavens, and the names of constellations and stars. More specialized information was available in this period in books on the computus, such as Bede's De Tempore Ratione (which is practical in character), Alcuin's De Cursu et Saltu Lunae et Bissexto (which also contains astronomical problems) and the Liber de Computo of Rabanus Maurus.[92]

Interest in astronomy persisted in the eleventh and twelfth centuries and knowledge increased. Books on astronomical instruments indicate that a certain amount of technical instruction was available in the eleventh century. Aratus' Phaenomena, Manilius' Astronomicon and other works of the late Roman Empire were used in this era. The greatest breakthrough, of course, was the appearance in Latin of the Almagest, first translated in 1116 by Plato of Tivoli from the Arabic. Books on the "theory of the planets"[93] helped make the astronomy of the Almagest (with certain improvements) available to advanced students. Since these difficult books were not suitable for elementary instruction in the art, summaries of the fundamental astronomical principles and conclusions appeared, of which the most popular was Sacrobosco's De Sphaera.[94] The philosophical side of the science was taught from the De Caelo in the thirteenth and fourteenth centuries. Some interesting commentaries on this work exist, including one by Buridan.

In the fourth quadrivial art, music, there was no great text of ancient times to be recovered. The history of medieval musical instruction, which in academic circles was purely theoretical, was one of a gradual, and perhaps largely unconscious, departure from ancient musical doctrine and practice.[95] For a long time, Boethius' De Re Musica served as the standard text; this work summarized Greek musical theory and contained matters of musical controversy as well. Eventually it was summarized and excerpted to form more simplified texts suitable for instruction.

Beginning in the tenth century, medieval musical theory wandered away from its Greek ancestor and a new and quite original approach to music developed. Given the changes in sung and performed music, it would be very surprising if musical theory did not change too. New ideas in musical theory found their way into the textbooks. One of the most important of these was the Ars Novae Musicae of John De Muris, professor of the Sorbonne.[96] This fourteenth century work on musical theory became a standard text for the study of music, and it was not without influence upon musical composition in the later middle ages.

The seven liberal arts were not merely a list written down in the books of academics. They did indeed serve as elements of a curriculum in the middle ages, even as late as the fourteenth and fifteenth centuries.[97] Each one had its place in elementary training, but all of the arts had some place in higher instruction as well and were even the subjects of advanced and specialized treatises. This is true even of grammar, as the appearance of such works as Thomas Erfurt's

Grammatica Speculativa testifies. These arts were not the end of education, however; they were preparations for philosophy. Accordingly, we must consider the most important elements of the medieval divisions of philosophy. These are to be found in the works of Aristotle and of his transmitter, Boethius.

[1] Recent works of importance on the seven liberal arts include The Seven Liberal Arts in the Middle Ages, ed. David L. Wagner (Bloomington, Ind., 1983); Artes libéraux et philosophie au moyen âge, Acts du quatrieme congrès de Philosophie Médiévale (Montreal, 1969); Artes Liberales von der antiken Bildung zur Wissenschaft des Mittelalters ed. J. Koch (Leiden, 1959). Older accounts include Paul Abelson, The Seven Liberal Arts: A Study in Medieval Culture (1906; rpt. 1965) and H. Parker, "The Seven Liberal Arts," English Historical Review 5 (1890), 417-461.

[2] For a picture of education in the Homeric era, see H. I. Marrou, A History of Education in Antiquity, trans. George Lamb (London, 1956), pp. 3-13; Thomas Davidson, Aristotle and Ancient Educational Ideals (New York, 1907), pp. 15-25; Frederick Beck, Greek Education 450-350 B.C. (London, 1964), pp. 55-66. Marrou writes (p. 13): "This is the secret of Homer's education: the heroic example--paradeigma." Though to call this education liberal may be anachronistic, the idea--the education of a free man--is essentially the same as the classical idea, despite the differences about the nature of this education.

[3] Beck (Greek Education, p. 48) points to evidence in Homer for a large body of specialized knowledge in carpentry, metallurgy and agriculture.

[4] The Iliad contains many examples: V, 48ff (trans. S. Butler): "Menelaus . . . killed Scamandrius the son of Strophius, a mighty huntsman and keen lover of the chase. Diana herself had taught him how to kill every kind of wild creature that is bred in mountain forests." V, 59ff: "Meriones then killed Phereclus the son of Tecton . . . a man whose hand was skilled in all manner of cunning workmanship, for Pallas Minerva had dearly loved him." See also XI, 832 and XXIII, 307.

To these should be compared Aristotle's lucid comments on the originators of the sciences in Metaphysics, I, 1, 891b13-24.

[5] See Iliad, IV, 219ff. Chiron was Asclepius' foster father, and Machaon was Asclepius' son.

[6] This is the ideal Phoenix holds up to Achilles, Iliad, IX, 442. Cf. Marrou A History of Education, p. 8.

[7] Beck, Greek Education, p. 60: "The development of character was the chief objective of Epic Education." Beck lists some of the virtues making up the admired character: "sense of honor, high courage, intelligence, friendship, hospitality, leadership, patriotism, modesty and courtesy, with fidelity, domesticity and beauty the chief virtues of women."

[8] The Laws, trans. T. J. Saunders (Harmondsworth, England, 1970), par. 643, p. 73.

[9] Davidson, Aristotle, p. 17. According to Marrou (History of Education, p. 31), when schools first appeared they were held in contempt by the aristocracy because instructors were paid and because they were thought to give technical instruction, not education.

[10] A true classification, it seems to me, is not merely a list of items; it is a rational ordering of parts into a whole, and so it must be based upon principles. The nature of these principles depends upon the nature of the things being classified. To classify subjects of instruction, one must have a philosophy of education and hence of man as a knower and learner. To classify theoretical sciences, one must understand nature. A classification of technical arts calls for an understanding both of nature and of man, the artificer.

[11] Marrou, History of Education, p. 43. Cf. Beck, Greek Education, p. 127: "There can be little doubt that the lyre school has a longer history than the letter school." Literary education was at one time obtained from the same source as musical training. Davidson (Aristotle, p. 73) emphasizes the importance of musical education: "In treating of Athenian, and indeed of all Greek education, it is of the utmost importance to realize that the intellectual and moral part of it has music and poetry for its starting point. This is the core round which everything else gathers; this is what determines its character, influence, and ideal."

[12] Homer was widely regarded as the father of all the arts and sciences. To study was to study Homer. The following text from Xenophon (Symposium, IV, 6) is revealing. Nicerates, an authority on Homer, says, "You all know, or I am much mistaken, there is nothing that relates to human life but Homer has spoken it. Whoever then would learn Economy, Eloquence, Arms, whoever would be master of every qualification that is to be found in Achilles, Ajax, Ulysses or Nestor, let him but apply himself to me and he shall become perfect in them, for I am entirely master of all that." (Trans. J. Welwood.)

[13] Davidson, Aristotle, pp. 76-77.

[14] Concerning this development many details may be read in Marrou, History of Education, Chs. IX-XI.

[15] History of Education, Ch. V.

[16] Marrou, History of Education, p. 80.

[17] When the early Christian writers adopted the pagan classifications of the arts and sciences, the study of Sacred Scripture became the ultimate science. All the arts and even philosophy were for the sake of divine learning. See below, p. 106.

[18] John Burnet, Aristotle on Education: Extracts from the Politics and Ethics (Cambridge, 1973), p. 136.

[19] In Politics, VIII, 2, 1337b4ff. Aristotle says that children should be taught only those useful skills which are really necessary. Any occupation which makes a free man less apt for virtue is vulgar and illiberal. Even some liberal arts ought not be pursued too strenuously.

[20] Republic, II, 376e. Marrou, History of Education, pp. 76-7, presents this sketch of the ideal education according to Plato. Book VII of the Laws should also be consulted.

[21] See Republic, VII, 525c. E. W. Strong has some interesting things to say in Procedures and Metaphysics (Berkeley, 1936) about Plato's conception of mathematics. For Plato, mathematics was an intermediate study, the entryway to philosophy. "From the pedagogue's point of view, the theoretical character of mathematical studies, upon which Plato insists, removes the student from mere sense-knowledge and prepares him for dialectic" (p. 17).

[22] Politics, VIII, 3, 1338a9-11. The English is quoted from W. D. Ross' translation, included in The Basic Works of Aristotle, [hereafter cited as BW], ed. Richard McKeon (New York, 1941). Cf. Politics VII, 1337b21f.

[23] Abelson comments, Seven Liberal Arts: "There is no evidence to support the theory that he [Aristotle] placed grammar, rhetoric, dialectic, arithmetic, geometry and astronomy in the preparatory curriculum of Greek education as has been asserted." Abelson is referring to Davidson, Aristotle and Ancient Educational Ideals, pp. 198-99.

[24] According to Abelson, Seven Liberal Arts, p. 3, "scientific studies," whether mathematical or biological, were never a part of the education of the young Greek before he reached the "ephebean" age. The ephebia was a system of compulsory military training for citizens of Athens between the ages of 18 and 20. Higher education took place at the same time as the ephebia. (Marrou, History of Education, p. 37; 103.)

[25] Such higher studies included not only mathematics, the natural sciences and metaphysics, but also ethics and politics. It is clear that Aristotle regarded politics as a "master art" which is served by such lesser arts as rhetoric (Nic. Eth., I, 1-2.) He goes on to say (1095a1f.) that a young man is not a proper hearer of lectures on political science.

[26] Strong, Procedures, p. 20, cautions, however, concerning Aristotle: "His rejection of metaphysical mathematics is a rejection of theories of existence involving forms and numbers as separately real. It is not a rejection of mathematics or the use of mathematics."

[27] Marrou, History of Education, p. 95.

28 The notion of paideia--which Marrou renders as "culture" but which is often translated by "education"--is fundamental to later Greek thought. "Paideia," says Marrou (History of Education, p. 98) "is here no longer the technique by which the child--pais--is equipped and made ready early in life for the job of becoming a man. . . . The same word, in Hellenistic Greek, is made to denote the results of this educational effort, pursued beyond the years of schooling and lasting throughout the whole of life, to realize ever more perfectly the human ideal." He goes so far as to call Hellenistic Greece the civilization of the "paideia." For a discussion of the history and meaning of the term "enkyklios paideia," see Friedmar Kuehnert, Allgemeinbildung und Fachbildung in Der Antike (Berlin, 1961), pp. 7-50. Werner Jaeger's famous study, Paideia, the Ideals of Greek Culture (New York, 1945), should also be consulted.

29 History of Education, p. 177.

30 This struggle is outlined by Marrou in History of Education See especially pp. 210-12.

31 This claim was made in the lost dialogue Sophists. Our source is Diogenes Laertius, Lives of the Philosophers, 8, 57; 9, 25. In fact, Aristotle seems to have regarded himself as the discoverer of dialectic, at least if it is considered as an art. See Sophistical Refutations, 34, 183b16ff.

32 Protag., 318e.

33 Archyt. Frag. 1.

34 Davidson claims (Aristotle, p. 240) that Pythagoras divided "musical education" into three parts: letters; arithmetic, geometry, astronomy and music (in the narrow sense); philosophy (the "highest music"). Unfortunately, no source is given for this division.

35 Abelson, Seven Liberal Arts, p. 3. Teles (fl.ca.235 B.C.) gives this list of the intellectual disciplines pursued by youths. (Stobaeus xcviii, 72.)

36 On this development, see Marrou, History of Education, pp. 182ff.

37 Marrou, History of Education, p. 177; p. 407, n. 5. Marrou cites Marx's Prolegomena to his edition of Celsus, in Corpus Medicorum Latinorum, I (Leipzig, 1915), p. x.

38 Despite the scarcity of evidence, it is safe to say that even in the first century B.C. the list of the seven liberal arts had not been established once and for all. Kuehnert summarizes a great number of lists of liberal arts, from Xenocrates (4th century B.C.) to St. Augustine, in a flyleaf attached to the work cited above in n. 28. Kuehnert's table reveals considerable diversity in the lists prepared by Latin authors writing before 400 A.D. The lack of uniformity, it

should be noted, was only in the particular selections made from a "master list" of arts, which may conveniently be excerpted from Kuehnert's table: grammar or poetics; dialectic or philosophy; rhetoric; music; arithmetic; geometry; astronomy; medicine; gymnastics; painting or drawing; jurisprudence; architecture; history. The latter two occur only once in the table, and the previous three only twice. What we might call the restricted master list includes the seven liberal arts and medicine.

39 The native Roman conception of the arts worthy of a free man's study was quite unlike the Greek in its emphasis on the practical. The Romans valued above all those arts which made possible the life and prosperity of a great empire. The manuals on agriculture, rhetoric and medicine which the elder Cato (234-149 B.C.) wrote for his son's study typify the old Roman approach. (See Oxford Classical Dictionary, p. 215.) The encyclopedia of liberal arts attributed to Celsus (14 B.C.-37 A.D.) reveals similar interests almost two centuries later. Besides the extant books on medicine, this compilation treated agriculture, military science, rhetoric and (probably) philosophy and jurisprudence. (See Friedrich Marx, Corpus Med. Lat., I, vi.)

Greek ideas and Greek customs were widely admired and imitated by the Romans. The effect of this tendency to borrow from the older and more intellectual culture can be seen in the writings of the Stoic philosopher Seneca (ca.1-65 A.D.). The liberal studies, according to Seneca, are grammar and its companion arts, history and poetry; music; mathematics (arithmetic and geometry); and astronomy. The other arts are explicitly excluded: sculpture, wrestling, perfumery, cookery, and others of this sort.

40 De Ordine II 35ff. In De Quantitate Animae, 33, 72 he lists: poetics, dialectic, rhetoric, music, arithmetic, geometry, and astronomy. In Confessions, IV, 30 we find rhetoric, music, arithmetic, geometry; and in De Ordine, II, 14, music, arithmetic, geometry, astronomy. In one text he adds philosophy, listing also grammar, dialectic, rhetoric, music and geometry (Retractiones, I, 5-6).

41 A recent English translation of De Nuptiis is available: Martianus Capella and the Seven Liberal Arts (1971), Vol. 2, trans. William Stahl and Richard Johnson. In Vol. 1, pp. 72-79, Stahl discusses the MSS and editions of De Nuptiis.

42 Abelson, Seven Liberal Arts, 6, writes of Capella: "judging from the very little that is known of his life, [he] could hardly have been the formulator of a curriculum; hence his work which describes the content of the seven liberal arts . . . would seem to have represented the accepted standards of his time." The evident unoriginality of the poem gives support to this claim.

43 See Stahl, Martianus Capella, I, 21; I, 23. De Nuptiis has been accused of being dull, dry, tasteless, but also of being bizarre and extravagant. Stahl writes of Martianus (p. 55): "As a stylist he is outlandish. If 'barbaric' is too harsh a word to describe his

style, 'difficult' is too mild. . . . To compensate for the inadequacies in his ability to describe and comprehend, he resorts to grandiloquence, abstraction, and obscurity." That one book could be deficient in such diverse ways is astonishing.

44 Stahl, Martianus Capella, I. The influence of De Nuptiis is traced at length on pp. 55-71.

45 Stahl, Martainus Capella, I, 22: "it had the salient advantage of offering a well proportioned and comprehensive treatment of all the liberal arts in the compass of one comfortable-sized book. The De Nuptiis was the foundation of the medieval trivium and quadrivium."

46 Some have assumed that De Nuptiis was written as a textbook, but others deny it. Claudio Leonardi described it as the product of a decadent culture, an act of self-justification and defense: " a defense by the parading of all one's 'property,' one's accumulation of learning." (Quoted by Johnson in Martianus Capella, I, 97. Johnson supports this position, showing how it explains various peculiarities in the book.

47 Stahl, Martianus Capella, I, 32-33.

48 Of Martianus' presentation of astronomy Stahl writes, "It is in several respects unique in Latin literature; in its orderly arrangement of topics, sense of proportion and generally professional style of presentation, it is a gem in comparison with other Latin cosmographical treatises."

49 See the chapter entitled "Sources" in Martianus Capella, Vol. 1, and also Johnson's discussion of the sources of the books on the trivium in the same volume (pp.98ff). On p. 43 Stahl writes, "It is usually a moot question, in any case, whether we are confronted with a direct or indirect use of Varro as a source."

50 See below, section I, B.3, for an overview of instruction in the liberal arts in the middle ages. This content changed very little in the period from late antiquity to the "Aristotelian renaissance."

51 Stahl, Martianus Capella, I, 143.

52 Stahl, Martainus Capella, I, 134ff. "Pliny's four books of geography, together with excerpts from other books, which had been reduced by Solinus to a treatise of less than one hundred pages, were condensed by Martianus into an excursus one fourth as long as Solinus' book. . . . When Martianus further distills Solinus the result is ludicrous."

53 Adam of Bremen's Gesta Hammenburgensis Ecclesiae Pontificum. Wright's work, originally published by the American Geographical Society, has been reprinted by Dover Publications in 1965. This

detailed and thorough book is a delightful source for anyone interested in geographical lore.

54 Wright, Geographical Lore, p. 128. This author points out that geography was not always considered a part of geometry. Gundissalinus included it as a part of astrology. That it belonged to the quadrivium was universally agreed. The iconography of Geometry, both verbal and visual, frequently depicts her as carrying a measuring rod or compass and the globe of the earth.

55 It is probable that Martianus was a pagan. See Stahl, Martianus Capella, I, 85-90.

56 De Arithmetica, I, 1, Patrologiae Cursus Completus, Series Latina [referred to hereafter as PL], ed. J. P. Migne (Paris, 1844-64), 63, 1079: "Inter omnes priscae auctoritatis viros qui, Pythagora duce, puriore mentis ratione viguerunt, constare manifestum est haud quemquam in philosophiae disciplinis ad talem cumulum perfectionis evadere, nisi cui talis prudentiae nobilitas quodam quasi quadrivio vestigatur, quod recte solertiam intuentis non latebit."

57 De Arithmetica, I, 1, cols. 1081-82: "Hoc igitur illud quadrivium est, quo iis viandum est, quibus excellentior animus a nobiscum procreatis sensibus, ad intelligentiae certiore perducitur. Sunt enimquidam gradus certaeque progressionum dimensiones, quibus ascendi progredique possit, ut animi illum oculum, qui (ut ait Plato) multis oculis corporalibus salvari constituique sit dignior, quod eo solo lumine vestigare vel inspici veritas queat."

58 Abelson, Seven Liberal Arts, p. 9, n. 2, implies that Isidore used those names, but the references he gives yield only the use of "artes liberales" and "disciplines," Etymol., I, 2; III, 1.

59 Kuehnert, Allgemeinbildung, p. 4, writes: "Die vier mathematischen Disziplinen werden erstmalig von Boethius als quadruvium, die drei ersten faecher seit den neunten Jahrhundert als trivium zusammengefassed."

Pio Rajna shows, in "Le denominazioni Trivium e Quadrivium," Studi med., nuova serie 1 (1928), 4-36, that this terminology began to be used towards the beginning of the ninth century. He rejects the notion that these names were brought to France from England. See especially pp. 35-36.

60 De Artibus ac Disciplinis Liberalium Litterarum, Preface, PL 70, col. 1149: "Sciendum est plane quoniam frequenter quidquid continuum atque perpetuum scriptura sancta vult intelligi, sub isto numero comprehendit; sicut dicit David: septies in diem laude dixi tibi (Psal. xcviii, 164); cum tamen alibi profiteatur: Benedicam Dominum in omni tempore, semper laus eius in ore meo (Psal. xxxiii,2)."

61 Grammatica, PL, 101, 853. Seven is also the number of the gifts of the Holy Spirit, as Alcuin points out. After quoting Solomon he adds: "tamen sapientia liberalium litterarum septem columnis confirmatur; nec aliter ad perfectam quemlibet deducit scientiam, nisi his septem columnis vel etiam gradibus exaltetur."

62 See the books cited above, p. 52, n. 1.

63 Abelson, Seven Liberal Arts, pp. 35-36, n. 1, presents a table summarizing the number of pages devoted to each art in the most popular encyclopedias, which include works by Martianus, Cassiodorus, Boethius, Isidore, Alcuin and Rhabanus.

61 Grammatica, PL, 101, 853. Seven is also the number of the gifts of the Holy Spirit, as Alcuin points out. After quoting Solomon he adds: "tamen sapientia liberalium litterarum septem columnis confirmatur; nec aliter ad perfectam quemlibet deducit scientiam, nisi his septem columnis vel etiam gradibus exaltetur."

64 Alcuin's treatment of astronomy cannot be called compendious, however. His De Cursu et Saltu Lunae ac Bissexto has a more particular nature.

65 Jeffrey Huntsman, "Grammar," in The Seven Liberal Arts in the Middle Ages, p. 71.

66 Huntsman, pp. 78-9, "Grammar." This versified grammar took into account changes in the Latin language since classical times and included an improved treatment of prosody and figures of speech. Alexander's work is discussed in E. K. Rand, "The Study of the Classics in the Thirteenth Century," Speculum V (1929), 253-4.

67 Abelson, Seven Liberal Arts, p. 39. Priscian states this aim in his dedicatory letter.

68 Huntsman, "Grammar," p. 73.

69 H. Rashdall, The Universities of Europe in the Middle Ages (Oxford, 1936), I, 36: "Under grammar had long been included, not merely the technical rules of grammar as formulated by Priscian and Donatus, but all that we should include in the studies known as classical or philological."

C. H. Haskins writes in The Renaissance of the Twelfth Century (Cleveland, 1955), p. 135: "At its best the study of grammar in the twelfth century carried with it the study of literature, as it is described by John of Salisbury." Rand argues at length in the article cited above that the study of the classics did not wither in the later middle ages, as some have thought.

70 Huntsman, "Grammar," pp. 76-7.

71 Martin Camargo, "Rhetoric," in The Seven Liberal Arts in the Middle Ages, pp. 98-99.

[72] Camargo, "Rhetoric," pp. 99-100.

[73] Camargo, "Rhetoric," p. 99.

[74] Carmago, "Rhetoric," pp. 105-6.

[75] De Top. Dif., PL, 64, 1205-1206.

[76] Camargo, "Rhetoric," p. 100.

[77] Dialogus de Rhetorica et Virtutibus, PL, 101, 947. Alcuin describes the parts of dialectic as follows: "Isagogae sunt introductiones; et sunt earum species quinque. Categoriae sunt praedicamenta, quae in decem verbis constant. Topica sunt sedes et fontes argumentorum, et sunt numero sedecim. Periermeniae sunt interpretationes specierum orationis. Diffinitiones sunt circumpositiones sensuum, et sunt quindecim."

[78] This question already had a long history. Rashdall, The Universities of Europe, pp. 40-41, writes: "In a sense the history of scholastic philosophy begins with the revival of Aristotelian dialectic in the Carolingian schools, but its characteristic question about the reality of universals did not come into great prominence till the far-reaching issues of the conflict were brought out by the teachings of the realist Johannes Scotus Erigena in the second half of the ninth century. From this time onward there is a succession of dialecticians by whom the question is more or less distinctly raised. But the hottest battles of the long campaign do not open until we come to that great intellectual revival of the eleventh and twelfth centuries."

[79] Abelard's method is ably summarized and illustrated by A. O. Norton, Readings in the History of Education (New York, 1909), pp. 19-25.

[80] Eleonore Stump, "Dialectic," in The Seven Liberal Arts in the Middle Ages, p. 129.

[81] "Dialectic," p. 132.

[82] "Dialectic," pp. 135-41.

[83] Etymol., III, 4; PL 82, 155: "Ratio numeri contemnenda non est; in multis enim Sanctarum Scripturaum locis quantum mysterium habeant elucet."

[84] In a very revealing passage, Isidore indicates the sources of the arithmetical doctrine of the early middle ages (III, 2, col. 155): "Numeri disciplinam apud Graecos primum Pythagoram autumant conscripsisse, ac deinde a Nichomacho diffusius esse dispositam, quam apud Latinos primos Apuleius, deinde Boethius transtulerunt."

85 The contents of this work are summarized briefly by Michael Masi, in his article, "Arithmetic," in The Seven Liberal Arts in the Middle Ages, pp. 152-155.

86 Masi, "Arithmetic," p. 156.

87 Masi, "Arithmetic," p. 157.

88 Masi, "Arithmetic," p. 161.

89 John Murdoch, "Euclid," in the Dictionary of Scientific Biography, 4 (1970), p. 443.

90 PL, 63, 1307-1555.

91 See James A. Weisheipl, "Curriculum of the Faculty of Arts at Oxford in the Early Fourteenth Century," Med. Stud. 26 (1946), 171.

92 The computus tradition is discussed by A. C. Crombie in Medieval and Early Modern Science (New York, 1959), I, 20-22.

93 Claudia Kren, "Astronomy," in The Seven Liberal Arts in the Middle Ages, p. 238. Campanus of Novara's Theorica planetarum is available in a modern critical edition by F. S. Benjamin and G. J. Toomer (Madison, 1971).

94 Kren, "Astronomy," p. 237.

95 Theodore C. Karp, in The Seven Liberal Arts in the Middle Ages, pp. 174-77, discusses the theoretical approach to music, which was ancient in origin. He includes an interesting section in his article on later medieval musical theory and practice.

96 D. Stevens, New Catholic Dictionary (New York, 1967), VII, 1004.

97 James Weisheipl establishes this point in his article, "The Place of the Liberal Arts in the University Curriculum During the XIVth and XVth Centuries," in Arts libéraux et philosophie au moyen âge, pp. 209-213.

I C: The Boethian-Aristotelian Classification

C 1: Aristotle Without Boethius

If this study of the classification of the sciences were to conclude with the early medieval classifiers, a consideration of Boethius' version of Aristotle's doctrine would suffice. But it is essential for our understanding of Buridan and the other scholastics of the thirteenth and fourteenth centuries that we first understand Aristotle's division of knowledge as thoroughly as possible. We may seem to go beyond what is strictly required for a treatment of the history of the classifications of science in the middle ages, but the discussion of the philosophical aspects of the problem is for the sake of our deeper understanding of that history. We proceed, therefore, to a consideration both historical and philosophical of Aristotle's division of philosophy.

Aristotle's treatment of the division of knowledge was far from simple. He sometimes took an empirical approach, as when in the _Politics_ he considered the customary branches of education. He did not invent the distinction between theoretical and practical science, or between practical and productive. He found them in the tradition. Even his subdivisions of these arts and sciences derived from current educational practice and theory.[1] In his most theoretical and systematic discussions of the problem, Aristotle did not stray from ther realities of Greek education; rather, he ordered its parts into a rational whole.

The peculiar difficulties of the Aristotelian division come from the philosophical underpinnings which support it. Unlike the other two classifications we have considered, Aristotle's rests upon a carefully argued doctrine of knowledge and of being. In fact, his discussion of of the division of philosophy is so closely integrated with his philosophy as a whole that he treats it in many places in his writings. The discussion of the problem extends throughout the *Metaphysics*, where it most properly belongs, and beyond into works as diverse as the *Physics* and the *Politics*. No one text may be pointed out as a complete treatment of the problem. A well-rounded account of his position must take into consideration all these texts.[2] Certain general philosophical considerations based upon these texts will also be required.

C 1a: The Basis of Aristotle's Division in the Knower and the Known

Two levels must be discerned in Aristotle's division of knowledge, the levels of the knower and of the known. The part played by the knower--what we might call the role of the psychology of knowledge--can be discerned by considering what Aristotle considered knowledge to be, in general terms. Thought, Aristotle tells us, is an immanent act of the soul. It is in fact the characteristic act of the rational soul, and speculative knowledge, theoria, is the most perfect kind of thought. Theoria is the contemplation of the true and the evident and the certain, and it is in fact a god-like activity. In another sense, knowledge is a habit--a potential for thought of a certain kind. To say that a man possesses a science or art is to say that he has the habitual ability to produce acts of knowledge belonging to that science or art.[3].

Knowledge can also be looked at as if it were outside man. All knowledge, of course, is someone's knowledge, but it is possible to abstract from the knower and consider only what his knowledge is about. Whenever we say that a man knows an art or a science we are thinking of knowledge in this external way.

The first and most general difference distinguishing the parts of knowlege may best be understood from the first viewpoint, that of the knower. Aristotle teaches in the Metaphysics and in the Nicomachean Ethics that knowledge is of three general kinds, speculative, practical and productive. In the Ethics this division is grounded in a corresponding distinction within man's intellect.[5] Each kind of knowledge is a perfection of the knower, but the perfections have among themselves an hierarchical order. The value of each is determined by its end, which is to be understood as that for the sake of which the knowledge is possessed. Looked at from a different viewpoint, the end is the perfection which the knowledge attains.

Productive knowledge terminates in the making of an external object. It is valued therefore for the things it makes. The thing made need not be a material object, though commonly it is. The art of medicine is productive, because it "makes" health in the patient. All productive arts differ from mere experience, the "knowledge" of a mere empiric, in that they are reducible to general precepts and rules. Even this lowly species of knowledge is, to some extent, knowledge through causes.[6]

The next rung on the ladder of the sciences is practical knowledge. "Practical" in English means "concerned with making or doing." To the Greek it meant "concerned with doing" alone. The difference between practical and the productive science is the difference between activity and making a product. Both may be called human activities, but the former terminates within man, the latter without. Ethics, accordingly, is practical. Aristotle says in fact that practical knowledge (or wisdom) is virtue rather than art.[7]

The superiority of practical knowledge over productive is easy to see. As man is higher and more noble than anything he sees about him, his own perfection is far superior to the perfection he bestows upon matter by transforming it into a useful object. But the perfection of the active man alone is not the greatest perfection attained by practical wisdom. Greater still is the perfection of domestic society and the larger society of the city.[8]

Still greater than the perfection of man as moral agent is the perfection of man as a thinker. Of all knowledge the theoretical is most to be desired. This knowledge alone makes man god-like, for this alone is the mortal imitation of divine activity.[9] Although some texts indicate that the life of man in the city is the highest kind of life, other texts make it abundantly clear that the life of the speculative intellect is higher still.[10] Politics may perfect man merely as man, but in so far as there is some spark of the divine in him, *theoria* represents the higher perfection.

The subdivisions of speculative, practical and productive wisdom can best be understood from the point of view of the thing known, which in the scholastic tradition is usually called the object of the science. Aristotle proposes no subdivisions of productive science, nor does he even attempt to enumerate them, although he does of course give examples now and then. We should not blame him for this. Since the kinds of producible objects are almost beyond counting, even to list these arts exhaustively would be difficult and tedious and to arrange them systematically, probably impossible, although some medieval classifiers tried to do so.

Aristotle's commentators infer from passages in the *Ethics* a three-fold division of practical knowledge corresponding to the three levels of human organization: the individual, the family, and the state. Ethics is the science of human virtues and vices. Economics considers domestic activity and institutions, and Politics is the science of the city.[11] The division of theoretical knowledge is likewise into three parts: first philosophy or theology, natural philosophy, and mathematics. Because of the great interest and importance of this division I shall examine it in considerable detail, looking first at its origin.

C 1b: The Three-fold Division of Speculative Knowledge: Its Origin and Basis in Reality

The three-fold division of speculative knowledge emerges only gradually in the <u>Metaphysics</u>. The immediate context is the search for wisdom. Referring to the <u>Nicomachean Ethics</u> and the distinction drawn there between art, science, and the "other kindred faculties," Aristotle proposes as his starting point the universal assumption that wisdom has to do with the first principles and causes of things.[12]

In the <u>Ethics</u> Aristotle enumerates five kinds of knowledge: art, science, practical wisdom, philosophical wisdom and intuitive reason. Philosophical wisdom is not considered as something other than science and intuitive reason; in fact it is compounded of them. Intuitive reason is the faculty which grasps first principles, and science is the knowledge of conclusions by means of demonstration from first principles, definitions, and premises following from them.[13] The distinctive character of wisdom is left in doubt, however. Is one particular science wisdom, or is it something other than all particular sciences? Is wisdom one or many? These questions are proposed and answered in the <u>Metaphysics</u>.

The following points quickly emerge: (a) Wisdom is to be sought among the theoretical branches of knowledge rather than among the productive. (b) It is of all sciences the one that is most for its own sake; the most universal; the hardest to attain; the most authoritative and instructive. (c) It is also the most honorable and the most divine.[14]

In his search for this divine wisdom Aristotle considers the candidates proposed by his predecessors and contemporaries. For the Presocratics natural philosophy was wisdom and for the Pythagoreans mathematics.[15] Plato and his followers held that wisdom was knowledge of the Forms. In the course of his examination of the "Platonic"[16] doctrine concerning the kinds of speculative knowledge Aristotle presents his own division and the theoretical grounds for it. His division is, on the surface and in its general features, the same as the Platonic, but the theoretical foundation is uniquely Aristotelian. We shall consider "Plato's" division before turning to Aristotle's.

In its origin the tripartition of knowledge corresponded to, and followed from, a tripartition of substance. It is, in fact, in this context that the division of science into theology, mathematics and physics becomes most readily intelligible.[17] According to Aristotle, Plato taught that being is divided into Forms, mathematical objects, and sensible bodies.[18] Although this doctrine is not proposed in any extant Platonic dialogue, the germ of it can be found in the _Timaeus_.

Plato distinguished two "unmixed" realms of being in the _Timaeus_, the realm of the sensible and the realm of the intelligible.[19] The world of sensible creatures is a reflection of the world of intelligible beings (the Forms). Between these two, however, is the world soul, which partakes of both realms: of the indivisible and the divisible, the changing and the unchanging, the same and the different.

Could this text be the basis for Aristotle's statement that Plato posited three kinds of substance, the Forms, mathematicals and sensible bodies? Yes, if the World soul may be identified with the mathematicals. There are three reasons for equating these two. The description of the World Soul invites it. Plato later describes the soul in mathematical terms. Finally, the Neoplatonists explicitly assert their equivalence.

The World Soul partakes of the divisible and the indivisible, the changing and the unchanging, the same and the different. Mathematics embraces all three contraries. The unit is indivisible and so are the prime numbers. Other numbers and geometrical figures are divisible. Or perhaps it should be said that as mathematical forms all these are indivisible, but they exist in or are participated by divisible bodies. Arithmetic and geometry deal with the unchanging; there is no motion in number or figure. But the objects of astronomy are in motion, and perhaps those of music as well. One thinks of changing tones, not to mention vibrating strings. Finally, the same and the different are in the Timaeus (and in the Almagest) the names of the daily and yearly motions of the heavens. In short, the description of the World Soul as that which partakes both of the sensible and the intelligible could easily be a description of mathematics.

If this is not sufficient evidence for the indentification of the World Soul with the mathematicals, Plato's division of the soul into harmonic intervals and his description of its transformation into circles[20] strengthens the case. Finally, the identification of soul and mathematical objects was made by certain disciples of Plato, for example, by Xenocrates and Speusippus.[21] We may conclude that, even if it is not properly Plato's, the three-fold division of being reported by Aristotle was indeed Platonic, that is, a characteristic doctrine of Plato's followers and successors.

The subsequent history of the three-fold division of being can be traced through the writings of Posidonius and thence through the Neoplatonic school. In his commentary on the Timaeus Posidonius makes the correspondence "soul = intermediate = mathematicals" explicit and identifies the tripartition of the dialogue with the tripartition reported by Aristotle.[22] This identification was repeated by writers of the Neoplatonic school, who took it for sound Platonic doctrine.

Iamblichus, a Neoplatonist, took the next step, which was the explicit identification of the tripartition of being with a tripartition of science: Theology corresponding to the intelligibles; mathematics corresponding to the mathematicals; and Physics corresponding to the sensibles.[23] Iamblichus probably did not originate this triple equation of being and knowledge. It is there for anyone to see in Aristotle's account of Plato's division and it was certainly implicit in the Platonic tradition.

The relation of the division of being to the division of the sciences is problematic in Aristotle. Certain texts seem to indicate that he, like the Platonists, held that the division of knowledge is parallel to the division of being into genera and species. Other texts, however, show that he envisioned a more complex and variable relation between knowing and being. Aristotle ultimately did not believe that the three theoretical sciences corresponded to three realms of being.

I shall try to show how Aristotle's statements in the Metaphysics concerning the relation of being to knowledge can be reduced to a coherent whole. But a word concerning the historical importance of this matter is in order first. Medieval interpretations of Aristotle's division of the theoretical sciences varied considerably, especially in the matter of the nature of the subjects of the sciences. When we take into account the tensions in Aristotle's text between the Platonic account, which he sometimes seems to favor, and his own more complicated position, the variety of interpretations of Aristotle's doctrine is not surprising.

It is significant for the history of classification that medieval accounts of Aristotle's division of knowledge show a gradual shift from Neoplatonically inspired realistic interpretations to interpretations that are almost purely logical. "Essentialist" interpretations identified the subject matter of each science as an essence or form having being in its own right. Such interpretations tended to disappear as the Aristotelian texts themselves, as opposed to second-hand accounts, became available.[24] The great medieval commentators were very well aware that Aristotle had presented a more subtle explanation of the relation between knowing and being than a mere one-to-one correspondence. On the other hand, the extremely logicist explanations of the nominalists fail as interpretations of Aristotle because they do not give due weight to the insights into being which Aristotle and Plato shared.

Aristotle, like Plato and his followers, admitted the existence both of sensible substances and of purely intelligible substances.[25] Two of the three sciences have to do with these beings.[26] If theology and physics have as their subjects intelligible and sensible substances, and if mathematics is to be grounded in the same manner, mathematicals must also have some being in their own right--they must be _ousiai_ (substances).

For a time, it seems, Aristotle was doubtful about the status of mathematicals.[27] He always allowed that they exist in some sense, but he rejected the position that they are substances, thereby abandoning the most obvious basis for the Platonic division of knowledge.

Nevertheless, an abundance of evidence shows that Aristotle continued to see the division of knowledge as parallel to some extent to the division of being. Looking at the sciences from the perspective of the Platonic background, Aristotle could write that every special science (every one, that is, except the science of being _qua_ being) takes one part of being and investigates its attributes. This is the case even in mathematics, for he adds that "this is what the mathematical sciences for instance do."[28]

Leaving aside for the moment the science of being qua being, we must discover what Aristotle means when he says that the parts of mathematics investigate parts of being. This statement is either a flashback to the Platonist view of mathematicals as substances or, as I think more likely, Aristotle used "parts of being" analogously. His meaning seems to be that the subjects of the special branches of mathematics are related to the subject of a first and universal science of general mathematical principles as parts to a whole. Similarly, the special philosophical sciences take as their subjects parts of being, properly speaking, while the first philosophy deals with being simply. If Aristotle's intention is to draw this analogy between philosophy and mathematics, he is of course looking at mathematics as a kind of knowledge distinct from philosophy.

This interpretation is borne out a little later, when he writes that there are as many parts of philosophy as there are kinds of substances. "For the philosopher is like the mathematician, as that word is used; for mathematics also has parts."[29] We may infer from this passage that the parts of philosophy exhaust the kinds of substance. Mathematicals, then, are not substances, but they do differ in kind from one another, and to each kind pertains a special branch of mathematics.

A text in the Physics confirms that the knowledge of substances pertains to the parts of philosophy rather than to mathematics. "There are three branches of study," he writes, "one of things which are incapable of motion, the second of things in motion but indestructible, the third of destructible things."[30] The study of the latter two pertains to physics. Of the first Aristotle remarks that the study of it lies outside natural science. In the Metaphysics he argues that the study of these immobile substances pertains to the first philosophy.

The same division of substance is presented in Metaphysics XII.[31] As in the Physics, Aristotle assigns the study of all mobile substances to natural philosophy. Concerning the immobile substances he says (1) some assert that they can exist apart, but (2) they disagree about whether or not they ought to be divided into two categories, Forms and mathematicals. Later on in Book XII the first point is settled by the proof of the separated unmoved movers of the heavenly spheres. To uncover the resolution of the second point we shall turn to Book VI, where Aristotle explicitly raises the question of the nature of mathematical objects.

Three sciences are identified as theoretical in Metaphysics VI: physics, mathematics, and the "first science," or wisdom, for which he is still searching. Aristotle asks how these three sciences are related to the various kinds of substance. He uses two terms and their opposites to describe the objects of these sciences:[32] kineta (moved) and chorista (separate), which are contrasted to akineta and ou chorista. The objects of physics are separate[33] but movable and the objects of first philosophy are separate and immovable. His description of the objects of mathematics is hesitant. Whether or not these are separate in reality, some theorems consider them as such. Shortly after he says that "some parts of mathematics deal with things which are immovable but presumably do not exist separately, but as embodied in matter."[34]

It is Aristotle's consistent position that the objects of mathematics, with the exception of astronomical objects, are immovable.[35] In the passage just quoted, he does not state definitely that mathematical objects cannot exist separately, although he presumes this is the case. Elsewhere he states without hesitation that mathematicals do <u>not</u> exist apart from sensibles. Whatever they are, mathematical objects are not parts of being.

If being is not divided into three genera or parts, the status of the three-fold division of the sciences becomes unclear. It is, as Philip Merlan points out, no longer a true trichotomy, since the division between first philosophy (or theology) and physics is no longer on the same level or according to the same principle as the division between mathematics and the other two.[36] Several responses might be given at this point. One might say that there is no reason to expect an exact equality in the status or nature of the three theoretical sciences, and leave it at that. Or, one might question the assumption that the distinction between physics and theology/first philosophy is based upon a distinction between the kinds of substances dealt with in the two sciences. The dual characterization of the first philosophy as the science of being and the science of the separate immovable substances suggest that the second approach might be fruitful. We must accordingly inquire more closely into the nature of this branch of theoretical science.

C Ic: THE SCIENCE OF BEING *QUA* BEING

Aristotle rarely mentions "theology" in the *Metaphysics*. The science he is pursuing is called "wisdom," "first philosophy," the "science of being *qua* being," or simply "philosophy." All these are names for one kind of knowledge. We must ask ourselves where this science fits in Aristotle's division of knowledge and, particularly, what its relation is to theology.

We have already seen that there is something unusual about the science of being *qua* being. While other, special, sciences take some part of being as their subjects, this science is universal.[37] Aristotle elaborates the distinction between the universal science and the special sciences in *Metaphysics*, XI, 7. Each special science "marks off a certain class of things for itself and busies itself about this as about something existing and real--not however *qua* real." A distinct science, first philosophy, treats all these things *as* real, that is, *qua* beings."[38] What does Aristotle mean by this? He gives us a clue in *Metaphysics*, XIII, 3.

Although the primary concern in XIII, 3 is the nature of mathematical abstraction, Aristotle indicates that other sciences also involve a certain abstraction or separation. "Each question," he says, meaning each question investigated in a special science, "will be best investigated in this way--by setting up by an act of separation what is not separate, as the arithmetician and the geometer do."[39] Seeing that a man is indivisible, the arithmetician treats him as an indivisible thing, not as a man. In a head-count a man is nothing more than a unit. The geometer, similarly, treats man as a solid.

We would be wrong to conclude that the objects of mathematics in no sense exist. The geometers rightly claim that their subjects exist; "for being has two forms--it exists not only in complete reality but also materially."[40] The objects of mathematics, therefore, exist not in their own right but materially in sensible things.

Even the physicist does not consider things as they exist in their own right; he considers things only as mobiles. He does not concern himself with their specific natures. To give a Newtonian parallel, the astronomer accounting for the motion of the moon considers it only as a gravitational mass and not as a body composed of a certain kind of rock, having undergone volcanic activity in the past, lacking an atmosphere, and so on. Such considerations belong to a more specialized science. In short, neither physics nor mathematics nor indeed any special science treats things in their complete and determinate being.

It remains to be seen what kind of knowledge the science of being is, which does treat things in their complete reality. Aristotle presents the following argument in XI, 7: (1) There is a science of being qua being and capable of existing apart; (2) if there is a substance which is separate and unmoved (*choriste kai akinetos*) then the science of this substance is the science of being *qua* being and the universal science; if no such substance exists, physics is first philosophy; (3) unmovable and separable substance does exist, and it is divine. Theology, therefore, is first philosophy.[41]

The first premise asserts the existence of a science of "being *qua* being and capable of existing apart," but initially no commitment is made concerning the exact nature of this subject. There are two possibilities. If separate and immovable substance exists, it is clearly superior and prior in intelligibility to movable physical substances. The science of being *qua* being would then be the science of these substances. But if only physical substances are capable of separate existence, natural philosophy will be the science of "being *qua* being and capable of existing apart." Asserting the existence and divinity of immobile separated substances, Aristotle then affirms that theology is the first and universal science of being.

Aristotle deduces the universality of theology/first philosophy from its priority to physics.[42] The priority of theology evidentally derives from the priority of its subject. Unfortunately, Aristotle does not explain how the universality of theology follows from the priority of its subject. This has been a fruitful source of controversy both ancient and modern. Put slightly differently the problem is this: how can theology and the universal science of being *qua* being be one and the same? Whether or not this position is hopelessly contradictory has been a matter of hot debate.[43] We may at least say this: the dual conception of the subject of first philosophy found in the Metaphysics produced an important disagreement among Aristotle's medieval commentators. The two great Moslem Aristotelians, Avicenna and Averroes, represented the two opposing resolutions of the dilemma.

Almost all the Latin schoolmen followed Avicenna, holding that being, not God, was the subject of the first philosophy, or metaphysics.[44] It was generally granted that metaphysics did treat of God in a certain way, at least by considering him as the cause of all things. But this was not the main business of metaphysics. Averroes' view,[45] that God is the proper subject of metaphysics, was much less popular, although it was very much in harmony with earlier medieval conceptions of the classification of the sciences.

The reader should perhaps be reminded that the "science of being" did not mean to a scholastic philosopher a mere logical consideration of the most general class to which all things may be assigned. Being, we must remember, is the proper name of God ("I am who am.") To call a creature a being is not to name it in the most empty and uninformative way but rather to affirm its likeness to its creator in his primary attribute. Although it is not the same science as theology, metaphysics has a certain affinity to divine learning. Since "being," moreover, may refer not only to existence but to essence or quiddity--the "what it is" of a thing--metaphysics can also be described as the science of quiddities.[47]

Many of the scholastics, including Buridan and St. Thomas,[48] found support for this thesis in Metaphysics, XI, 7. Aristotle says in this chapter that no special science demonstrates the nature of the substance with which it deals, but accepts it either from perception (in the natural sciences) or by hypothesis (in mathematics). If there is a demonstration of such natures, it must be provided by the first philosophy. The natural philosopher often must use descriptive definitions[49] and the mathematician must admit hypotheses and postulates among his first principles. The metaphysician provides only very general quidditative definitions to the special sciences, for example, the definition of motion given in the Physics.[50]

The giving of quidditative definitions to the special sciences is not the only business of metaphysics, nor even its primary one. This science is not to be thought of as the servant of the other sciences, not even as a superior servant. Metaphysics is more like a rich and wise parent who shares with her daughters whatever might be of use to them in their own humble pursuits.

Although the metaphysician does not know all things in their specific natures, he does indeed know them all in a universal way. This is the general consensus among the schoolmen, and this thesis is amply confirmed by Aristotle in the preliminary discussion of the Metaphysics. First philosophy is characterized as the science of first principles, axioms and causes in all genera of being. In fact, the universality of its subject gives rise to a doubt whether metaphysics is one science. This doubt is aired and, I think, adequately solved in the *Metaphysics*.

The criterion for the unity of a science is explained in *Posterior Analytics* I, 7. Every demonstrative science is characterized by three elements, the subject genus; the "axioms," or primary premises of the science; and the attributes, which are shown by demonstration to inhere essentially in the subject genus.[51] The subject genus alone gives the science its unity, since axioms and even essential properties or attributes may be common to various sciences.[52]

Every special science is unified by its subject genus. This is true even of mathematics, which does not have a substance as its subject. The science of being *qua* being presents a special problem, because Aristotle held that being is not a genus.[53] A genus is predicated univocally of all things falling under it ("animal" is predicated of all animals univocally), but being is not predicated in this manner of all beings. If a science is unified by its subject genus and being is not a genus, can there be one science of being as such? Aristotle addresses this problem in the *Metaphysics* and, as Buridan saw it, his solution not only unified the first philosophy, it suggested a consistent mode of interpretation of the classification of the sciences as a whole.

Although "being" is not said univocally of all beings, neither is it said purely equivocally. Aristotle, as is well known, divides being into ten categories. The first category, substance (*ousia*), is primarily and properly being. As predicated of the other nine categories, being has a different, but not unrelated, meaning. Reference is made to the primary kind of being (being a substance) in the definition of this secondary kind of being (being an accident).[54]

As predicated of substances, being implies independent existence. Substances do not derive their existence from anything accidental. As predicated of the other categories, being implies being in a substance. This non-univocal use of "being" is an example of what Aristotle calls pros hen equivocation, that is, eqivocation with reference to one. His standard example is "healthy," which is primarily and properly predicated of the healthy animal and secondarily of other things related to the primary notion in one way or another.[55] Thus exercise is healthy because it promotes health, and medicine because it restores it.

All beings, then, are so named either because they are substances or because they are related to substances in some way. Aristotle concludes that the knowledge of every being in so far as it is a being falls under one science, because "not only in the case of things which have one common notion does the investigation belong to one science, but also in the case of things which are related to one common nature; for even these in one sense have a common notion."[56]

The looser sort of unity which the science of metaphysics possesses makes the broad range of the matters it treats readily acceptable. Since its unity is not even the unity of a genus, it is possible for this science to treat of God as well as of the first principles of created beings.[57] One of the consequences of the terminist approach[58] to the division of the sciences was the loosening, or even the dissolution, of the unity of the sciences, as I shall show later. Aristotle's assertion that the unity of metaphysics was based upon the reference of all its subjects to one common notion provided Buridan with a method of restoring unity to the special sciences as well.

C 1d: Summary and Conclusions

Aristotle may have originally held an opinion similar to the Platonists, that each of the three theoretical sciences corresponds to a kind of substance, but his mature position rejects that notion. Neither mathematics nor even physics, taken universally, has as its subject one kind of substance. Mathematics treats sensible substances as numbered and extended (_ens quantum_). Physics treats sensible substances considered as mobile (_ens mobile_).[59] In a sense, sensible substance might be said to be the subject of both sciences, but only materially. The subjects which formally constitute these sciences are being _qua_ quantified and being _qua_ mobile.

First philosophy is not on the same level of generality as the other two theoretical sciences. Its subject is being _qua_ being, although it treats far more than _ens commune_, being in general. This science is also theology, the knowledge of the immobile and divine separated substances. In fact, this science studies all beings in so far as they can be said to be. Aristotle hints that this involves the knowledge of the quiddity or "what it is" of each thing.

None of the three theoretical sciences, then, is formally specified by the particular kind of substance with which it deals. But physics and mathematics, and all the more specialized sciences falling under them, deal with sensible substances only. Presumably, this is the reason why Aristotle calls all the special sciences parts of Wisdom.[60] Wisdom, which is the first philosophy, stands as a whole to these parts because it deals with all substances, sensible and insensible, mobile and immobile.

When we go down from the level of the three "generic" sciences to the more specific level the principle of the division of sciences by a division of substances begins to play a part. The particular sciences under physics, or at least some of them, take a particular kind of sensible substance as a subject. The science presented in the De Caelo treats the celestial spheres, De Generatione et Corruptione treats the four elements, De Anima and several other books treat living things. Under universal mathematics we find special mathematical sciences (geometry, astronomy and so on), each of which treats a species of quantity.[61] Although these are not kinds of substances, they are divisions of being.

Nothing Aristotle says contradicts the notion of a correspondence of certain specialized sciences to determinate parts of being. But this principle can by no means account for the most general features of his classification. Moreover, it cannot explain the "intermediate" sciences which depend upon both physics and mathematics or the fact that one kind of substance is studied by more than one science. Man, after all, may be treated by chemistry as well as by physiology, by mechanics as well as by ethics.

This interpretation of Aristotle's division is not new. The medieval commentators were well aware that the hierarchy of the sciences involves differing relations between knowledge and reality. Exactly how the two orders are related is one of the major problems in the medieval discussion of the classification of knowledge. No one desired totally to abandon Aristotle's doctrine, but they often disagreed about how to interpret it. Buridan and the other commentators of the thirteenth and fourteenth centuries, almost without exception, intended to explain and perhaps refine the doctrine of classification presented in the *Metaphysics*, which they accepted as substantially correct.

C 2: The Boethian Division of Knowledge

Ancius Manlius Boethius (ca.480-524) was, more than anyone else, the man responsible for the early medieval philosopher's knowledge of Aristotle. Boethius took upon himself the immense and impossible task of reconciling the philosophies of Plato and Aristotle. His ambitious project of translating and commenting upon all the works of the two great philosophers of antiquity was barely begun when he was imprisoned at Pavia in 523 A.D. Boethius was executed the next year by the emperor Theodoric, whose minister he had been.[62] Fortunately for the centuries to come, a few commentaries, some handbooks of liberal arts, the theological tractates and his masterpiece, De Consolatione Philosophiae, survived him.

The classification of sciences found in the works of Boethius has been labelled "Boethian-Aristotelian," and not inappropriately. But Boethius was not merely a reporter; he was an interpreter. As a student of Plato and of the Neoplatonist Porphyry, Boethius explained the three theoretical sciences as an ascending order of knowledge paralleling a hierarchy of being. As a result, the true character of Aristotle's classification was obscured. Boethius' classification might just as appropriately be called Boethian-Neoplatonic.[63] Nevertheless, his First Commentary on Porphyry (ca.509) and De Trinitate (ca.520) served as the best source for Aristotle's classification of the sciences before the Metaphysics was translated in the twelfth century. The classification presented in the Commentary is the more complete, but De Trinitate contains the more accurate representation of Aristotle's division of the sciences.

In the Commentary, which takes the form of a dialogue between the author and his friend Fabius, Boethius distinguishes two genera of philosophy, the speculative and the practical. Practical philosophy, also called active, studies man and his actions as a man. Although Boethius does not name these sciences, they are the ones identified by early Aristotelian tradition as practical: ethics, economics and politics.[64] Boethius emphasizes virtue rather than knowledge in his description of these sciences, and in this he follows Aristotle. Most strikingly, the science of the city is identified with the political virtues, prudence, justice, fortitude and temperance.

Boethius states that there are three theoretical sciences and he describes each one, but he gives names to only two, theology and physiology. The subject of each is summed up by one word; one part of philosophy deals with "intellectibles," one part with "intelligibles," and the third with "naturals." This naming of the subjects of the parts of theoretical philosophy brings to mind the ancient Neoplatonic descriptions of the sciences, but one term, "intellectibles," demands explanation. Boethius was aware that he was introducing a new term, and so he has Fabius request an explanation of each name.

"That is intellectible," Boethius explains, "which, always remaining one and the same by itself in its own divinity, can never be grasped by any act of sensation but only by the intellect."[65] This philosophy consists in "incorporeal considerations" of God and the soul. Its name is Theology.

The second part of philosophy is the science of intelligibles, "which, looking up with the intelligence at the first intelligible [i.e. God], comprehends by those things which are the supernal causes of all heavenly works and of whatever thrives under the moon with a more blessed soul and a purer substance."[66] Boethius did not name this branch of philosophy, which stands in the place of mathematics. The twelfth century Neoplatonists, who adopted Boethius' division, explained the intelligibles as the Ideas or forms of bodily creatures.[67]

Finally there is "physiology," which expounds the natures and properties of bodies.[68] The division of philosophy presented in the Commentary may scarcely be called Aristotelian. The universe it envisages is frankly Neoplatonic. Man, purely intelligible in his causes, has degenerated into material nature. He is as it were a mean between God and matter, and so he is known through a science intermediate between theology and physiology.[69]

Mathematics has no place in this Boethian classification.[70] Since the Isogoge is an introduction to the study of logic, Boethius considers the relation of logic to the branches of philosophy just outlined. He contrasts the Stoic and the Peripatetic doctrines, explaining that the former considers logic a part of philosophy and the latter sees it as an instrument. Although he does not resolve the dispute, Boethius points out the necessary role of logic in all parts of philosophy, and in the arts of grammar and rhetoric as well.[71]

Boethius did not propose to establish a new classification of the sciences in the First Commentary on Porphyry. But it is doubtful whether he intended to present faithfully Aristotle's classification, or anyone else's. As in all his works, Boethius was synthesizing various Greek philosophical notions, not all of which were compatible. The classification presented in the Commentary, which uses Aristotle's theoretical/practical distinction and leans toward the Peripatetic conception of logic, but which is thoroughly Neoplatonic in its treatment of speculative knowledge, may not resemble any particular ancient classification, but it is not incoherent. As we shall see in the next chapter, the classification of the Commentary was influential in the early middle ages, especially among the Platonists of the twelfth century.

In the later middle ages, the account given in De Trinitate was seen as Boethius' major contribution to the division of the sciences. The text in which Boethius presents his division of theoretical knowledge is so important for the scholastic tradition that it is worth quoting in its entirety:

> There are three parts of speculative science; natural science deals with non-abstract separable things in motion (for it considers forms of bodies together with matter, which forms cannot be actually separated from bodies. Because these bodies are in motion, as earth descends and fire ascends, the forms joined to matter are in motion.) Mathematics deals with non-abstract things without motion (for it considers these forms of bodies without reference to matter or, consequently, to motion; but these forms exist in matter, which cannot be separated from them.) Theology considers things which are abstract and separable (for God's substance is without either

> matter or motion.) Therefore in physics we proceed by reason, in mathematics by instruction, but in the divine science it is right to proceed by means of the intellect; nor ought we to be reduced to imaginations in this science. Rather, we view the form itself, which truly is a form and not an image, which is being itself and that from which every being comes to be.[72]

This passage not only proposes the three-fold Aristotelian division of speculative philosophy, it also gives a philosophical account of its basis in reality. It is appropriate to ask ourselves at this point, to what extent is Boethius' account Aristotelian?

That his explanation of the three theoretical sciences was molded in large part by Aristotle's doctrine is clear. Mathematics and physics both deal with bodily forms, but they consider them differently. Physics treats bodily forms in conjunction with matter and motion. Mathematics, on the other hand, treats forms which may not in reality be separated from bodies but which may be considered apart from matter and motion. Theology deals with the divine substance, lacking matter and motion. This doctrine looks to be Aristotelian, but closer examination reveals certain differences between Boethius' explanation of the subjects of these sciences and Aristotle's.

Boethius describes natural philosophy as "<u>in motu inabstracta</u>," mathematics as "<u>sine motu inabstracta</u>," and theology as "<u>sine motu abstracta atque separabilis</u>." Thus physics and mathematics are alike in being "inabstract," but mathematics and theology are alike in treating what is without motion. We found that Aristotle admits the latter affinity, but what of the former? Did Aristotle hold that theology alone deals with _abstracta_? To answer this question, we must first see what Boethius means by abstract and inabstract.

The description of theology is most revealing in this regard. "Abstract" is coordinated with "separable," and the two adjectives are explained in the parenthetical remark which follows: "nam dei substantia et materia et motu caret." This sentence suggests that "abstract" means "that which considers forms existing apart from matter and motion." If this interpretation is correct, Boethius understands abstraction as a mode of existing rather than the act by which the mind grasps universals.

We have seen that Aristotle described the objects of physics as separate and movable (_chorista_ and _kineta_), the objects of mathematics as not separate and immovable (_achorista_ and _akineta_) and the objects of theology as separate and immovable (_chorista_ and _akineta_). But according to the Greek version available to Boethius, physics is said to deal with things which are _achorista_ (literally, not-subsistent or not-separate). This reading makes no sense, of course, and Boethius was forced to interpret the word otherwise. Accordingly, he took it to mean "not separate from matter" and rendered it as "_inabstracta_."

What are the consequences of this change? The notion that both physics and mathematics treat forms existing in bodies is certainly Aristotelian. In a sense, then, Boethius did not depart from Aristotle in his description of the subjects of the three sciences. The terminology was not apt, however. "Abstractio," pcints to a "drawing out," and it came to be used for the apprehension of the universal implicit in the experience of singulars. If read in this sense, Boethius' description of both mathematics and physics as dealing with inabstracta conveys the un-Aristotelian notion that only theology involves abstraction.[73]

A more fundamental objection to Boethius' presentation of Aristotle's doctrine is that Aristotle chose to focus on the subsistence or non-subsistence of the objects of the science as a distinguishing feature, but Boethius' account replaces this criterion with the relation of the subjects of the sciences to matter. As a result, Boethius draws attention to an affinity between mathematics and physics, while Aristotle points rather to a similarity between physics and theology. This is not without consequence for one's conception of the relative dignity of the three sciences. On Aristotle's view physics and theology are superior to mathematics in treating subsistent natures. Boethius' account stresses the superiority of theology and implies that mathematics is superior to physics, since the former treats unchanging objects.

Another serious defect of Boethius' discussion, considered as a presentation of Aristotle's position, is his treatment of theology. There is no hint that theology is the science of being qua being. Boethius describes the mode of procedure in theology as "intellectual." Theology is contemplative. In its pure form, it does not involve reasoning from effect to cause or from cause to effect. It is, rather, a direct intellectual apprehension of pure form, the "true form which is not an image."[74] Aristotle wrote of the possibility of the contemplation of divine things in Metaphysics, XII, 7 as the highest activity of man, the culmination of wisdom. Although this is the ultimate end of the first philosophy, it is not the science as such.

The descriptions of these modes of procedure are important Boethian additions to the tradition. Because he did not explain the words he used to describe the methods of the three sciences, various interpretations were proposed by his commentators. The interpretation which follows is, I think, a plausible one. Mathematics is said to proceed "disciplinaliter" because it begins with certain things being given (definitions, common notions, postulates) and from these it deduces their consequences, instructing the mind by leading it from what is prior and more evident to what is posterior and hidden.[75] Physics proceeds "rationabiliter" because its most obvious characteristic is scientific demonstration from effect to cause and cause to effect. The contrast being drawn here is between physics and theology, because mathematics also proceeds by demonstration.

The short passage from De Trinitate which we have been considering was for a long time the only Latin source from which Aristotelian notions concerning the classification of the sciences could be drawn. It is fair to say that only an incomplete and somewhat misleading conception of Aristotle's doctrine could be formed by a reading of this text. Since Boethius did not mention Aristotle's name in either of his discussions of the parts of knowledge, there is no reason to suppose that he intended to transmit the Philosopher's position in a pure form. This consideration should not cause us to underrate the importance of

Boethius' writings for the subsequent history of the Aristotelian division of philosophy. Having been exposed to certain aspects of Aristotle's doctrine in Boethius' work, the schoolmen were inclined to glance back at *De Trinitate* as they struggled to interpret the account of the sciences in the *Metaphysics*. And St. Thomas took the opportunity of his *Commentary* on Boethius' treatise to present in definitive form his own reading of Aristotle's division.

[1] In one interesting text Aristotle uses the "Stoic" division (Topics, I, 14, 105b19-20; BW, p. 199): "of propositions and problems there are--to comprehend the matter in outline--three divisions: for some are ethical propositions, some are on natural philosophy, while some are logical."

[2] Because of this circumstance Buridan's treatment is also scattered through several works, including his questions on the Physics, Ethics, Politics, Metaphysics, and De Caelo.

[3] Concerning knowledge as a habit, see Cat., 8, 8b26-30. On actual and potential knowledge, see De Anima, III, 4-8.

[4] Meta., VII, 1, 1025b25; see also XI, 7; NE, VI, 2.

[5] Writing of correct moral choice, Aristotle says (NE, VI, 2, 1139a26ff; pp. 1023-24): "Now this kind of intellect and of truth is practical; of the intellect which is contemplative, not practical nor productive, the good and the bad state are truth and falsity respectively . . . while of the part which is practical and intellectual the good is truth in agreement with right desire." The practical faculty is indeed intellectual.

In VI, 4 Aristotle insists on the distinction between making and acting. Art is a matter of making, but acting has to do with virtue.

The distinction of species of thought in the Ethics is actually more complicated than I have indicated. There are said to be five species of knowledge, but three of them fall under the heading "theoretical." More will be said about this later.

[6] Meta., I, 1, 981a24-29. In XI, 7 (1064a1,ff.) the productive sciences are said to seek principles and causes. Gymnastics as well as medicine serve as examples of such "sciences."

[7] NE, VI, 5, 1140b24.

[8] In NE, VI, 8, 1141b23-31 he distinguishes practical wisdom in the restricted sense, which deals with the individual, from household management, legislation and politics. The latter are practical wisdom in a general sense. Legislation and political wisdom are grouped together as the "wisdom concerned with the city." The former is universal, the latter particular. The superiority of the wisdom of the city is asserted in I, 2.

[9] Meta., XII, 7, 1072b14ff.

[10] Aristotle makes the superiority of philosophical wisdom clear even in the Ethics, a work in which the loftiness of politics is much insisted upon. "It would be strange to think that the art of politics, or practical wisdom, is the best knowledge, since man is not the best thing in the world . . . it is plain, then, that philosophical wisdom is scientific knowledge, combined with intuitive reason, of the things that are highest by nature." (1141a20-b4.)

[11] Ludwig Baur, in his discussion of the sources of Dominicus Gundissalinus' De Divisione Philosophiae, BGPTM 4, Nos. 2-3 (1906), 197, attributes the first occurrence of this division of practical science to Eudemus, Aristotle's pupil. It is clearly related to the text cited in n. 8 above.

[12] Meta., I, 1, 981b25-29.

[13] NE, VI, 3-7.

[14] Meta., I, 2, 981b30-82a1; 982a5-b10; b28-a11.

[15] See Meta., I, 5, 987a2-29. Since the earliest philosophers believed that the first principle or principles were corporal, they thought physics was wisdom. The Pythagoreans, on the other hand, held that number was the substance of all things, and so mathematics was wisdom.

[16] We shall call the views which Aristotle attributes to Plato "Platonic," leaving aside any objection which might be made to his presentation of Plato's views. A few words will be said presently about the grounds for calling the division of theoretical science into theology, mathematics and physics "Platonic."

[17] Philip Merlin, From Platonism to Neoplatonism (The Hague, 1953), p. 53, states: "it is obvious that this tripartition of philosophy fits the preserved writings of Aristotle very badly . . . the tripartition of theoretical philosophy into physics, mathematics, and theology makes sense only within the framework of Platonism, while it hardly makes any sense in the non-Platonic phase of Aristotle's philosophy." Taken by itself, this three-fold division certainly is an oversimplification of Aristotle's position, and is somewhat misleading as well. But that non-Platonic interpretations of genuinely Aristotelian inspiration are possible is proven by the work of the scholastic commentators.

[18] Meta., VII, 2, 1028b19-21 (p. 784): "Plato posited two kinds of substance--the Forms and the objects of mathematics--as well as a third kind, viz. the substance of sensible bodies." See also Meta., II, 6, 987b14-16; 28-29.

[19] Plato's Cosmology: The Timaeus of Plato, trans. F. M. Cornford (London, 1937), 35A, pp. 59-60: "The things of which he [the Demiurge] composed soul and the manner of its composition were as follows: (1) Between the indivisible Existence that is ever in the same state and the divisible Existence which becomes in bodies, he compounded a third form of Existence composed of both. (2) Again, in the case of Sameness and in that of Difference, he also on the same principle made a compound intermediate between that kind of them which is indivisible and the kind that is divisible in bodies. (3) Then, taking the three, he blended them all into a kind of unity, forcing the nature of Difference, hard as it was to mingle, into union with sameness, and mixing them together with Existence." In his commentary on this passage, Cornford describes it as "one of the most obscure in

the whole dialogue." Whatever Plato meant in this description of the making of the world soul, his commentators saw in it the three realms of being which are treated by the three theoretical sciences. (See Merlan, _Neoplatonism_, pp. 10ff.)

20 Plato describes the division of the soul into harmonic intervals (35B-36B; Cornford, pp. 66-72) and its transformation into circles (36B-D; Cornford, pp.72-93).

21 Merlan, _Neoplatonism_, pp. 17-18. Xenocrates thought of the soul in arithmetical terms, identifying it with "self-moving number." Speusippus saw the soul as the form of the "all-extended three-dimensional." Moderatus, on the other hand, identified the soul with proportion or harmony. Iamblichus, our source of the above information, disagreed with them all and held that only a combination of all three--arithmetic, geometry and harmonics--provides an adequate account of the soul.

22 Merlan, _Neoplatonism_, p. 35.

23 Merlan, _Neoplatonism_, p. 8. Merlan gives references to the relevant passages in Iamblichus' _De Communi Mathematica Scientia_.

24 John Duns Scotus is an exception of sorts. But his reading of Aristotle is based upon a subtle and difficult conception of essence. Scotus' treatment of the division of the sciences is at once "essentialist" and "logicist"; it bears the character both of his almost Platonic realism and of the _logica moderna_. It is my conviction that Scotus' understanding of the nature of the object of science was pivotal in the later middle ages.

25 For Aristotle these include, at least, the unmoved movers of the heavens.

26 Because the separated movers are conceived as divine, the science having to do with them is called theology. Its other name is "first philosophy." First philosophy (the science of being _qua_ being) differs from the special sciences in its universality, and in other ways as well. All beings fall under it in some way. The peculiar nature of first philosophy will be considered later.

27 Merlan (_Neoplatonism_, p. 54) claims that Aristotle was hesitant to reject the existence of mathematicals in _Meta._, XIII, 1-15. But Aristotle argues that mathematical objects cannot exist either in sensible things or separate from them. He is willing to say that the objects of mathematics exist (4, 1078b7), but they do not exist without qualification (3, 1077b17). That is, they do not exist _qua_ mathematical objects. They exist rather as sensible bodies. Elsewhere (_Meta._, XII, 8, 1073b5-7) he simply says that the mathematical sciences other than astronony do not treat of substances. However we are to interpret Aristotle's position, it is clear that he rejects the existence of mathematicals in the sense in which Plato's followers held them to exist. (The manner in which they existed for Plato himself is problematic.)

[28] Meta., VII, 1, 10031a25; BW, p. 731. Compare De Anima, III, 8, 431b24; BW, p. 595: "knowledge and sensation are divided to correspond with the realities . . ." The Translatio vetus (quoted by Kilwardby in De Ortu Scientiarum, III) reads: "scientia secatur in res."

[29] IV, 2, 1004a2-9; p. 733: "And there are as many parts of philosophy as there are kinds of substance, so that there must necessarily be among them a first philosophy and one which follows this. For being falls immediately into genera; for which reason the sciences too will correspond to these genera. For the philosopher is like the mathematician, as that word is used; for mathematics also has parts, and there is a first and a second science and other successive ones within the sphere of mathematics."

[30] II, 7, 198a29-30; p. 248. Mathematics, as Aristotle conceives it, does not have anything to do with this division of substance.

[31] 1069a30-b3, p. 872: "There are three kinds of substance--one that is sensible (of which one subdivision is eternal and another is perishible . . .), of which we must grasp the elements, whether one or many; and another that is immovable, and this certain thinkers assert to be capable of existing apart, some dividing it into two, others identifying the Forms and the objects of mathematics, and others positing, of these two, only the objects of mathematics. The former two kinds of substance are the subject of physics (for they imply movement); but the third kind belongs to another science, if there is no principle common to it and to the other kinds." Here Aristotle temporarily suspends his judgment about the existence of a science, distinct from physics, which treats of immovable substance. In fact, he accepts such a science, but he does not accept any of the three opinions about its subject which are proposed here.

[32] Merlan, Neoplatonism, p. 56. This description of the objects of the three sciences is in Meta., VI, 1, 1026a11-16. The interpretation of this passage was made difficult by a textual mistake discovered by A. Schwegler (Die Metaphysik des Aristoteles, IV (1848), 14-16). Schwegler's emendation is now generally accepted. Physical beings are described in the text as achorista, but the true reading must be chorista, "subsistent." Interpreters got around the difficulty caused by the faulty text by interpreting choriston as "immaterial" or "abstract," and thus achoriston as material or "inabstract." Merlan, Neoplatonism, p. 57.

[33] This is not the place to discuss the exact meaning of choriston. Merlan takes it to mean "subsistent." Ross translates it as "separable." Moerbeke renders 1026a13 (containing the reading achoriston for choriston) as: "Physica namque circa inseparable forsan quidem sed non immobilia." St. Thomas (In Meta., L. VI, lect. 1) takes this to mean that physics deals with things which cannot be understood apart from matter.

[34] 1026a14-15; *BW*, p. 779.

[35] In addition to the affirmation in the previous paragraph that the objects of mathematics are unmoved, we see Aristotle assuming this elsewhere as a matter of course (*De Caelo*, III, 6, 305a25-26; *De Motu Animalium*, I, 1, 698a25-26). But, if Merlan is correct, Aristotle intends to say in *Meta.*, XI, 7, 1064a30-b3 that mathematicals are *considered* as unmoved (see *Neoplatonism*, pp. 66-67). Even so, we must remember that motion does not enter into mathematical objects *qua* mathematical objects, and thus it is fair to say that they are unmoved, remembering that they "are" only in a qualified sense. In *Meta.*, I, 8, 989b32-33 Aristotle says: "The objects of mathematics, except those of astronomy, are of the class of things without movement." Astronomy is not a purely mathematical science.

[36] Merlan *Neoplatonism*, p. 56. Using scholastic terminology, Merlan points out that the division of Aristotle is based upon two principles, the *ratio essendi* and the *ratio cognoscendi*. He suggests the following interpretation of Aristotle's division as a subdivided dichotomy: "The dichotomy is 'moved-unmoved'; the member 'moved' is subdivided. Physicals are moved and are being considered as moved; mathematicals are moved but are being considered as unmoved." *Phys.*, II, 2 may be cited as evidence for this view.

A different interpretation is possible and, I think, more plausible:

being

akineta | *kineta*, *chorista*

chorista | *achorista*

science

of the unmoved | of the moved [PHYSICS]

considered as it is (*chorista*) [THEOLOGY] | considered as it is not (*achorista* considered as *chorista*) [MATHEMATICS]

The strongest reason for the superiority of this interpretation is Aristotle's insistence upon the immobility of the objects of mathematics. This interpretation of Aristotle's division should be accepted only as provisional. As we shall see, the nature of the science called theology is more complicated than this picture indicates.

[37] In this it resembles dialectic and sophistic. Dialecticians, sophists and philosophers all claim to deal with all things. (Cf. Meta., IV, 2,1004b17ff.)

[38] 1064a2-4.

[39] 1078a21-23; p. 983.

[40] 1077b31-a5; p. 892.

[41] Although Aristotle does not order mathematics and physics in this text we may infer the superiority of the former from the claim that theology is the best of the theoretical sciences because "it deals with the highest of existing things, and each science is called better or worse in virtue of its proper object." (1064b2-6; p. 861.)

[42] XI, 7 1064b10-14: "But if there is another entity and substance, separable and immovable, the knowledge of it must be different and prior to physics and universal because it is prior."

[43] For a thorough account of this controversy, see Joseph Owens The Doctrine of Being in the Aristotelian Metaphysics (Toronto, 1963). And see below, p. 252.

[44] For a brief documentation and summary of the major scholastic interpretations of the subject of metaphysics see Owens, Doctrine of Being, pp. 5-6. Actually, at least three possibilities were considered: the separated substances (for the Christians, God); the first causes; being qua being, usually understood as ens commune.

[45] Buridan identifies this as Averroes view in Quest. super Meta., VIII, 1, 109rB; IV, 5, 16rB.

[47] Substance, quiddity and being (ens) are not synonyms, but they are related in meaning. They are casually identified here because of their relationship and because metaphysics uses all three notions. See St. Thomas, De Ens et Essentia, for example. Owens discusses the corresponding Greek words at length in The Doctrine of Being.

[48] For Buridan, see Quest. Meta., VI, 1, 33r; Quest. Phys., I, 3, 4r. For St. Thomas, see In Libro VI Meta., lect. 1, 1148; In Libro XI Meta., lect. 7, 2251.

[49] The contrast between the two sorts of definitions is brought out in De Caelo, I, 3, 269b20-23 (p. 401): "As a preliminary we must explain in what sense we are using the words "heavy" and "light," sufficiently, at least, for our present purpose; we can examine the terms more closely when we come to consider their essential nature." Even when he can get them, the physicist need not use essential definitions in every circumstance. For Buridan's account of these kinds of definition, see below, pp. 245; 248-49; see also Appendix I, sect. 1g. Buridan calls essential definitions "quidditative."

[50] It is not so clear that in mathematics the quidditative definitions are given by metaphysics. Perhaps universal mathematics serves that function vis-a-vis the special mathematical sciences. On the other hand, it is clearly a task for the first philosophy to determine what mathematical objects are--are they subsistent, immobile, or the contrary? These questions are treated in the Metaphysics.

[51] Ch. 7, 75a38-b2; 10, 76b11-15. Cf. Meta., III, 2, 997a19-24.

[52] This is an inference, made by the medieval commentators, from what Aristotle says. His claim is that demonstrations in one science stay within one genus--one does not pass from one genus to another while demonstrating (7, 75138). The axioms may be identical in two or more sciences (75b2-3). Since every science possesses its own genus (75b8) it is a reasonable inference that the subject genus is the unifying principle of the science. See also Meta., III, 2, 997a15-24.

[53] Meta., III, 3, 998b21: "But it is not possible that either unity or being should be a single genus of things." For the different senses of being, see V, 7.

[54] Meta., III, 3, 998b22-27; IV, 2, 1003b5-10 (trans. Owens, Doctrine of Being, p.265): "In this way 'Being,' too, is expressed in many ways, but always in reference to one primary instance. For some things are called 'Beings' because they are Entities [ousiai], others because they are affections of Entities, others because they are a way toward Entity or corruptions or privations or qualities or productive or generative principles of Entity or of the things expressed by reference to Entity, or the negations of any one of these or of Entity itself; for which reason we say that even not-Being is not-Being."

[55] Meta., IV, 2, 1003a33-b5; translated by Owens, loc. cit.): "'Being' is expressed in many ways, but pros hen, that is, in reference to one definite nature, and not equivocally, but as is also for instance 'healthy.' Everything which is healthy is referred to health, one thing in the sense that it preserves health, another in the sense that it produces it, another in the sense that it is a symptom of health, another because it is susceptible of it. And that which is 'medical' is referred to the medical art, one thing being called medical because it possesses it, another because it is naturally adapted to it, another because it is the function of the medical art. And we shall find other things expressed similarly to these."

[56] IV, 2, 1003b13-15, p. 732.

[57] Joseph Owens finds a resolution for the dilemma about the subject of metaphysics in the doctrine of pros hen equivocation. According to Owens, to say that metaphysics is the science of being qua being is to say first of all that it is the science of the primary instance of being. But, the argument continues, the primary instance of being is the immovable, separated divine substance. Metaphysics is theology. But this science will also be the science of the universal

principles and causes of being and of truth, for every being, and indeed every true proposition, is comprehended in a way in the primary instance. To know a being *qua* being is to know it in and through its relation to the divine immovable *ousia*. (Owens infers from texts in *De Anima* and *De Caelo* that the relation of all entities (substances) to the primary instance is one of final causality. See pp. 293-4.) Metaphysics is the science of being precisely because it is theology.

[58] See below, pp. 216-17. I am using the phrase "terminist approach" to describe the typical fourteenth century approach to the classification of the sciences. These philosophers (including Buridan) looked at science primarily as a collection of propositions and at the subject of a science as a term. Not all of these classifiers were nominalists, but the terminist approach to classification would seem to have the greatest appeal to those who reject common natures.

[59] This is affirmed in XI, 4. See the text quoted in the next footnote.

[60] XI, 4, 1061b28ff; p. 856: "Physics is in the same position as mathematics; for physics studies the attributes and the principles of the things that are, *qua* moving and not *qua* being (whereas the primary science, as we have said, deals with these, only in so far as the underlying subjects are existent and not in virtue of any other character); and so both physics and mathematics must be classified as parts of wisdom."

[61] 1026a23-27; p. 779: "For one might raise the question whether first philosophy is universal, or deals with one genus, i. e. some one kind of being; for not even the mathematical sciences are all alike in this respect--geometry and astronomy deal with a certain particular kind of thing, while universal mathematics applies alike to all." *Cf.* 1064a29-b14.

[62] For biographical details, the reader may consult the *Dictionary of Scientific Biography* (New York, 1980), the *Encyclopedia of Philosophy* (New York, 1967), or the *New Catholic Encyclopedia* (New York, 1967). Although the precise reason for his imprisonment is unknown, it is conjectured that religious differences between the Catholic Boethius and the Arian Theodoric lay behind it.

[63] Doctrinally, the appellation "Boethian-Neoplatonic" would actually be more suitable, for Boethius' interpretation of the division is strongly colored by his Platonist inclinations.

[64] *PL*, 64, 11-12: "Est enim prima quae sui curam gerens cunctis sese erigit, exornat, augetque virtutibus, nihil invita admittens, quo non gaudeat, nihil faciens poenitendum. Secundo vero est quae reipublicae curam suscipiens cunctorum saluti suae providentiae solertia, et justitia libra, et fortitudinis stabilitate, et temperantiae patientia medetur (?). Tertia vero quae rei familiaris officium modiocri (?) componens dispositione distribuit."

Migne calls this work *In Porphyrium Dialogus*.

65 PL, 64, 11: "Est enim intellectibile quod unum atque idem per se in propria semper divinitate consistens, nullis unquam sensibus, sed sola tantum mente intellectu capitur. Quae res ad speculationem Dei atque verae philosophiae indagatione componitur. Quam partem Graeci theologian nominant."

66 Loc. cit.: "Secunda vero pars est intelligibilis, quae primam intelligibilem cogitatione atque intelligentia suscipiens, ea comprehendit quae sunt omnium coelestium supernae divinitate operum causae, et quidquid sub lunari globo beatiore animo atque puriore substantia valet."

This science also considers the state of human souls as they exist "in the intellectibles," before they degenerate to the realm of mere intelligibles by becoming corporeal. These may be understood only in so far as they understand, remarks Boethius.

67 See, for example, Gilbert of Poitiers, Commentary on Boethius' De Trinitate, in The Commentaries on Boethius of Gilbert of Poitiers, ed. Nikolaus M. Haering (Toronto, 1966), pp. 82ff.

68 Loc. cit.: "Tertia theoretikis species est, quae circa corpora atque eorum scientiam cognitionemque versatur, id est physiologia, quae naturas corporum passionesque declarat."

69 Loc. cit.: "Secundo vero, intelligibilium substantia, merito in medio collocata est, quod habeat et corporum animationem, et quoddammodo vivificationem, et intellectibilium considerationem cognitionemque, ut dictum est."

70 If it belongs anywhere, I should be inclined to place it among the sciences of the intelligible, both in light of earlier Neoplatonic divisions and with a view to his own De Trinitate. The description of the middle science suggests that astronomy, at least, might have a place in it."

71 Col. 12. He does not call this division Stoic, of course. Cf. also Commentaria in Porphyrium [Isogogen], Lib. I, cols. 73-75. In the latter text Boethius adduces arguments for both positions, which he tries to reconcile by claimimg that each is right in its own way.

72 My translation, from The Theological Tractates, H. F. Steward and E. K. Rand (Cambridge, Mass., 1926), pp. 8-9.

73 It may also be misleading, then, to say as Fr. Weisheipl does that only mathematics is "abstract." ("The Nature, Scope and Classification of the Sciences," in Science in the Middle Ages, ed. David Lindberg (Chicago, 1979), p. 467. If "abstract" is defined in a restricted way (so that to consider the quantitative aspects of sensible being is to abstract, but to consider its mobile aspects is not) then mathematics alone abstracts.

74 This is what Boethius means when he says "neque [in divinis] diduci ad imaginationes, sed potius ipsam inspicere formam quae vere forma neque imago est." (Theological Tractates, p. 9.)

75 "Mathesis" means "learning." St. Thomas explains in his commentary on De Trinitate that of all sciences mathematics is most properly called "disciplinary" because it is most certain and establishes the firmest and most stable belief. (In Librum Boethii De Trinitate, Quaestiones Quinta et Sexta, ed. Paul Wyser (Fribourg, Switz., 1948), p. 54.

Chapter Two: A Brief History of the Classification of the Sciences in the Middle Ages

Having examined the essential elements of all medieval classifications of knowledge, let us now turn to the educators and scholars of the middle ages and see how they combined them and put them to use. The history of medieval classifications falls roughly into three periods. We find in the first eleven centuries of the Christian era an encyclopedic approach to the division of knowledge. The classifiers of the early middle ages were primarily interested in preserving and handing on the existing body of secular learning. Their classifications are eclectic and unelaborated. The twelfth and early thirteenth centuries were a period of transition in which the encyclopedic classifications of the early middle ages were elaborated and eventually modernized under the influence of the new Aristotelian learning. During this period the detailed classificatory treatises of the encyclopedists gradually gave way to the textual approach of the scholastic commentators. In the final period, the thirteenth and fourteenth centuries, the classificatory treatises of the earlier period were preserved and even read, but they were not replaced by new works in the same genre. In their place a great body of Aristotelian commentary on the division of knowledge began to accumulate. A lively debate ensued over the principles underlying the Aristotle's division. This debate, in which Jean Buridan took a notable part, will be considered in detail in a later chapter.

During the first eleven centuries of the Christian era, the classificatory traditions of the ancients were neither forgotten nor modified in any important way. The approach of the Fathers[1] to the classification of the sciences was conservative and encyclopedic, as anyone familiar with the first millenium of the middle ages must expect. "Conservative" is meant here in the strictest sense. The Fathers desired to preserve the intellectual traditions of the ancients, and the divisions of knowledge were a part of the inheritance. Their method was encyclopedic and descriptive rather than systematic. They recorded, praised or blamed, and sometimes explained, but they did not subject the problem of classification to critical scrutiny. Their discussions of the arts and sciences are, to use the words of Cassiodorus, "crowded with etymologies and full of a discussion of definitions."[2]

It is probable that the Fathers would not have been interested in the ancient classifications if they had not seen secular learning as the road to divine wisdom. Although such knowledge was not required of all believers, nor was it necessary for holiness, it was indeed the necessary key for the understanding of Holy Scripture.[3] Rhabanus Maurus urges this point most insistently, pointing out to young clerics the merits and usefulness, as well as the dangers, of the liberal arts.[4] The education of priests in the liberal arts was of capital importance in the eyes of the Fathers.

The organization of knowledge was therefore a practical concern to the educators of the middle ages. The proper order of instruction in the arts depends upon a proper ordering of the arts themselves, and the arts can be neither ordered nor taught well if the nature of each one is not comprehended. The Fathers, recognizing these truths, preserved the old classifications along with the scraps of knowledge they were supposed to classify.

The Fathers had little interest in elaborating the ancient classificatory schemes. As a rule, the need for a fundamentally new classification is felt only when new sciences are being cultivated or old sciences are being reevaluated. With one exception, neither condition held during the first few centuries of the medieval era. The exception, of course, was Sacred Theology, a part of knowledge unknown to the ancients. The Fathers tended to place the sacred science outside (and above) the human sciences of the ancient divisions. As a result, no modifications of the ancient classifications were necessary.

We must not conclude from the conservatism and "bookishness" of these early classifiers that they all took exactly the same approach to the problem. All show the same general characteristics, for the data were always the same. Each one had the same understanding of the nature and purpose of the arts and sciences. Their considerations of the nature and order of the arts vary in thoroughness and in the emphasis placed upon the various strands. And because the inherited tradition was not uniform, because it contained conflicting if not contradictory elements, the early medieval classifications vary in their details.

The earliest of the patristic classifiers was Cassiodorus, whose Institutes of Divine and Human Learning is both an incitement and a guide to the study of Sacred Scripture and the human sciences. Cassiodorus' treatment of the individual arts is brief. The Institutes is not so much a textbook as a guide to study. The book itself is organized about the seven liberal arts, each of which is treated in a separate chapter. This procedure is characteristic of the pedagogical works of the early period. Cassiodorus prefers the Boethian scheme to the Stoic. The latter is presented in some but not all manuscripts of the Institutes, and it is not discussed in the text.[5]

The Etymologies[6] of St. Isidore of Seville is intended to be a summary of all the knowledge of antiquity. His treatment of the arts and sciences is therefore much more detailed than Cassiodorus'. Like Cassiodorus, he uses the seven liberal arts as a framework for his discussion of the arts and sciences. It seems clear that Isidore preferred the Stoic (Platonic) to the Boethian division. He presents the former as a self-contained and somewhat detailed classification. But he does not neglect the other scheme. He presents it in exactly the same form as Cassiodorus, suggesting it as an alternate view of the division of philosophy. If we may speculate upon his preference, we might suppose he prefers the Stoic division because it does not subordinate divine to human learning, as the Boethian classification seems to do. This difficulty with the Boethian division can hardly be resolved without distinguishing between sacred and rational, or merely human, theology, a distinction these early theologians do not make.

Alcuin, the tutor of Charlemagne, wrote compendia of all the trivial arts and a more specialized treatise on astronomy. In the compendium De Dialectica,[7] which is in the form of a conversation between Alcuin and his pupil, the latter responds to the questions of his tutor concerning the nature and the division of philosophy. The catechetical form insures a discussion that is brief and elementary. Alcuin presents the Stoic and the Boethian divisions of philosophy in the dialogue. The Stoic division is the primary scheme, and it is elaborated in the same way as Isidore's version. An imperfect account of the Boethian scheme is given by the pupil in his explanation of theology. Neglecting the other two speculative sciences, he contrasts theology ("inspective" science) with "actual science," or moral philosophy.[8] Had the Stoic division provided a place for theology, it seems likely that Alcuin would have been content to mention that scheme only.

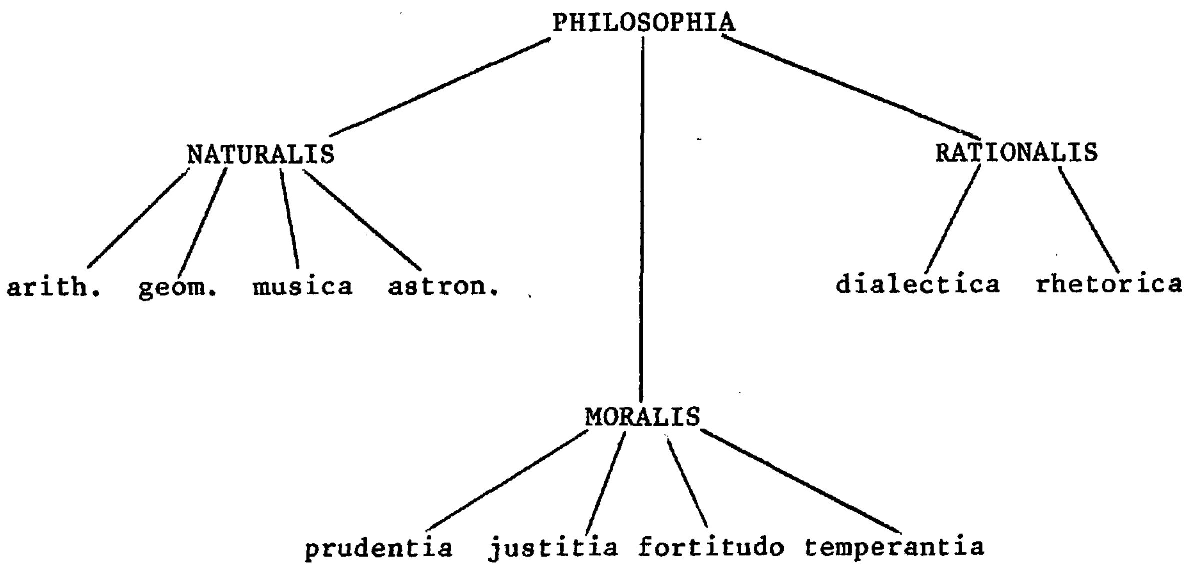
The Institutes, the Etymologies, and to a lesser extent the De Dialectica are valuable as indicators of the state of the classification of the sciences in the first millenium of the Christian era. As my examples indicate, the Fathers were concerned to preserve and to educate. The context of their classificatory doctrine varies, but not radically. The same may be said of the contents of their divisions. The ancient elements are not always used in exactly the same way, but they provide the materials and limit the range of the patristic classifications.

The common features of the Patristic classifications are easily described. Among the ancient classifications, the seven liberal arts are singled out as the organizing principle of the discussion, as I have already noted. Within this framework the contents of the arts and sciences are presented in greater or lesser detail in accordance with the interests and purposes of the writer. A common procedure is to discuss the major divisions of philosophy in the chapter or book devoted to dialectic.[9] It is nevertheless true that the Fathers subordinate the liberal arts to the philosophical disciplines. Whether the Stoic or the Boethian division is presented, some of the liberal arts are always integrated into the scheme. When the Stoic division is used (see Figure 2.1a), dialectic and rhetoric are given as the parts of logic, or rational philosophy. Grammar, although it is always included in lists of the liberal arts, is omitted from all the combined schemes. The Fathers regard it as a propadeutic to philosophy and nothing more. Physics, or natural philosophy, contains the quadrivial arts: arithmetic, geometry, astronomy and music. A diagram included in one manuscript of Alcuin's works adds other branches of physics, astrology mechanics and medicine, but these may be editorial additions of a later date.[10] No other text from this period includes any non-mathematical arts under the heading of physics.

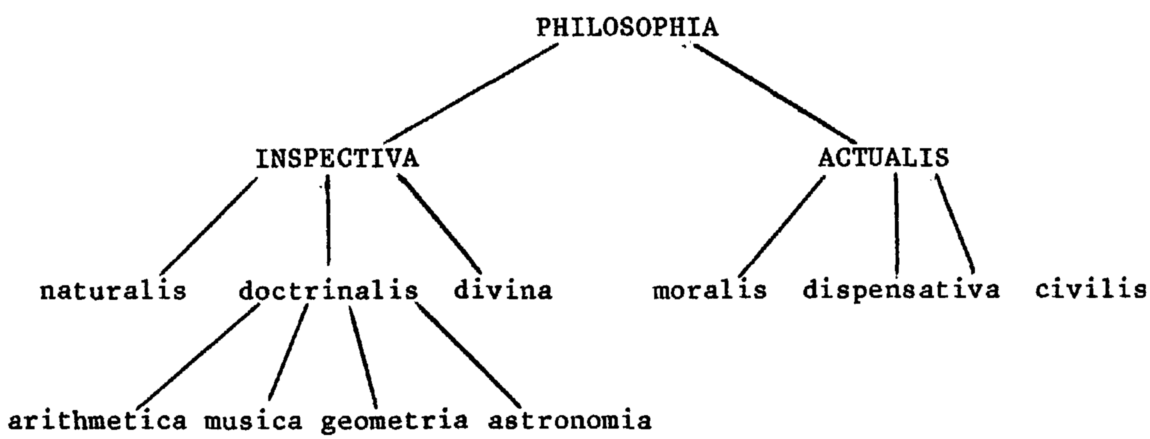
The Boethian-Aristotelian division does not include logic, so the trivial arts are omitted altogether from the patristic versions of this scheme. Mathematics in the Boethian division corresponds to physics in the Stoic, and it is of course divided into the four arts of the

FIGURE 2.1: Patristic Classifications

(a) Isidore's "Platonic" scheme (*Etymologiarum Libri*)



(b) Boethian scheme presented by Cassiodorus (*Institutiones*) and Isidore (*Etymologiarum Libri*)



quadrivium. The Boethian classification, as it appears in the works of Cassiodorus and of Isidore, is shown in Figure 2.1b.

Both the Stoic and the Boethian schemes include ethics as a principle branch of philosophy, but the subdivisions of this science differ in the two classifications. The subdivisions of the Boethian-Aristotelian "philosophia actualis" ("practical" in Greek) are based upon the Nicomachean Ethics.[11] The first branch, which deals with individual morals, appropriates the name "moral" or "ethics." The second branch, domestic or dispensative, deals with the family, and the third branch, civil philosophy or politics, deals with the moral life of the state. This division of ethics was used almost universally in the later middle ages, but an alternate occasionally appears. Isidore and others divide the Stoic moral philosophy not into more specialized sciences but into the four cardinal virtues, prudence, justice, fortitude and temperance.

The divisions of knowledge presented by the Fathers preserved the elements of the ancient classifications, but they failed to present a satisfying synthesis of these elements. It is impossible, moreover, to find an undisputed favorite among the three ancient schemes; Cassiodorus inclined to the Boethian-Aristotelian division and Isidore to the Stoic; Alcuin shows only the barest aquaintance with Boethius' scheme. The one constant was the seven liberal arts. These Pillars of the Temple of Solomon were acknowledged by all to be the foundations of all higher knowledge, both secular and sacred.

The twelfth century was, in more than one way, a turning point in the history of medieval divisions of knowledge, just as it was for the sciences themselves. Since Charles Homer Haskins introduced the name and the notion, the Renaissance of the twelfth Century has become a commonplace among medieval scholars.[12] The word "renaissance" is scarcely applicable to the classifications of this era, since the essential elements had been present continually in the tradition. But the twelfth century was indeed an era of growth in the history of the classifications of knowledge. Three distinct developments may be noted. The first was the culmination and perfection of the encyclopedic classifications of the Fathers. This was the work of the "didascalic" authors, among whom the most important was Hugh of St. Victor.[13] The second, and historically most important, development was the introduction to the west of Arabic-Aristotelian classificatory doctrine, primarily through the translations and treatises of Dominicus Gundissalinus. Finally, we see the beginnings of a new style of discussion in the Boethian commentaries of Gilbert of Poitiers and the other twelfth century "Platonists." Although these commentaries were barren of effect on the history of medieval classifications, they forshadow the method almost universally followed by the scholastic commentators of the thirteenth and fourteenth centuries.

The <u>didascalica</u>, or <u>introductiones ad artes</u>, were the natural offspring of the patristic writings which we have just considered. Although they are similar in purpose to the books on the arts in the ancient encyclopedias and compendia, their style is decidedly scholastic. A typical introduction might contain the definition of the art being considered, its genus and parts, its inventor, its utility, its place in the order of teaching.[14] It is not my purpose to treat of the didascalic tradition in general. Hugh's Didascalicon, which transcends by its excellence the merely typical, may nevertheless be taken as a specimen of the genre.

The Didascalicon of Hugh of St. Victor is in many respects a remarkable book. Unlike Isidore's Etymologies, it is not a collection of definitions or an outline of received knowledge. Unlike the Institutes of Cassiodorus or the writings of Alcuin, it is not addressed exclusively to particular groups of monks or clerics. The Didascalicon is a guide for the serious student, whomever he may be. Although the book contains some doctrine, its primary intention is not to teach the arts and science but to help order one's pursuit of them.

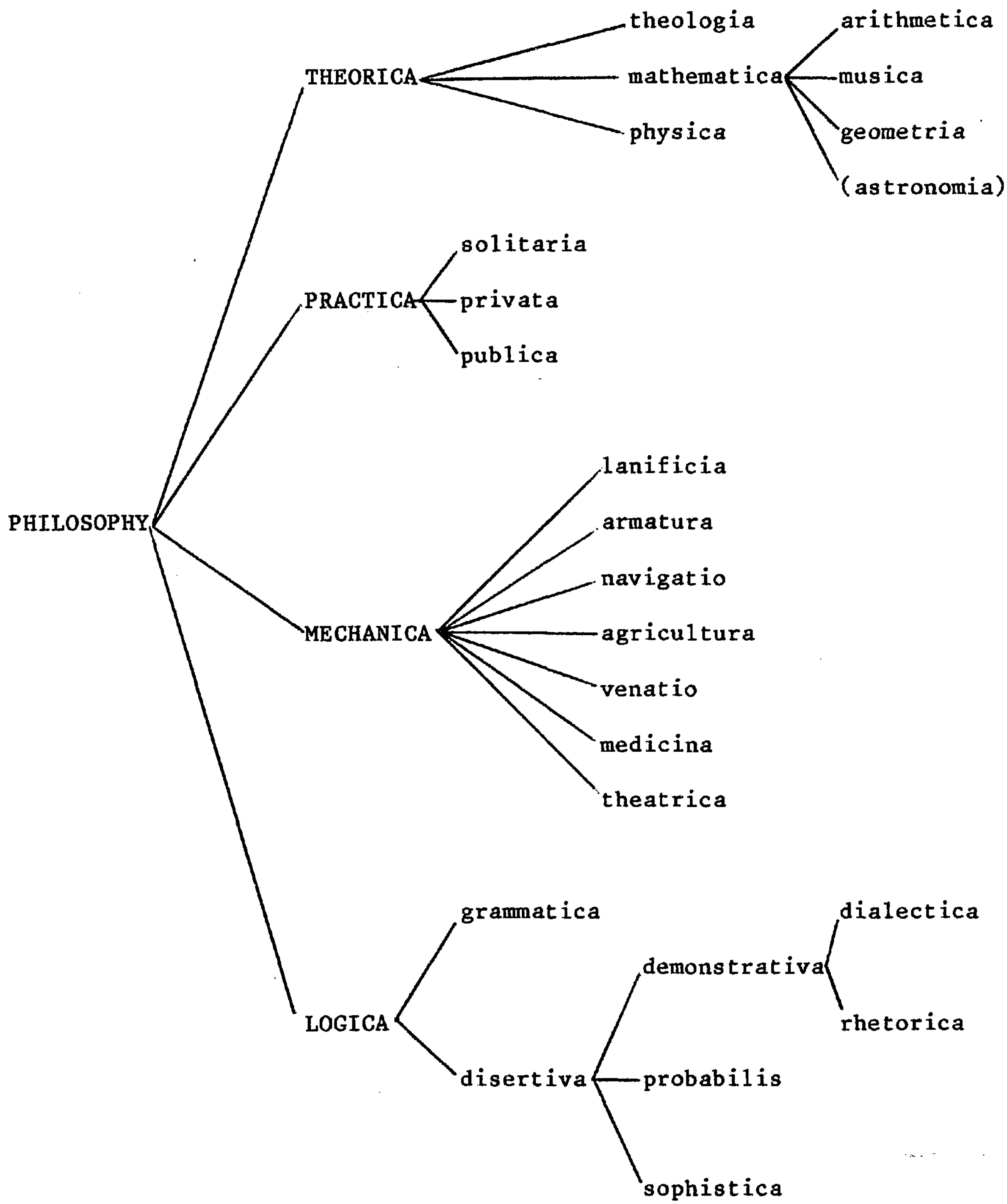
Hugh was concerned with the intellectual and moral preparation required for the pursuit of wisdom, a pursuit which culminates in the study of Sacred Theology. On the intellectual side, science is to be obtained first by reading and then by meditating. The first thing the student should know is which books to read, and then the order in which he should read them. Because of these two requirements Hugh devotes a considerable part of his book to the classification of the arts and sciences. On the side of morals, the student should understand the virtues and dispositions required of him as a student. The latter part of the Didascalicon is devoted to these topics.

The three ancient classifications find a place in Hugh's division of knowledge, as shown in Figure 2.2. The manner of their arrangement, however, is original. Hugh achieved what is probably the best possible integration of the Aristotelian and Stoic divisions by admitting four species of philosophy: speculative, practical, logical and mechanical.[15] Three of these categories are Aristotelian and one is Stoic. Hugh used this basic division as the starting point for an elaborate classification of the known arts and sciences.

Philosophy is the discipline of all things human and divine,[16] according to the common maxim of the Fathers. Hugh's interpretation of human things, however, is narrower than most. The Fathers intended to contrast Sacred Theology and the human sciences. According to Hugh, human things are the subject matter of the mechanical arts. All the other branches of knowledge are <u>de divinis</u>. Clearly, Hugh intends to add to the dignity of the liberal arts and sciences.

The mechanical arts were a new addition to the classificatory tradition, and one which persisted throughout the later middle ages. Although the Aristotelian division included the productive arts,[17] no one had taken them seriously before Hugh. The Greeks had thought the arts of production were beneath the dignity of free men, and this notion shut these arts out of classificatory schemes for a long time. Although Hugh did not think that the practice of the mechanical arts was philosophical, he recognized that skillful making presupposes rational principles.

FIGURE 2.2: The Division of Philosophy according to Hugh of St. Victor:



Hugh's treatment of the mechanical arts is interesting, though not very satisfying. He distinguishes seven arts, obviously to parallel the liberal arts. Although the classification of these arts is not worked out in great detail, Hugh did try to give a rationale for his arrangement of them. They are divided into groups of three and four, corresponding to the trivium and the quadrivium. The three arts serving man extrinsically are weaving, armament and navigation; the four arts benefiting man intrinsically are agriculture, hunting, medicine and theater.[18] Each art is broader than its name indicates. Hugh tries to make these seven comprehend all mechanical arts by expanding their contents. Navigation, for example, includes everything involved in trade. This art, he notes, is in its own genus a sort of rhetoric, for much smooth talking is needed in buying and selling.

The mechanical arts look to the necessities of life on earth, but the other arts cause us to resemble God in wisdom (theoretical and logical philosophy) or in virtue (practical philosophy). For this reason they are called divine. Hugh says of the divine arts that they tend to the same end, but by different roads.[19] Hugh is not referring simply to their different subject matters. Each art has its own proper procedures, determined by the faculty of the soul which it most properly exercises.[20]

Among the sciences accessible to human effort, logic corresponds to the intellect, mathematics to the reason, and physics to the faculty of sense. Physics alone has to do with things; the other two disciplines deal with the conceptions (<u>intellectiones</u>) of things.[21]

Logic handles the concepts themselves, considering them as predicaments (genus, species and so on). Mathematics, on the other hand, treats them "according to an integral composition." This seems to mean that the mathematical concepts are composed by the imagination from various parts, as the triangle is made up of three lines.

One might think that because logic and mathematics correspond to the higher faculties, Hugh regards them as superior to physics, but this is not the case. Indeed, the two are servants and instruments of physics, which without them must rely upon deceptive experience [<u>fallax experimentum</u>].[22] With their aid, however, physics attains truth resting on reason alone. Hugh's notion that physics is perfected through mathematics was a favorite theme of the twelfth century classifiers,[23] even though there was little basis for it in contemporary natural science or mathematics.

Hugh's understanding of mathematics was very primitive, to judge from the subdivisions he proposes.[24] Arithmetic's subject includes odd and even number and their subdivisions. The description of geometry is extremely rudimentary. As the name indicates, geometry is the art of measurement, and it has three species: the measure of length and breadth (planimetry), of height (altimetry), and of the cosmos (cosmimetry). Astronomy deals with the cosmos in so far as it is in motion, treating the courses of the stars and the intervals of time. More interesting is his description of music, borrowed from Boethius.[25] Music, which of all arts is the most philosophical, is of three sorts, mundane, human and instrumental. Each of the quadrivial arts is further subdivided, most frequently into three species.[26]

Hugh has very little to say about physics. In the short chapter devoted to it (Book II, Chapter 27) he describes its purpose (to investigate the causes of things in their effects and effects in their causes) and discusses its name. No subdivisions are proposed. The treatment of logic is fuller. The parts of logic are the arts of the trivium,[27] but its first division is into grammar and the method of reasoning (ratio disserendi). This branch is the equivalent of "logic" in the earlier classifications. Unlike the Fathers, Hugh wants to include grammar in his classification of the arts and sciences.

If we may judge from the amount of space given to each branch of knowledge, Hugh was most interested in the quadrivium, and much more interested in logic than in physics. The relative neglect of physics should not suprise us, since the ancient learning about the natural world was for the most part unknown to Hugh. His purpose was not unlike that of the earlier classifiers. Like Cassiodorus and the others, Hugh intended to help the scholar organize his studies of the secular arts, received from the ancients, for the sake of a better understanding of Holy Scripture.

Although Hugh's aims were not essentially different from his predecessors', his classification of knowledge is in several respects superior to theirs. His synthesis of the ancient elements is coherent and sensible, and his division of philosophy is much more detailed than the classifications of the Fathers. His scheme is also more comprehensive, including servile as well as liberal arts. Finally, we see in the Didascalicon a philosophical complexity absent in the earlier texts. Because Hugh did such a good job of summarizing and explaining the tradition, references to the earlier classifiers are rare in the texts of the later middle ages. The Didascalicon, on the other hand, was widely read and its influence may be seen in many subsequent divisions of knowledge.

Dominicus Gundissalinus, for example, was undoubtedly familiar with the Didascalicon. A converted Spanish Jew, Gundissalinus was both an author and a translator of Moslem philosophical texts. As an author, he wrote within the didascalic tradition of the twelfth century, as R. W. Hunt has shown.[28] As a translator, he promoted the cause of Latin Aristotelianism by translating an Arabic version of De Anima.[29] Because he inhabited a broader and more varied intellectual world than his predecessor, his account of the arts and sciences is richer than Hugh's.

Gundissalinus was responsible for three works pertaining to the classification of the sciences: translations of Alfarabi's De Scientiis and De Ortu Scientiarum, and his own De Divisione Philosophiae.[30] Marshall Clagett has called the latter the most important classificatory work of the twelfth century.[31] Although partisans of Hugh's Didascalicon might dispute the claim, and with some reason, Clagett's view may stand if one takes a forward look at the history of classifications. De Divisione was the herald of new trends in the classification of the sciences.

Moslem Aristotelianism was not the unadulterated thought of the Philosopher himself, but the writings of Averroes, Avicenna, Alfarabi and others stirred up in the west a great interest in Aristotle's philosophy. The writings of Alfarabi in particular were a channel for Aristotle's ideas about the division of knowledge. De Ortu Scientiarum[32] is the shorter of the two and is inferior in content. Although it shows some Aristotelian influence, it contains elements foreign to that tradition. De Scientiis is a more elaborate treatise, in which the author proposes briefly to run through the "famous sciences," teaching what each one is and what its parts are. The treatise is intended to be of use to the students of the sciences, helping him to know the order of the sciences in utility, in certitude and in power.[33]

The treatise De Scientiis contains more than a classification of the sciences. In it one finds a long treatment of the principles of nature and of knowledge. The doctrine of the book is based rather loosely on Aristotle and on the ancient traditions of classification, but it does not follow them exactly. Alfarabi often uses old distinctions in original and sometimes suprising ways. His first enumeration of the sciences, for example, does not fit any of the patterns used in the west. (See below, Figure 2.3.) Although the elements are familiar, Alfarabi places on the same level of classification parts of knowledge which Latin authors assign to different levels of division. Most interestingly, Alfarabi does not distinguish speculative and practical science in this first division.

FIGURE 2.3: Alfarabi's Division of Science (De Scientiis):

SCIENTIA LINGUAE	SCIENTIA LOGICA	SCIENTIA DOCTRINALIS	SCIENTIA NATURALIS
a) sci. of the significations of words	a) demonstrative	a) arithmetic	(contains eight parts)
	b) tentative (Topics)	b) geometry	
	c) sophistics	c) sci. of aspects	
b) sci. of the rules of speaking	d) rhetoric	d) sci. of the stars	
	e) poetics	e) music	
		f) sci. of weights	
		g) sci. of machines	

In view of Alfarabi's extensive use of Aristotle, one might be justified in calling his division Aristotelian, but this is appropriate only in a limited sense. There is no account in De Scientiis of abstraction from matter, and in general the work shows no real comprehension of Aristotle's classificatory principles. In this way De Scientiis falls short of other works available in the later middle ages, including Gundissalinus' De Divisione. But De Scientiis lacks the Platonic framework, the hierarchy of being proceding from pure and simple being, which characterizes De Ortu Scientiarum. It may at least be said that we find in De Scientiis a classification based primarily upon the works of Aristotle.

A Latin reader unaquainted with Aristotle's logical and natural treatises would learn from De Scientiis the names and the subjects of many of these works, since Alfarabi uses them to distinguish the sciences falling under the general headings of logic and of natural philosophy.[34] Logic had in the past been so divided, but lack of familiarity with Aristotle's natural books made such a procedure impossible for physics.

Alfarabi's treatment of mathematics (doctrinal science) is very interesting, as he did not restrict himself to the traditional quadrivium; his science of mathematics has seven parts.[35] Among them are sciences which Aristotle considered intermediate between mathematics and physics. According to Alfarabi, mathematics includes arithmetic, geometry, the science of aspects (of visual rays, mirrors, and so on), the science of the stars, music, the science of weights, and the science de ingeniis, of clever machines.

Natural science and mathematics, according to Alfarabi, embrace the natural books of Aristotle and the disciplines which Aristotle considered either purely mathematical or intermediate. Alfarabi's treatment of the third Aristotelian speculative science also accords, on the surface at least, with the Philosopher's doctrine. Boethius most seriously misunderstood (or mis-reported) Aristotle's third science, metaphysics. Aristotle himself regarded this as the divine science, and the one which teaches about God, but it was not the science which later would be called natural theology. Still less was it revealed theology. Following Boethius, the early medieval classifiers regarded this third speculative science as theology, natural or even, in some cases, revealed. Alfarabi has, in some measure, a conception of the Aristotelian science of being _qua_ being.

Alfarabi, like the Latins, admits the existence of divine science or theology. This science has three parts, which he describes as the science of essences and their accidents; the science of the principles of demonstration, and the science of incorporeal essences.[36] It is not clear what Alfarabi means by essence; that his notion is exactly the same as the Aristotelian _ens qua ens_ may be doubted. He does not face up to the conceptual difficulties involved in uniting the three sciences he distinguishes under the heading "divine science." But Alfarabi does at least pass on the notion of a science which is in some sense a universal science of being.

De Scientiis ends abruptly, delivering less than it promises. The penultimate chapter is supposed to be a description of civil science, the science of judging and the science of eloquence, but only civil science is treated. Alfarabi considers civil science a part of ethics, but he does not treat ethics as such, nor does he mention economics. Civil science, like mathematics, has both a theoretical and a practical side. Alfarabi's treatment of this science, and of the science of law (the last chapter) has a decidedly religious coloring. Ethics teaches that happiness is to be sought in the future life. The theory of law sets down how God is to be worshiped and worldly matters are to be directed, and law in practice means honoring God. The incomplete and abrupt character of these last chapters makes one wonder whether the

the text is complete. Gundissalinus, noticing the imperfection of these chapters, fills them out in his own work.

Gundissalinus, who was indebted to the author of De Scientiis for much of his doctrine and even for many of his descriptions of the sciences, and who borrowed from De Ortu as well, did not merely repeat the Moslem treatises he had translated. Drawing upon the long tradition of Latin classifications and making use of the work of his contemporary Hugh of St. Victor, Gundissalinus produced an eclectic classification of the sciences. De Divisione is perhaps more comprehensive than coherent, but its influence upon the later medieval classifications of science was considerable. Together with his translations, Gundissalinus' treatise brought to bear upon the discussion of classification aspects of Aristotle's thought unfamiliar to the Latins.

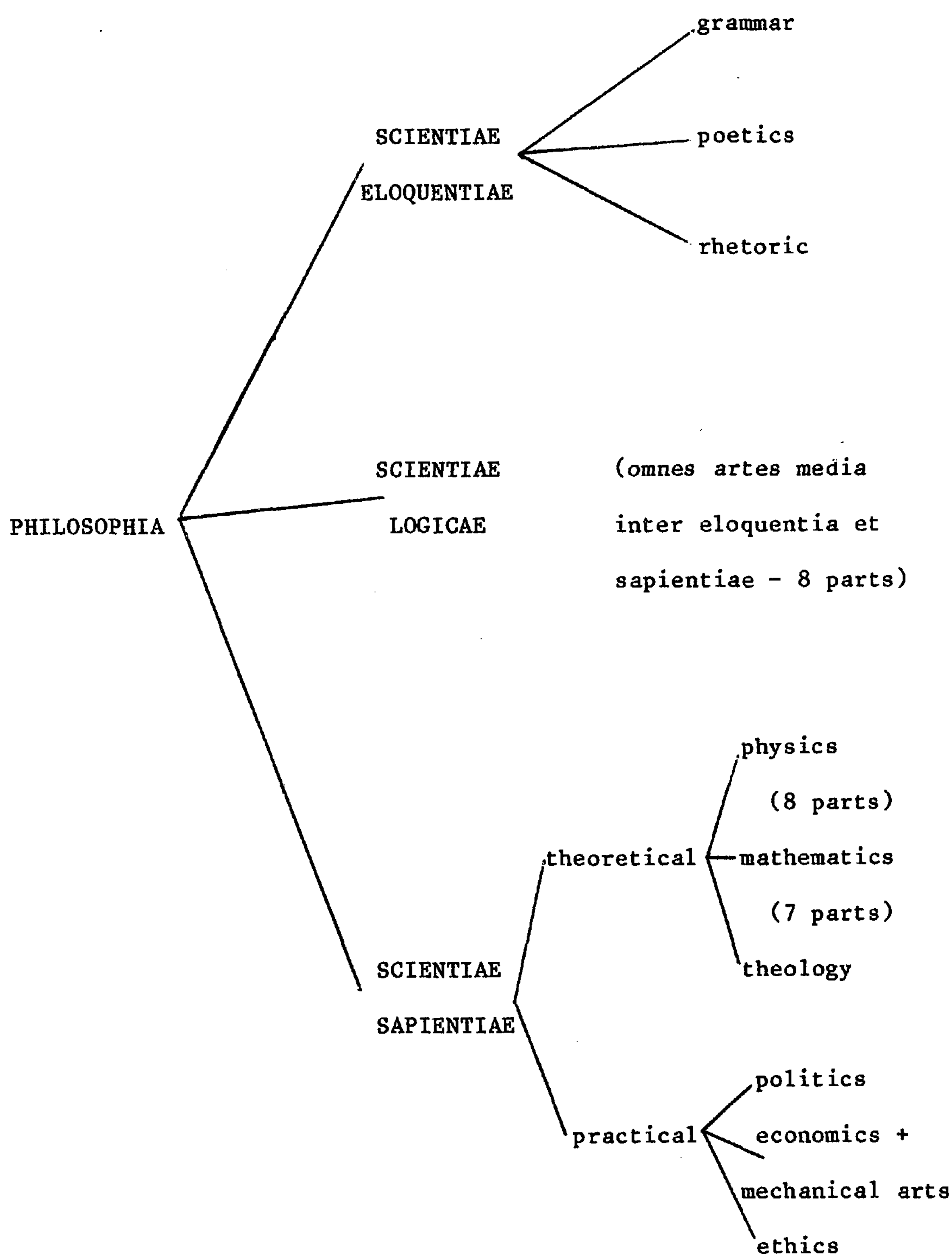
De Divisione has been analyzed at length by its modern editor, and the reader interested in pursuing Gundissalinus' thought further should consult this important work.[37] A summary of the most important aspects of Gundissalinus' classification will suffice for our purposes.

Gundissalinus sets up his classification of arts and sciences by distinguishing the things men desire.[38] There are desires of the body and of the soul, and he distinguishes three subdivisions of each. The body desires the necessary, the pleasurable and the curious. The soul desires the harmful, the vain and the useful. The harmful things are vices; the arts of magic, and worldly honors, are vain. Useful things are the virtues and the "honestae scientiae." It is the latter, of course, which are the subject of this treatise. For each art he explains what it is, what it studies, its end, who uses it, what its parts are, and its place in the order of learning. De Divisione is intended as a complete introduction to each of the arts, explaining the the nature and purpose of each one. The general outline of Gundissalinus' classification is summarized below in Figure 2.4.

Gundissalinus agrees with Hugh that honorable sciences are first divided into the divine and the human. Divine science is Sacred Theology, handed down by God Himself. Human sciences, of course, have been invented by human reasoning. Every human art and science is a part of philosophy, according to Gundissalinus. Following Hugh, he includes the mechanical arts in his divison of philosophy, but his basic arrangement comes rather from Alfarabi.

Gundissalinus borrows extensively from De Scientiis. Referring to Alfarabi by name, he accepts the division of logic by the logical books of Aristotle. He likewise accepts the division of natural science into parts corresponding to the works of Aristotle, a division which became something of a commonplace. Not wishing to omit anything, however, he borrows from De Ortu Scientiarum the following "particular" sciences falling under the universal science of physics: medicine, the science of indications, natural necromancy, the science of images, agriculture, navigation, the science of mirrors, and alchemy.[39] No attempt is made to reconcile this with the other, and better, division. This confusion points to the lack of a clear understanding of the difference between a science which is part, or species, of another, and a science which is subalternated to another.

FIGURE 2.4: Gundissalinus' Division of Philosophy (De Divisione Philosophiae)



Gundissalinus takes his account of the mathematical sciences from De Scientiis, but he makes significant additions. For example, he gives an extensive account of abstraction from matter in his section on mathematics in general. He defines abstraction as "the apprehension of the form of any kind of thing."[40] Abstraction is possible using either the senses, the imagination, the estimative power or the intellect. Intellectual abstraction, which is the most important for the sciences, involves the abstraction of the forms of things which only exist in matter, or which happen to exist in matter. (Immaterial forms do not need to be abstracted.) Gundissalinus indicates that the product of abstraction is the universal, that which is predicated of many.[41]

Having explained abstraction in general, Gundissalinus explains that mathematics deals with what is abstract and in motion.[42] This is the exact opposite of Boethius' doctrine, according to which mathematics deals with inabstracta sine motu. Boethius called mathematical objects inabstract, most probably, because they exist only in matter. They are not in themselves "separate," as are the objects of divine science. Gundissalinus, in calling the mathematicals abstract, is focusing on them not as they exist in the world but as they exist in the mind: abstracted from their real material conditions.

From an Aristotelian point of view, it seems more accurate to call the mathematicals abstract, as Gundissalinus does, than inabstract. On the other hand, Boethius' characterization of them as immobile is the more appropriate since, with the exception of the objects of astronomy, the mathematicals are thought of apart from motion. Perhaps Gundissalinus says that the mathematicals are mobile, focusing upon their existence in things rather than in the mind, because he wants to distinguish them in this manner from the objects of divine science, which are abstract and immobile.

Gundissalinus considers natural science the first and simplest of the speculative sciences, claiming that it ought to be learned after logic and before mathematics. The placing of physics before mathematics is unaristotelian. So too is his understanding of matter and form, which are the principles of the natural things physics studies. Natural forms, Gundissalinus holds, cannot be abstracted from matter. The forms of natural things, moreover, are always changing. It may be that Gundissalinus thinks that physics is not a demonstrative science, but only opinion. This interpretation is supported by his singling out of logic and mathematics as two (_the_ two?) species of demonstrative art.[43]

The third speculative science is of course the most difficult and the most important. Divine science is the knowledge of things separate in definition from matter, that is, of things into whose nature or essence matter does not enter. Such things do not exist in matter at all.

Invoking Aristotle, Gundissalinus refutes two mistaken views about the subject of divine science, that the subject is the four causes or that it is God. Because no science can inquire into the existence and nature of its own suLject, that being a task of a higher science, it follows that the highest science must have as its subject something about which no one can possibly inquire whether it is and what it is. This subject, according to Gundissalinus, is being, that which is common to all things.[44]

Gundissalinus does not solve the difficult problem posed by identifying both "being in general" and the forms which are abstract and immobile as the subjects of divine science. He restricts himself to listing four parts of the science, and an unspecified number of species. By doing so he hopes to set down in a general way all the things with which divine science concerns itself. The four parts are: (1) things altogether separated from matter and what follows from it; (2) things mixed with matter as constituent causes, which are not themselves material (as the soul); (3) what is found both in material and in immaterial things (for example, causality and unity); (4) some material things, such as motion and rest.[45] The species of divine science are the "consequences" of being, such as substance, accident, universal, act and potency.

Unlike most others, Gundissalinus sees divine science as useful to the other sciences, because it establishes the principles of each one and gives it certitude.[46] This genuinely Aristotelian notion was a novelty when it appeared, since the earlier classifiers were accustomed to think of the other sciences as useful to divine science, but not the reverse.

Of all the aspects of his classification, the treatment of divine science is the most unsatisfactory. Trying to combine doctrines which are not easily reconcilable, Gundissalinus does not have a profound enough grasp of the Aristotelian principles to explain in a satisfactory way the science of being. Not until the next century do we find satisfactory accounts of the Aristotelian first philosophy.

Gundissalinus' De Divisione may not be wholly satisfying from a philosophical point of view, but it had at least the merit of introducing new and important elements into the medieval discussion of the classification of the sciences. Noteworthy above all other points is its inclusion of an account of abstraction, without which it is impossible to make much sense of the Aristotelian schema presented by Boethius. De Divisione was without doubt a building block of future classifications. Robert Kilwardby, for example, borrowed extensively from Gundissalinus in writing his treatise De Ortu Scientiarum.

As its name suggests, De Ortu Scientiarum belongs to the didascalic tradition of classification, which we have examined in the writings of Hugh of St. Victor and Gundissalinus. Kilwardby was familiar with the classificatory writings of many of his predecessors and drew much of his doctrine from them.[47] His purpose in writing, moreover, was essentially pedagogical. According to Albert Judy, who recently edited Kilwardby's treatise, the book was written as an introduction to the arts for the use of his Dominican brethern.[48] De Ortu resembles the De Divisione and the Didascalicon in content and intent, and for the most part in form.

Kilwardby's treatise is much more than a compilation of old material, however. Not only does he carry out the task of describing the sciences and their mutual relations more thoroughly than had anyone before him, he also raises and resolves a number of difficulties on the basis of Aristotelian philosophical principles.

The time was ripe for such a book. Aristotelian doctrines were being debated in the universities and religious houses of study; it was not yet clear whether the teachings of Aristotle could be reconciled with traditonal learning or with the doctrines of the faith. Realizing the importance of the new Aristotelianism, Kilwardby desired to integrate the classificatory principles of the Philosopher with the received divisions of knowledge.

De Ortu Scientiarum has, therefore, a dual character. After the fashion of the introductiones ad artes, De Ortu gives an account for each science of its origin, subject, purpose, and place in the hierarchy of knowledge. Interspersed with this descriptive material are numerous chapters addressed to speculative questions about the principles of classification and their application to particulars. In Chapter XIV, for example, Kilwardby considers the diverse ways in which the mathematician and the physicist consider the same thing, continuous quantity. In Chapter XXIV he asks why there are only four mathematical sciences, and in XXV he considers in detail the three kinds of abstraction used in the three speculative sciences. Chapter XXV occupies six pages in Judy's edition. Kilwardby does not treat these questions merely in passing.

The influence of Aristotle is apparent not only in the philosophical digressions but also in the presentation of the details of his classification of the sciences. Kilwardby uses the common Aristotelian division of speculative philosophy into natural, mathematical and divine. Unlike the earlier classifiers, he does not explain the differences between the three speculative sciences by referring to Boethius. Rather, he turns to De Anima for justification of the claim that natural science considers mobile and material things as such, that mathematics considers these same things not as such but by abstracting from matter and motion, and that divine science studies things that are immobile and truly separate from matter.[49]

Kilwardby's division of natural science resembles Gundissalinus', but it is set out in a more orderly fashion and presents a better arrangement of Aristotle's treatises on natural philosophy.[50] More strikingly novel is his treatment of mathematics. Kilwardby accepts the quadrivial arts as the mathematical sciences, but he adds to them other sciences of a mixed character (such as perspective), as had Gundissalinus. Unlike his predecessor, Kilwardby was not content to list the mathematical sciences. The difference is attributable to his familiarity with the Aristotelian doctrine of subalternation of sciences.[51] Kilwardby presents a rather complex discussion of the relation of each mathematical science to the others, in which arithmetic is seen as the most universal and "ruling" science.[52]

Kilwardby's explanation of metaphysics, also known as divine science and first philosophy, is a far better account of Aristotle's doctrine than Gundissalinus'. Kilwardby explains that metaphysics is, above all, the science of substance and its principles, matter and form.[53] Our consideration of these things begins with corporeal substances, but since spiritual substance falls into the same genus as corporeal, "not only in terms of the predicaments, but really," first philosophy considers these as well. Next this science ascends to the creator of the corporeal and incorporeal substances. Primary philosophy also teaches how to define substance and accident, and finally it verifies and explains the principles of all other sciences which are not known in any other way.[54] First philosophy can thus be said to rule the other sciences, and in a sense to contain them. He denies, however, that the other sciences are parts of metaphysics or are subalternated to it.[55] Finally, Kilwardby identifies the subject of primary philosophy as being *qua* being.

Kilwardby's treatment of the three speculative sciences is thoroughly Aristotelian. Not every question could be resolved by a direct appeal to the Philosopher, however. In the Aristotelian tradition, three kinds of knowledge are distinguished on the most general level: practical science, speculative science and the manual or productive arts. It is not obvious where the trivium ought to fit into this division. Kilwardby's resolution of the problem is first to distinguish the sciences, after the fashion of Hugh and Gundissalinus, into those which are *de divinis* (the speculative sciences) from those which are *de humanis*. The latter he divides into two parts, which he calls *activa* and *sermocinalis*.[56] Active science has in turn two parts, ethics and operative science (the mechanical arts), corresponding to goods of the soul and of the body.[57]

Kilwardby agrees with Gundissalinus that logic is a science in its own right as well as an instrument for all the other sciences.[58] In a very interesting chapter he compares logic, metaphysics and sophistics as universal sciences, taking his beginning from Aristotle. According to the Philosopher, these three consider the same subject, being *qua* being. But there are differences among them, Kilwardby explains. Sophistics differs from the other two in its intended goal, which is to produce the appearance of truth rather than truth itself. Metaphysics and logic differ from one another not so much in their end as in the way they consider being. Metaphysics considers being "simpliciter secundum rationem entitatis" and the properties of being as such, but logic considers the same things "secundum quod rationabilia sunt."[59] In metaphysics, that is, one deals with all things as they are in themselves, grasping their essences, but in logic one deals with things as beings of reason: genus, species, difference and the like.

Turning to the mechanical arts, which the ancients did not trouble to classify, Kilwardby presents Hugh's seven arts. Being somewhat unsatisfied with the scheme, he divides mechanics "a little differently, and perhaps better."[60] Although he thinks he can improve upon Hugh's list by giving the arts more suitable names (see Figure 2.5 below), he seems to regard the classification of them as a mere presentation of examples. There is no reason to set out *seven* arts, he notes, except for the sake of symmetry. "The mechanical arts are as it were uncountable and diverse among diverse nations."[61]

FIGURE 2.5: The Mechanical Arts according to Hugh of St. Victor and Robert Kilwardby

HUGH	KILWARDBY
Lanificium (spinning)	Vestitiva (making of clothes)
Armatura (making of arms)	Armatura
	Archetectura
Navagatio	Mercatura (mercantile art)
Agricultura	Terraecultus (cultivation of of the earth)
Venatio (hunting)	Cibativa vel nutrativa (art food preparation or of nutrition
Medicina	Medicina
Theatrica	

Kilwardby does think that one art should be changed by Catholics: the detestable art of the theater should be eliminated from the list. (Allowable entertainment, he thinks, is reducible to medicine!) To preserve the number seven, Kilwardby divides one of Hugh's arts.[62]

In describing Kilwardby's division of philosophy, I have given only a small taste of the richness and complexity of the book. De Ortu Scientiarum is an intelligent and comprehensive treatise on the sciences, and it would no doubt repay a closer examination. That it was the last large-scale work of its kind in the middle ages is not unfitting, considering its merits. De Ortu is both a culmination of the pedagogical tradition of the first twelve centuries of the Christian era and an anticipation of the revolution to come in the medieval discussion of the nature and the division of human knowledge.

The division of knowledge, although it has implications for pedagogy, is primarily a philosophical problem. It is not suprising that the discussion of the problem continued long after new treatises in the didascalic tradition ceased to appear. The schoolmen were intensely interested in the nature of man and and of his powers, both intellectual and moral. The question before us now is, how did the philosophers and theologians of the later middle ages approach the classification of the sciences? Certain aspects of my reply must be deferred to a later chapter. The lively discussion about the underlying principles of the Aristotelian division will be considered in the next two chapters. My concern now is to convey an impression of the fate of the traditional classificatory schemes in the thirteenth and fourteenth centuries and beyond.

We should note first that the commentatorial style of the later medieval authors precluded the unified and comprehensive treatment of classification that we find in the didascalic treatises.[63] Because they restricted their discussions of the division of knowledge to their commentaries and books of questions, the schoolmen rarely gave a complete account of their opinions in one text. It is impossible to come to an understanding of the classificatory doctrine of many authors, due to the scarcity of material. For others, however, enough material remains to form a clear picture of their divisions of science.

The writings of St. Thomas Aquinas provide a perfect example of the new approach to the classification of the sciences. No one else has looked at the question from more angles. Jean Buridan, one of the most prolific scholastic commentators on Aristotle, may have touched on the question in as many philosophical treatises as Aquinas, but the Saint was a theologian as well, and his consideration of the sciences and their mutual relations includes a detailed consideration of the science of Sacred Theology.

The division of Aquinas may not be drawn entire from any one book. This is typical of the later scholastic schemes. The works in which Aquinas considers the division of knowledge may be broken down into the following categories: (a) theological writings (<u>Sentence Commentary</u>, <u>Summa Theologiae</u>); (b) commentaries and questions on Aristotle; (c) the <u>Commentary on Boethius' De Trinitate</u>. The middle category includes both prologues, which frequently contain a discussion of the place of the book being treated in the division of knowledge, and commentary on particular <u>loci</u> having some bearing on classification.

The most extensive treatment of the division of knowledge in the works of Aquinas is found in the <u>Commentary on De Trinitate</u>.[64] His scheme, which is general rather than specific, bears a striking resemblance to the basic division of philosophy presented by Hugh of St. Victor.[65] It is possible to fill in some of the details of St. Thomas' scheme by consulting other texts. For example, we find in the

Commentary on the Ethics that he accepts the standard three-fold division of moral philosophy.[66] Among the mathematical sciences St. Thomas numbers the traditonal four arts of the quadrivium, but he adds to them various "intermediate sciences," subalternated both to mathematics and physics. He never gives a list of mechanical arts, but when necessary he selects one or two examples from the almost endless number of possibilities. From the Prologue to the Commentary on the Posterior Analytics we learn how rational science is divided into its principal parts.[67]

St. Thomas uses the prologues to his expositions of various books of natural philosophy to expound his division of physics. The order he finds in the parts of physics is based upon the mind's process of reasoning from the more to the less general, from the whole to the parts, from elements to compounds, and from primary to secondary considerations.[68] St. Thomas' approach to the subdivision of natural philosophy reveals that he was not particularly interested in the schema for its own sake. Nowhere does he present it as a whole. His concern, rather, was to divide for the sake of instruction. Which part of science should be studied first, and which second? These are the questions St. Thomas thought important.

St. Thomas' concern for the proper order of learning is seen also in the commentary on the Nicomachean Ethics and in the commentary on De Trinitate.[69] The method of the sciences, logic, must be learned first, then mathematics, which requires imagination but little experience. Natural science, which requires considerable experience, comes next, and then ethics, which requires a mature and calm mind. Among human sciences metaphysics should be studied last, because of its difficulty.

The most difficult of sciences is the summit of natural knowledge. Although its subject is being as such, the most common of all notions, it considers the cause and principle of all being, God. This, as we have already learned from other commentators, is the reason why metaphysics may be called divine science or theology. St. Thomas follows the Christian classificatory tradition in distinguishing this "philosophical theology" from the doctrine of Sacred Scripture. He goes beyond his predecessors, however, in explaining the scientific character of Sacred Theology.[70]

It is interesting to note that Aquinas never incorporates Sacred Theology into a classificatory scheme. Unlike Hugh of St. Victor and others, he does not speak of it as a branch of philosophy. This science is not a part but a ruler of philosophy. He explains in the *Summa Theologica* that Sacred Doctrine, because it concerns what is revealed rather than what is naturally knowable, does not replace natural wisdom (metaphysics), which proves the principles of the other sciences.[71] Revealed theology is Wisdom in a higher sense than metaphysics, and as such it judges the principles of metaphysics as well as of the other sciences.[72]

If we leave out of account this best but naturally inaccessible science, St. Thomas' division of knowledge is Aristotelian in all its essentials. Aquinas' considerations of the division of knowledge go beyond Aristotle's, adding to rather than modifying the Philosopher's doctrine. He develops the basic Aristotelian framework in the interests of pedagogy. He considers the relation of the liberal arts to the philosophical sciences, reducing the former to the latter. He borrows from Boethius a way of describing the methods of the speculative sciences.[73] Most importantly, he adds to the order of human sciences the revealed science of theology.

St. Thomas' doctrine of the division of the sciences is well known to the students of medieval philosophy. Much less familiar are the classifications proposed by other schoolmen of the thirteenth century, to say nothing of fourteenth and fifteenth century authors. Twenty years ago Father Weisheipl wrote, "the writings of the fourteenth century which have been preserved reveal very little concern about the classification of the sciences or the polemic [concerning the relationship between mathematics and natural philosophy] of the thirteenth century."[74] No one has yet pursued the classification of the sciences into the fourteenth century in a systematic way, but evidence has been turning up that the discussion of the sciences, their subjects and mutual relations, did not cease as the middle ages drew to a close. Nicholas Steneck has provided us with a study of the classificatory doctrine of Henry of Langenstein (1325-1397).[75] Articles[76] by Edward O'Connor, Paul Spade and Armand Maurer have shown that the discussion of the principles of classification continued long after St. Thomas. Finally, inspection of the writings of Duns Scotus, Buridan and other schoolmen of the fourteenth century and later reveals many signs of interest in the problem. Classificatory schemes, some very brief and others more detailed, can be found scattered throughout the later scholastic texts.

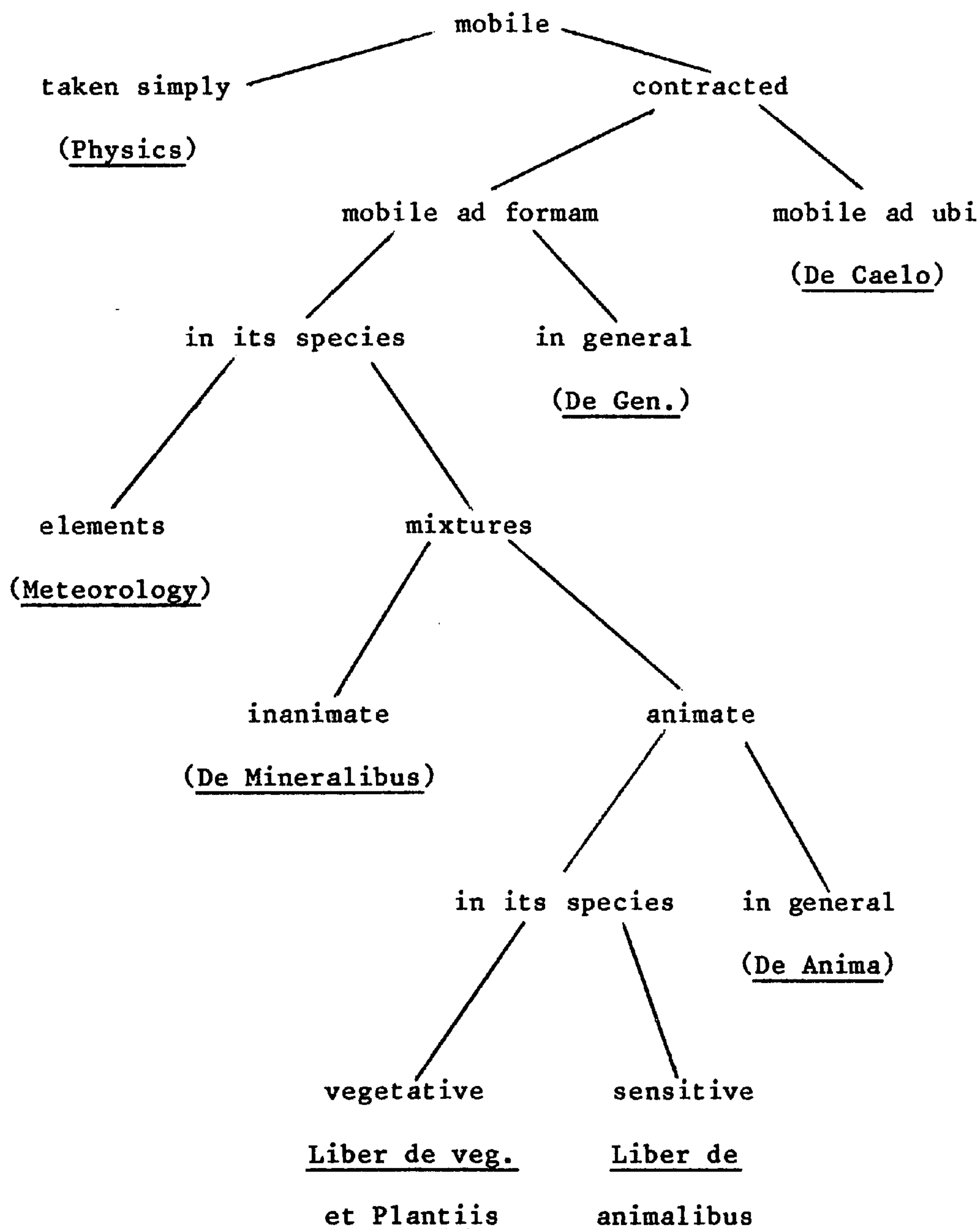
The collection of a large sample of classificatory discussion from the fourteenth and fifteenth centuries is greatly to be desired for the improvement of our knowledge of the history of the classification of the sciences. That is a task beyond the scope of this dissertation. To demonstrate that the texts are there to be found, and thereby to encourage further attempts to publish and describe them, I shall present a few specimens.

It will not be possible for me to draw firm conclusions about the development of classificatory doctrine after the thirteenth century except for a few tentative generalizations. Of this sort are the following: The details of the later classificatory schemes are borrowed from the three ancient divisions, with the emphasis on Aristotle's. The developments and refinements proposed by Hugh of St. Victor and others are often added to the basic Aristotelian scheme. A preference for bi-membered divisions can be seen in several later authors. In particular, the division of speculative science into real (dealing with things) and rational (dealing with thoughts and words) becomes popular. The emphasis upon the more philosophical aspects of the problem, which we find in the writings of St. Thomas, continues in the fourteenth century. Side by side with the discussion of the philosophical issues we find a continuing concern for pedagogy, that is, for the right order of teaching and learning. Many of these points will be verified in detail in the writings of Buridan. In the remaining part of this chapter, I will try to lend support to my tentative conclusions by surveying a small, but I hope typical, sample of late medieval and renaissance scholastic classifications. My discussion of the philosophical issues, however, will be postponed to a later chapter.

For an example of classificatory doctrine in the latter half of the thirteenth century we may look to Giles of Rome. Giles, an Augustinian Hermit who studied under St. Thomas Aquinas, is perhaps best known for his advocacy of the controversial doctrine of the unity of man's substantial form.[77] His division of knowledge follows Aristotle and Boethius, and he adopts the elaborate subdivision of physics which Gundissalinus had made popular.

In the Commentary on the Physics[78] Giles begins his division of knowledge in proper Aristotelian fashion, distinguishing sciences into the categories of speculative and practical according to their ends. He unifies the practical and the productive arts, saying that the practical sciences are directed toward either choice or artifice.[79] These sciences are not parts of philosophy, strictly speaking. He goes on to deny that the rational sciences are essential parts of philosophy. Philosophy, then, embraces only the three speculative sciences, physics, mathematics and divine science. Giles accounts for these three by means of their various degrees of abstraction, following the Boethian doctrine. Physics, he notes in passing, has a certain incidental connection to practical science. A striking feature of Giles' treatment of the parts of natural science is his use of bi-membered divisions. His scheme is shown in Figure 2.6.

FIGURE 2.6: The Subjects and Books of Physics (Giles of Rome)



Giles' method of dividing knowledge into two members, speculative and practical, and of including the productive arts under the practical sciences, was adopted by other classifiers of the late thirteenth and fourteenth centuries. John Duns Scotus carries the preference for two-fold division further: speculative science also has two parts, rational and real. His entire scheme shows a preference for the method of division into pairs, favored by Plato and described by Aristotle in the Prior Analytics.[80]

Scotus' classification is set out in his discussion of Book III of the Sentences, distinction 34, which deals with the gifts of the Holy Spirit.[81] Intending to distinguish the gifts from the virtues, Scotus lays out a division of habit, the genus of science as well as of virtue. Especially worthy of note are two features. Scotus considers rational science (logic) to be speculative. This is contrary to the Aristotelian classificatory tradition, but very much in keeping with the burst of theoretical interest in logic which charaterizes the intellectual life of northern Europe in the fourteenth century. Secondly, he connects the part of practical science dealing with action (circa agibile) with prudence, an intellectual virtue. Scotus thinks that prudence contains moral science, but is more extensive. The connection between the virtue of prudence and moral philosophy interested later moral philosophers as well, including Jean Buridan.[82]

Scotus' seventeenth century editor adds to the classification described in the text further subdivisions, developing the authors' comment that many divisions of the productive arts may be made before we arrive at the most specialized species.[83] The arts listed in the schematic diagram are six: Hugh's list minus theater, though with somewhat different names. Scotus himself did not trouble to list any of the finer divisions in his text, but he notes that the speculative sciences, too, have many subdivisions.[84]

The distinction between real and rational science is considered further in In XII Libros Metaphysicorum Expositio, Book VI, Question 1, "Utrum divisio scientiae in Physicam, Mathematicam et Divinam sit sufficiens?"[85] Aristotle's division of speculative science is sufficient, according to Scotus, only if we understand it as restricted to the sciences which deal with "first intentions," concepts abstracted from individual things and which signify things. These are the real sciences. The rational sciences speculate about second intentions, which are concepts signifying other concepts, as genus, species and the like.

In this question Scotus shows how the three speculative sciences may be distinguished into two categories, one of which contains two branches. The primary division has to do with the level of unity of the science. Omitting the details, it may be said that metaphysics, the science of the most common concepts, has a higher kind of unity than the sciences of less common concepts. The reason is that metaphysics is the science of one subject genus, ens. (In holding that being is a genus Scotus departs from Aristotle; this is in fact one of his most important departures.) The universal sciences of less common concepts are not as unified as metaphysics. Each one embraces many partial sciences having the same kind of unity as metaphysics. There are, according to Scotus, three of these universal sciences. One of them is completely unknown and inaccessible to us--the science of incorporeal substances, considered specifically. The other branch, the science of corporeal substances, includes two parts, physics and mathematics. Scotus has fit the three Aristotelian speculative sciences into a rather complex scheme of bi-membered divisions based upon the kinds of unity of the subject and upon its material or immaterial character.

Scotus' division departs in several important respects from the usual Aristotelian schemes. The preference for bi-membered divisions is striking. This preference is also seen in the classification of the fourteenth century theologian, Henry of Langenstein, as Steneck has shown.[86] John of Jandun (ca.1275-1328) also tends to favor two-fold divisions, but his treatment of logic is more in keeping with thirteenth century Aristotelian notions. Jandun's schema is presented in his Quaestiones in Libros De Anima.[87] The problem of classifying logic is uppermost in his mind in this text. His solution is to divide philosophy first of all into instrumental and non-instrumental. Instrumental ("organic") philosophy includes two branches, grammar and logic. John regards rhetoric as a part of dialectics, which, presumably, is a part of logic. Non-instrumental philosophy contains a speculative and a practical part, and the practical part contains an active part (ethics, economics and politics) and a factive part.

Speculative philosophy contains, predictably, metaphysics, mathematics and physics.

Jandun presents a detailed division of natural philosophy, adopting from Albert a distinction between bodies movable _ad ubi_ and _ad formam_.[88] Like Giles' division Jandun's is bi-membered, differing from Giles' only in the description given to the science of the _Meteorology_ (Jandun says that the book deals with imperfect mixtures) and in the divisions of the science of animate beings.

The classifications presented by the later scholastics are generally limited in scope, the particular emphasis being determined by the context. A good example of a focused discussion of classificatory problems may be found in the works of Marsilius of Inghen (d.1396). Marsilius, who professes to be a disciple of Buridan, subdivides natural philosophy in the _Questiones Subtilissime super Octos Libros Physicorum secundum Nominalium Viam_.[89]

Marsilius follows the classifiers who distinguish eight parts of physics: one dealing with mobile being as such, others dealing with beings mobile _ad ubi_ and _ad formam_, and others dealing with the genera of mobile beings (mineral, vegetable, animal). Unlike Giles and Jandun, he does not set out a bi-membered division, preferring to list the sciences in sequence without distributing them in an _arbor scientiarum_ (Figure 2.7). His description of the subjects of the sciences, clearly the work of a terminist logician, most closely resembles Buridan's.[90] The universal science of physics has as its subject _ens mobile inquantum mobile_. Subsequent sciences have as

FIGURE 2.7: The Books of Physics according to Marsilius of Inghen

1. Physics--de ente mobili inquantum mobili
2. De Caelo et Mundo--de ente mobili magis specialiter, i.e. ad ubi
3. De Generatione--de ens mobile ad formam generaliter
4. Meteorologicorum--de ente mobili ad formam mixti imperfecti
5. Liber de Mineralibus--de ente mobile ad formam mixti imperfecti inanimati
6. De Anima--de ente mobili ad formam mixti perfecti animati in generali
7. Liber de vegetabilibus et plantiis--de ente mobile ad formam mixti perfecti anima vegetativa
8. Liber de animalibus--de ente mobili ad formam mixti perfecti animati anima sensitiva

subjects terms formed by adding a qualifier to the subject of the science prior to it, contracting it to a more specialized consideration.

Other questions and difficulties which Marsilius considers in the Questiones Subtilissime have a bearing on natural philosophy and its relation to the other two speculative sciences. Mathematics, according to Marsilius, is the only speculative science which maintains a purity of subject matter. Natural philosophy, even the universal science of the Physics, borrows premises and conclusions from mathematics and from metaphysics. There are no more than three speculative sciences because there are only three ways of conceiving things,[91] but it is not clear whether the three sciences are altogether distinguishable.

Marsilius, a nominalist, approaches the classification of the sciences as a problem of categorizing propositions having different kinds of subjects. The reasons for this approach, and its significance, will be considered in a later chapter. The same method is apparent in an anonymous fourteenth century treatise on Metaphysics and Natural Philosophy (BN 6752).[92] The work of a realist philosopher,[93] this interesting text is intended as a compendium of Aristotelian doctrine for the use of young students who find the texts of the Philosopher himself too difficult. Interestingly enough, the author's idea of the division of philosophy is quite different from Aristotle's, and from any we have yet seen. It is not difficult to conjecture the reason for his modification of the traditional schema, however.

The author of the treatise claims that one can show from Aristotles' doctrine that there are three philosophies, two speculative and one practical. The speculative philosophies are natural philosophy and metaphysics. Moral philosophy, which is practical, completes the triad. This is almost, but not quite, the Stoic division: physics, ethics and logic. It seems certain that the division made here reflects the common saying that the Faculty of Arts embraces the "three philosophies," natural, moral and metaphysical.[94] But where is mathematics? Around 1230 or 1240, an anonymous master of arts in a manual for candidates preparing for the baccalaureate and for the license to teach, says that the mathematical arts are one of the divisions of natural philosophy.[95] In the university curriculum, it seems, mathematics did not have an independent status as a branch of philosophy. That the author should use the three philosophies as a division of knowledge is not strange, but one wonders why he presents them as Aristotle's division.

Like Marsilius, the author of BN 6752 thinks that natural philosophy and metaphysics borrow from one another, but he denies that this implies a confusion of the two.[96] If one looks at the process of reasoning leading to a given conclusion, one can determine which science the demonstration as a whole belongs to. This point is made and explained at greater length by Buridan, as we shall see later. It is worth noting here that the treatise on metaphysics and natural science seems to show the influence of Buridan in several ways.[97]

We have now seen examples of the classificatory doctrines of authors representing several schools of thought in the fourteenth century. Although each one owes something to Aristotle, and many show the influence of twelfth century authors, the classifications presented differ considerably. Interesting variations may be noted, for example, in the subdivisions of natural philosophy. Some differences may be traced back to ancient disagreements. One dispute of this sort concerns logic. Aristotle regarded logic as an instrument rather than a part of philosophy, but the Stoics regarded it as a part. Some fourteenth century classifiers sided with the Stoics, others with Aristotle. Even the peculiar omission of mathematics from the "Aristotelian" division of BN 6752 can be understood in terms of the modified Stoic division adopted by the universities as a description of the "upper division" of the Faculty of Arts.

Fourteenth century discussions of the division of knowledge are often (but not always) limited in scope. Marsilius of Inghen's consideration of natural philosophy is a good example. Even Scotus' division is more limited than appears in the seventeenth century edition, since the editor adds some of the details. Cursory treatments of classification are likewise to be found in the theological writings of the fourteenth and fifteenth centuries.

The problem of determining the nature of each science and the reasons for its distinction from other sciences was uppermost in the minds of many classifiers, as we shall see in the next chapter. Among the theologians, moreover, we find a surge of interest in the nature of theology and its place in the division of knowledge. Is theology a science? If so, is it speculative or practical? Take up any Sentence Commentary from the fourteenth century and you will find a discussion of these questions. Even a text as late as the Sentence Commentary of Johannes Eck (the opponent of Martin Luther) considers them.

As long as scholastic philosophy and theology existed in the universities, so long should we expect to find discussions of the classification of the sciences. This expectation is fulfilled in the introductory comments of Nicholas Vernia in his edition of Walter Burley's Expositio in Aristotelis Physica.[98] Vernia, an Averroist professor teaching at Padua in the 1490's, is especially helpful because he cites the sources of his doctrine and reflects upon past classificatory tradition.

"Burley and most of the moderns think it necessary to add no division of knowledge, or only a truncated one," comments Vernia.[94] This remark truly reveals the weakness of the classificatory tradition in the fourteenth century. The presentation and elaboration of detailed classificatory schemes had gone out of fashion. It is interesting to find fifteenth century scholastics lamenting the fact and trying to remedy it. Vernia's reaction in itself is proof that the ancient traditions were not yet dead.

Vernia explicitly adopts the principle that all good divisions are into two members. He rejects the division of philosophy into practical, speculative and rational branches, which he attributes to the ancient Peripatetics on the authority of Boethius. Starting with a division of philosophy into rational and real, he lays out his classification in considerable detail. The ultimate divisions into specific sciences, it should be noted, do not perfectly follow the rule of division into two parts. He lays out in great detail the subdivisions of logic and of physics, using bi-membered divisions as often as he thinks he can. He contents himself, however, with listing the seven mechanical arts; he prefers Hugh's names but adopts Kilwardby's substitution of architecture for theater.

Vernia's detailed classification is interesting as an example of late scholastic concern with the division of knowledge. A thorough survey of fifteenth and sixteenth scholastic editions and treatises might turn up many examples of classificatory schemes. Perhaps others felt the need to supply what was lacking in their predecessor's writings.

If the fourteenth century schoolmen devoted too little time to the presentation of complete classificatory schemes, it cannot be said that they passed too lightly over the fundamental principles underlying the Aristotelian division. To the difficulties already familiar in the thirteenth century were added new ones arising from the terminist logic and from the epistemological theories which accompanied it. In the remainder of this dissertation I shall show how Jean Buridan raises and solves the difficulties which the via moderna posed for the Aristotelian division of knowledge. His attempt to rescue Aristotle's scheme is noteworthy, if not altogether successful. In the concluding chapter I shall discuss the details of his classificatory scheme in light of the ancient and medieval classificatory traditions.

[1] I here use "Fathers" broadly, referring not only to those men who may be called Patres in the strict ecclesiastical sense of the word, but also to the other classifiers of the first millenium.

[2] An Introduction to Divine and Human Readings, trans. Leslie Webber Jones (New York, 1946), p. 143. He says this of his own book, but it describes the early pedagogical works generally.

[3] Cassiodorus speaks for them all when he writes (PL, 70, I 27, 1140-41): "Illud quoque commonendum esse credidimus quoniam tam in sacris litteris quam in expositoribus doctissimis multa per schemata, multa per definitiones, multa per artem grammaticam, multa per artem rhetoricam, multa per dialecticam, multa per disciplinam arithmeticam, multa per musicam, multa per disciplinam geometricam, multa per astronomicam intelligere possumus."

Rhabanus Maurus is helpful for explaining how each of the liberal arts aids in the understanding of Scripture. See De Clericorum Institutione, PL, 107, 18-26.

[4] Rhabanus is most critical of astronomy; see De Cler. Inst., PL, 107, 403-4.

[5] Cassiodori Senatori Institutiones, ed. R. A. B. Mynors (Oxford, 1937), p. 110. Only one MS used by Mynors adds the Stoic division (included in the PL text). Mynors relegates it to a note.

[6] The Etymologiae may be found in PL, 82.

[7] Alcuin's works are published in PL, 101.

[8] In De Dialectica, I, PL, 101, 952, Alcuin introduces the distinction, already seen in Cassiodorus' Institutes, between inspective (theoretical) and actual (practical) philosophy. In answer to the pupil's question, "Theologica quid est?" Alcuin replies, "Theologica est, quae Latine inspectiva dicitur, qua supergressi visibilia de divinis et coelestibus aliquid mente solum contemplamur. Nam et in has quoque duas partes philosophia vera dividitur, id est, in inspectivam et actualem. C: Actualis quae est? A: Actualis est, quae in operationibus huic vitae mortali necessariis consistit. Per hanc igitur modus honestus vivendi appetitur et instituta ad virtutes tendentia exercentur; per illam vero Deus amatur, spe et fide colitur." "C" is the pupil, Carolus, and "A" is Alcuin. Alcuin clearly has confused theoretical philosophy, which corresponds to the Latin "inspective," with theology.

[9] After comparing rhetoric and dialectic in terms of their use and difficulty, Isidore interrupts the presentation of the latter art with a chapter on the definition of philosophy. Fortunately for our understanding of his procedure, Isidore explains why he does so. First, this order is customary: "the ancient philosophers, before they proceed to the exposition of the Isagoge, lay out the definition of philosophy." (Etym., 82, 140.) In other words, the study of logic

ordinarily began began with a general consideration of philosophy. We have seen this procedure in the writings of Cassiodorus. Isidore then suggests a reason for the custom: philosophy is defined at the outset of the study of logic so that what pertains to philosophy may more easily be shown. How are we to understand this reason? Isidore probably means that by identifying the parts of philosophy and their relation to one another we are able to see where dialectic fits in the overall scheme. Since dialectic (or dialectic together with rhetoric) is the first part of philosophy to be treated, the definition of philosophy is very properly introduced here.

10 See the schema at the end of Dialogue on Rhetoric and the Virtues, PL, 101, 945-50.

11 See above, p. 68.

12 Haskins deals with many aspects of the cultural and intellectual history of the twelfth century in The Renaissance of the Twelfth Century (Cleveland and New York, 1955; rpt. of 1928 ed.).

13 Jerome Taylor, in the Introduction to his translation, The Didascalicon of Hugh of St. Victor: A Medieval Guide to the Arts (New York, 1961), compares Hugh's manual to the pedagogical works of his predecessors and contemporaries. Paricularly noteworthy is his comparison with William of Conches, on p. 17.

14 This list of topics is meant to be suggestive of the contents of the introduction, but it does not fit any real example exactly. For a consideration of the different classes into which these works fall, see R. W. Hunt, "The Introductions to the 'Artes' in the Twelfth Century," in Studia Mediaevalia in Honorem Admodum Reverendi Patris Raymundi Josephi Martin (Bruges, 1948), pp. 85-112.

15 Hugh acknowledges (II, 16, p. 35) that some equate physics and theoretical science and divide philosophy into three parts, physics, ethics and logic, omitting only the mechanical branch. He was quite aware that he was presenting a new arrangement of the old elements.

16 Hugonis De Sancto Victore Didascalicon De Studio Legendi, ed. Charles Henry Buttimer (Washington, D.C., 1928), I, 4, p. 11. "Philosophia est disciplina omnium rerum humanarum atque divinarum rationes plene investigans."

17 These were not generally included in the formal schemata, though Aristotle certainly admitted them. See, for example, Politica, I, 11, 1258b35ff; 13, 1260b2. A great number of texts referring to the productive arts may be found by consulting Hermannus Bonitz, Index Aristotelicus, Vol 5 of Aristotelis Opera ex Recensione Immanuelis Bekkeri (De Gruyter et Socios: Berlin, 1961).

18 Didascalicon, II, 20, pp. 38-39.

[19] II, 12, p. 35: "cum vero omnes artes ad unum philosophiae tendant terminum, non una tamen via omnes currunt." He wites in II 1, p. 23: "hoc ergo omnes artes agunt, hoc intendunt, ut divina similitudo in nobis reparetur, quae nobis forma est, Deo natura, cui quanto magis conformamur tanto magis sapimus."

[20] It is interesting to note that when Hugh coordinates the speculative disciplines with the three cognitive powers of the soul he does not include theology. Perhaps he omits Divine Science because he is considering the arts as paths to wisdom, not wisdom itself. Hugh's notion of theology, like that of the Fathers of the early middle ages, was essentially contemplative. Unlike the scholastic and the modern theologians, they do not consider it primarily as a matter for discursive reasoning.

[21] Didasc. II, 17, p. 36: "hoc etiam praetereundum non est, quod sola physica proprie de rebus agit, ceterae omnes de intellectibus rerum. logica tractat de ipsis intellectibus secundum praedicamentalem constitutionem; mathematica vero, secundum integralem compositionem."

[22] Didasc. II 17, p. 36: "quia enim logica et mathematica priores sunt ordine discendi quam physica, et ad eam quodammodo instrumenti vice fuguntur quibus unumquemque primum informari oportet antequam physicae speculationi operam det: necesse fuit ut non in actibus rerum, ubi fallax experimentum est, sed in sola ratione, ubi inconcussa veritas manet, suam considerationem ponerent, deinde ipsa ratione praevia ad experientiam rerum descenderent."

[23] The interested reader should consult Tina Stiefel's article, "The Heresy of Science--A Twelfth Century Conceptual Revolution," Isis 63 (1977).

[24] These passages, together with several others from Book II, may be found in A Sourcebook in Medieval Science, ed. Edward Grant (Cambridge, Massachusetts, 1974), pp. 54-59.

[25] See De Institutione Musicae, I, 2.

[26] Hugh's preference for trichotomies is worth noting. This preference was not unusual. The three-fold division was popular because of the ancient precedents but also, I suspect, because of the numerological parallel to the number of persons in the Holy Trinity. In any case, the love for recurring numerical patterns is clearly at work in these classifications.

[27] Didasc., pp. 44-47.

[28] "The Introductions to the 'Artes'," pp. 86ff.

[29] D. C. Lindberg, "The Transmission of Greek and Arabic Learning to the West," in Science in the Middle Ages, ed. Lindberg, p. 65. Gundissalinus supposedly translated Avicebron's Fons Vitae and

al-Ghazali's Aims of the Philosophers as well. Gundissalinus did not know Arabic. Avendauth (a Jew) translated the Arabic text of De Anima word for word into the vernacular, which translation Gundissalinus translated into Latin (p. 70). The shortcomings of such translations may easily be imagined.

30 Clagett disputes the attribution of De Ortu Scientiarum to Alfarabi, citing the differences in doctrine about the parts of physics. See "Some General Aspects of Physics in the Middle Ages," Isis 39 (1948), p. 34.

31 "General Aspects of Physics," p. 34.

32 Alfarabi Ueber den Ursprung der Wissenschaften, ed. Clemens Baeumker, Beit. Gesch. Phil. Mitt., 3 (Munich, 1916).

33 Domingo Gundisalvo De Scientiis, ed. P. M. Alonso Alonso (Madrid-Granada, 1954), Prol. pp. 57-58.

34 Alfarabi divides natural science into "eight great parts" in De Scientis, pp. 120-27: (1) the investigation of what is common to all natural bodies (Physics); (2) the investigation of simple bodies (De Caelo et Mundo); this inquiry has several distinct parts, including an investigation of these simple bodies as elements of composite bodies; (3) the investigation of the mixing and decomposing of natural bodies, and of the generation and destruction of the elements (De Generatione et Corruptione); (4) the investigations of the principles of the actions and passions of the elements and of things composed of them (Book I of the Meteorology); (5) the investigation of composite bodies (Meteorology IV); (6) the study of bodies composed of similar parts (De Mineralibus); (7) the study of plants (De Vegetabilibus); (8) the study of animals (De Animalibus, De Anima, and the Parva Naturalia.) Gundissalinus adopts this division of physics and passes it on to his successors. Buridan, as we shall see in Chapter Five, presents a similar division of physics.

35 Mathematics is treated in De Scientiis, Ch. 3. Clagett translates some passages from this chapter in "General Aspects of Physics," p. 32.

36 De Scientiis, Ch. 4, pp. 127-28.

37 Ed. Clemens Baeumker, Beit. Gesch. Phil. Mitt., IV, 2-3 (Munich, 1906). Much of this work appears in English in Edward Grant's Source Book, pp. 59-76.

38 De Divisione, Prol., pp. 4-5.

39 The parts of natural science: De Div. pp. 20-23; the partial sciences under natural science: p. 20.

40 De Divisione, p. 28.

41 De Divisione, p. 30: "a materia quidem et ab omnibus appendiciis materie abstrahit et apprehendit illud apprehensione simplici, ita ut exempli gracia fiat sicut homo qui predicatur de pluribus."

42 De Divisione, p. 31: "Genus eius est, quod ipsa est secunda pars theorice philosophie a materia abstracta et cum motu."

43 De Divisione, p. 33.

44 De Divisione, pp. 36-37.

45 De Divisione, p. 37: "Partes autem huius sciencie sunt quattuor: quoniam earum, que inquiruntur in hac sciencia quedam sunt separata omnino a materia et ab appendiciis materie; et quedam sunt commixta materie, sed ad modum quo commiscetur causa constitutens et precedens, materia enim non est constitutens illa; et quedam, que inueniuntur in materia et in non-materia, ut causalitas et unitas; et quedam sunt res materiales, ut motus et quies. Species uero huius artis sunt consequencia entis, in que scilicet diuiditur ens.

46 De Divisione p. 41: "Vtilitas autem huius sciencie est profectus certitudinis principiorum singularum arcium et certitudo eorum que sunt eis communia quid sint . . . taliter hec sciencia est utilis omnibus aliis scienciis."

47 Kilwardby's first distinction among the sciences is taken from Gundissalinus. All sciences are either divine or human; of human sciences some are commendable and some are reprehensible. Divine science is Sacred Theology, which has God both as its principle subject and as its author. The human sciences are those discovered by man, who may either look up to the eternal rationes and discover the truth about things, or consult what is below him, his own concupiscence or the suggestions of evil spirits (De Ortu Scientiarum, ed. Albert Judy (Toronto, 1976), p. 9). Gundissalinus had made a similar division, contrasting the honestae scientiae (divine and human) with harmful and vain pursuits (De Divis., prol., pp. 4-5). Hugh also had contrasted the arts of magic to the philosophical sciences, relegating his discussion, or rather criticism, of the magical arts to the end of the sixth book of the Didascalicon.

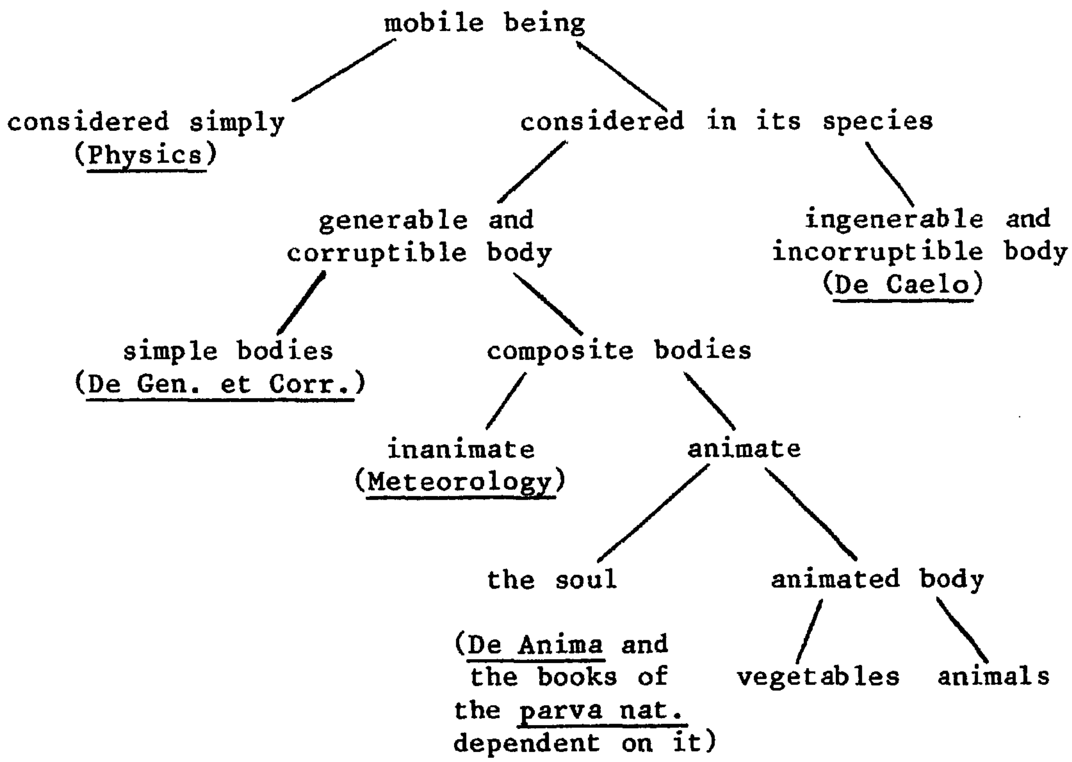
Although the speculative sciences are human sciences, Kilwardby says that they are all de divinis. Quoting Aristotle's De Anima to the effect that the sciences are divided according to a division of things, Kilwardby distinguishes things made by God immediately from things made by man, with God's help. The former deserve to be called divini, and they belong to speculation. The latter are humani, and they belong to ethics, mechanics and the arts of speech (De Ortu, pp. 10-11). Taken together, Kilwardby's divine and human sciences are the same as Hugh's four parts of philosophy.

It is worth noting that Kilwardby takes care to distinguish the sciences de divinis from the divine science that is a part of Catholic Theology (De Ortu, p. 14). Having noted this distinction, Kilwardby has nothing further to say about this kind of theology. *De Ortu* is concerned only with the sciences accessible to human reason.

48 *De Ortu*, p. xv.

49 Aristotle, *De Anima*, I 1 (403b12-19), in the Translatio Vetus, ed. Alonso, p. 92; quoted from *De Ortu*, p. 14: "Non autem separabilium, nec, in quantum huius corporis sunt, passiones sunt. Sed ex remotione, mathematicus est; secundum autem quod sunt separabiles, primus philosophus est."

50 After distinguishing the science of mobile body considered simply and generally (*Physics*) from the sciences of mobile body considered in its species, Kilwardby applies the principle of division according to subject matter to divide natural science into its species:



The distinction between simple and composite bodies was anticipated by Alfarabi and Gundissalinus, but Kilwardby adds two new divisions. The division of mobiles into ingenerable and incorruptible, on the one hand, and generable and corruptible on the other, distinguishes *De Caelo et Mundo* from the subsequent books of natural philosophy. The books dealing with composites are divided by Kilwardby into those concerning the soul and those concerning animated bodies. His treatment of inanimate bodies is different from his predecessors'; these he assigns to the *Meteorology*, making no mention of the treatise *De Mineralibus*.

51 Subalternation is not a relation of part to whole but a kind of relation of superiority and inferiority. In Chapter XVI Kilwardby states the following requirements for the subalternation of one science to another: (1) the subject of the lower science must fall under the subject of the higher; (2) demonstration must descend from the superior to the inferior science.

One subject can be under another either simply (as a species is under a genus) or by contraction. Kilwardby explains the latter by giving an example. Number and magnitude have diverse natures and so are not related as species and genus, but they are apt to be found together. Number is said to be contracted by magnitude because magnitudes are numbered, and demonstrations about number hold good for numbered magnitudes.

The second condition implies that premises are supplied to the lower science by the higher. Often the higher science provides a _propter quid_ demonstration for what the lower science knows _quia_ (see _Posterior Analytics_, I, 13).

52 _De Ortu_, XIX, 54-55. Kilwardby considers arithmetic the "mother" of all the other mathematical sciences, even of geometry, which is in some respects its "sister." That is to say, geometry is partially subordinated to arithmetic. Kilwardby disagrees with Boethius' view that geometry deals with immobile magnitude. Rather, it deals with magnitude abstracted from mobile and immobile. (When given a gender, the sciences are always female, in keeping with their names.)

53 _De Ortu_, XXVI, 82.

54 _De Ortu_, XXVI, 83: "ideo haec scientia prima habet verificare et aliquo modo explanando notificare principia omnium aliarum scientiarum non aliunde nota."

55 _De Ortu_, XXVI, 84; XXII, 117.

56 _De Ortu_, XXXIV, 122.

57 _De Ortu_, XXXVI, 124.

58 _De Ortu_, XLVIII, 153-160.

59 _De Ortu_, LVIII, 198-99.

60 _De Ortu_, XXXIX, 129.

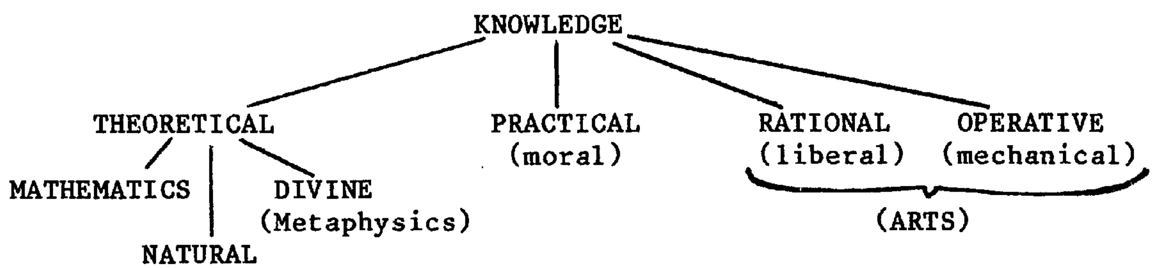
61 _De Ortu_, XXXIX, 129. Kilwardby lets his feelings be known several times about the value of this classification (as on p. 133, "si velimus quod sint septem.") In XL he remarks that it would perhaps be easy to think of an art not reducible to one of the seven.

62 He presents his modifications of Hugh's scheme in Ch. XL.

63 The shift in style, it should be noted, predated the birth of medieval Aristotelianism. The first treatments after this fashion of the division of knowledge are to be found in the "Platonic" commentaries on Boethius' *De Trinitate* of the twelfth century. Because these divisions have little direct connection with the Aristotelian schemes of the later middle ages, I shall not consider them here. The interested reader should consult the works listed in the bibliography under the names Clarenbaldus of Arras, Gilbert of Poitiers, Thierry of Chartres, and William of Conches.

64 *In Librum Boethii De Trinitate Quaestiones Quinta et Sexta*, ed. Paul Wyser (Fribourg, 1948), Q. V, art. 1, ad 3, p. 28.

65 The schema presented in *De Trinitate* is as follows:



That St. Thomas found Hugh's principal division acceptable is supported by a text in the *Commentary on the Ethics*. In the first *lectio* Aquinas relates the faculty of reason to four modes of order in things. The first is the order found in natural things, which reason examines but does not make; secondly there is the order reason produces from its own concepts and words. In the third place reason orders the acts of the will. Finally, reason brings order to material things in various ways, producing artifacts. To these four orders correspond four different sciences, explains St. Thomas: natural philosophy, rational philosophy, moral philosophy and the mechanical arts. Under natural philosophy he includes metaphysics, but, strange to say, he does not tell us how mathematics fits into the division.

66 *In Ethicorum* I, *lectio* 1, p. 4.

67 *In Aristotelis Libros Peri Hermeneias et Posteriorum Analyticorum Expositio*, ed. Raymund M. Spiazzi (Turin, 1964), second edition, pp. 147-48.

68 This order is explained in *In Libros Aristotelis de Caelo et Mundo Expositio*, Prooemium, *Opera Omnia*, III, editio Leonis (Rome, 1886), pp. 1-2.

69 *In Ethicorum Expositio*, Lib. VI, *lect*. 7, pp. 330-31; *In De Trinitate*, Q. V, 1 ad 3, pp. 27-28.

[70] St. Thomas argues at length that Sacred Theology is a science in Summa Theologiae, I, Q. 1, art. 2.

[71] Summa Theologiae, I, 1, 6, ad 2.

[72] That Sacred Theology is a science became something of a commonplace after St. Thomas, though not a doctrine universally received. That it is Wisdom is admitted by all Christians, but no one before him, it seems, tried to show that this kind of knowledge has the character of a demonstrative science, fitting to perfection Aristotle's characterization of the "primary condition of knowledge" (Post. An., I, 14, 79a24).

[73] According to Boethius, the method of physics is rational, the method of mathematics is disciplinary, and the method of theology is intellectual. See above, pp. 92-93.

[74] "Classification of the Sciences in Medieval Thought," Mediaeval Studies 27 (1965), pp. 54-90.

[75] "A Late Medieval Arbor Scientiarum," Speculum 50, 2 (1975), pp. 245-264.

[76] Armand Maurer, "Ockham's Conception of the Unity of A Science," Medieval Studies 20 (1958), 98-112; "The Unity of A Science: St. Thomas and the Nominalists," in St. Thomas Aquinas, 1274-1974: Commemorative Studies, (Toronto, 1974), II, 269-91; Edward O'Connor, "The Scientific Character of Theology According to Scotus," in De Doctrina I. Duns Scoti (Rome, 1968), pp. 3-50; Paul V. Spade, "The Unity of a Science According to Peter Auriol," Franciscan Studies 32 (1972), 203-17.

[77] Gilson, in History of Christian Philosophy discusses the controversy over the unicity or plurality of substantial forms, and Gile's role in it, on pp. 416-20.

[78] Egidii Romani Commentaria in Octo Libros Phisicorum Aristotelis (Venice, 1502; repr. Frankfurt, 1968), Prologue.

[79] Commentaria in Phisicorum, Prol., 2rA.

[80] For Plato, see especially Statesman, 279cff; for Aristotle, see Prior Analytics, I, 31.

[81] Opera Omnia, Vol. VII.2, ed. Lucus Wadding (London, 1639; repr. Hildesheim, 1969), p. 728.

[82] See below, pp. 277-78.

[83] In III Sent., D. 34, p. 728: "circa factibile, plures habet divisiones antequam deveniatur ad species specialissimas."

84 In III Sent., D. 34, p. 728: "quodlibet membrum illius [scientiae naturalis] divitur forte multis divisionibus, antequam deveniatur ad species specialissimas."

85 Opera Omnia, Vol. 4, ed. Lucus Wadding (London, 1639; repr. Hildesheim, 1968).

86 Steneck, "Arbor Scientiarum," p. 250.

87 Quaestiones in Libros Aristotelis De Anima (Venice, 1561; 1587), Prooemium.

88 Quaestiones, Proem., col. 6: "Alio modo per ens mobile ad formam possumus intelligere ens, quod in se habet potentiam ad motum . . . et de tale ens considerat scientia de Generatione, et in hoc distinguitur a scientia coeli et mundi, quae considerat ens mobile ad ubi vel ad locum. . . . Et haec est solutio Alberti. l. de Generatione."

89 Questiones Subtilissime, Book I, Q. 1 (London, 1518); rpt. under the title Kommentar zur Aristotelischen Physik (Frankfurt, 1964).

91 Quest. Subt. I, 1, 2rB.

90 For Buridan's division of natural philosophy, see p. 275.

92 Bibl. Nat. fonds latins 6752, 236ff. Lynn Thorndike lists the contents of this MS in A History of Magic and Experimental Science, III (New York, 1934), appendix 34, pp. 761-66.

93 BN 6752, 4r. That the author is a realist may be seen from chapter 7, "Utrum universalia ponenda sit," 10v-11v. His is a qualified realism, somewhat along the lines of St. Thomas.

94 Concerning the three philosophies, see J. A. Weisheipl, "The Place of the Liberal Arts in the University Curriculum During the XIVth and XVth Centuries," p. 209, and Pearl Kibre, "The Quadrivium in the Thirteenth Century (with Special Reference to Paris)," p. 191. Both articles are in Artes libéraux (Montreal, 1969).

95 Pearl Kibre, "The Quadrivium," p. 191.

96 BN 6752, 4r-v.

97 For instance, his explanation of the "subject of attribution" and of the subject genus of a science (5r) is like Buridan's. His words, in fact, echo Buridan's: "subiectum dicitur terminus communissimus in alique sciente consideratus non transcendens metas illius scientie." Compare Buridan, quoted on p. 241.

98 In Physicam Aristotelis Expositio et Quaestiones (Venice, 1501; repr. Hildesheim, 1972).

99 In Physicam Expositio, lrA: "Burleus et plerisque modernorum nullam aut truncatam philosophie divisionem ponunt equidem necessitatem."

Chapter Three: Buridan's Conception of the Nature of Scientific Knowledge

A classification cannot be comprehended unless the nature of what is being classified is first grasped. This becomes a problem of considerable difficulty in the case of medieval classifications of science, since our modern understanding of the nature and extent of scientific knowledge does not suffice for a complete understanding of the scholastic conception of science. Nor does the difficulty lie only in our conception of science. The common scholastic explanation of the cognitive act itself is foreign to most modern philosophers and scholars. We cannot hope to understand the fundamental principles of classification assumed by Buridan and his contemporaries if we do not first understand their view of the nature of scientific knowledge.

Buridan's understanding of science was in many respects the same as Aristotle's.[1] From the point of view of the inherent characteristics of scientific knowledge, Buridan stood squarely in the tradition inherited from antiquity, which assigned to science an exalted and noble status and required that it meet strict requirements of evidence and certainty. But if science is considered from the point of view of the knowable,[2] we find that Buridan took a position both "modern" and original. A radical departure from Aristotle's conception of the knower and the knowable underlies Buridan's treatment of scientific knowledge.

Buridan's conception of the objects of knowledge was in keeping with the views of the nominalists of the later middle ages.[3] For Buridan, as for Ockham and his followers, science was knowledge of propositions,[4] the terms of which signified and stood for individual substances and their properties. In certain respects, however, Buridan's opinions were quite unlike those of other famous nominalists, as I shall show later.

Buridan was by nature or by inclination a traditionalist. He was much more concerned than Ockham to adhere as closely as possible to Aristotle. This is apparent in his treatment of the classification of the sciences.[5] Rather than reject or tacitly omit traditional terminology, Buridan frequently used and explained such terms.[6] He often reinterpreted old language, however, in the light of his own logical and metaphysical theories. His discussion of the classification of knowledge is interesting precisely because it is a coherent integration of new and old elements.

According to the scholastic manner of proceeding, to say what something is one must state its genus and specific difference. In the _Questions on Aristotle's Physics_, Buridan defines science "properly speaking" as "a habit acquired through demonstration or demonstrations."[7] While this statement may not be a formal enunciation of the definition of science, it goes a long way towards conveying Buridan's conception of scientific knowledge.

First, Buridan pinpoints the genus; science is a habit. "Habit" has for the medieval philosopher a special meaning, related to but different from its current meaning. Habit is one of the four divisions of the category "quality," which is one of the nine categories of accidents in the Aristotelian logic. According to Aristotle, a habit is an acquired quality. Moral virtues, as well as sciences, are classified as habits.[8]

The habit which is a quality is not the same thing as a state, which is also rendered by "*habitus*." Aristotle sets out in *Categories*, Chapter 15 various meanings of the verb "to have," from which "*habitus*" is derived. The habit of knowledge is similiar to a disposition, but it is more long lasting and firmly established (8b26ff).

Following Aristotle[9] and tradition, Buridan distinguished habitual knowledge from actual knowledge. This is a special case of the more general distinction between habit and act. A habit is the ability to do something with ease and assurance; Aristotle calls it "second nature." It is acquired by experience and practice. An act is the doing itself. It occurs in a particular moment, and it may or may not result from the exercise of a habit.

An example will make the distinction clearer. A brave man has acquired the habit of courage from good training and practice. This habit enables him to act courageously whenever it seems appropriate. He does not have to deliberate about the courageous act or work himself up to it. A cowardly man has no such ability. He may act as a brave man would in a particular instance, but the act does not come from his virtue. It is merely the result of a special circumstance.

Similarly, actual knowledge is the mind actually knowing a particular conclusion at a particular moment. The knower may or may not possess the habit of that conclusion. When a student grasps a mathematical demonstration for the first time, he has actual knowledge of the conclusion. Later, perhaps after he has worked through the demonstration several times, he acquires habitual knowledge of the conclusion. The habit enables him to bring the conclusion into his consciousness and <u>know</u> (not merely remember) it whenever he chooses.[10]

Habitual knowledge is similar to memory, but also different, since knowing is more than remembering. The habitual knowledge of a conclusion allows its possessor not merely to recall the conclusion but to see it as following demonstratively from certain premises. The habit refers to more than the conclusion, although this reference may only be implicit. On Buridan's account, as I shall show in another chapter, the scientific habit extends beyond one conclusion and one demonstration to embrace an entire science.

Buridan's understanding of a science as an integral whole, having a particular character, particular limits, and particular relations to other sciences, cannot be isolated from his conception of science as a habit. This approach implies that Buridan, in company with most other scholastic philosophers,[11] put great emphasis on the psychological aspects of science, that is, on science as a characteristic of the knower. In this respect they differed from both ancient and modern classifiers of science.[12]

The genus of science is "habit" and its specific difference, as Buridan defined it in the text quoted above, is "acquired through demonstration." Concerning this differentiating characteristic of scientific knowledge, two points must be considered: first, what demonstrative knowledge is knowledge of, and, second, what are the characteristic marks of knowledge which is acquired through demonstration.

Aristotle held that all habits have a relative character; knowledge is no exception. It follows that something external specifies and distinguishes them.[13] In short, a science is about something, is knowledge of something, and in every case it must be seen what this something is. To use the scholastic language, this is the problem of the object of knowledge.

Buridan shared the opinion of the _moderni_, that the immediate objects of knowledge are linguistic entities. The mind forms and grasps terms and sentences. By the mediation of these linguistic objects, however, the mind grasps individually existing things.[14] Demonstrative knowledge, properly so-called, is of four things, Buridan tells us in the _Questions on Aristotle's Physics_: first of the conclusion which is demonstrated, second of the premises of the demonstration, third of the significative terms from which the premises and conclusion are formed, and fourth of the things which are not terms or premises or conclusions but are the things existing in the world which are signified by the terms.[15]

Scientific knowledge, according to Buridan, is knowledge of real things mediated by knowledge of terms and propositions. Any other kind of knowledge of real, singular things is not science.[16] For Buridan, propositional knowledge has such transparency that it takes us immediately and, if one is well-grounded in logic, without confusion to the knowledge of things. This was commonly believed by his contemporaries, but rarer was his insistence upon the primary importance of our scientific knowledge of concrete things. As he puts it himself, we do not seek knowledge of terms and propositions except to have knowledge of things. The artisan would not care about propositions and terms unless he believed that he could by means of them have knowledge of things he wants to make or procure for his use.[17] The example Buridan uses here reveals a man who, despite his speculative ability and interests, had a highly practical mind. This impression is confirmed by a reading of his works on moral philosophy.

Although Buridan held that it is proper to speak of demonstrative knowledge of conclusions, premises, terms and things, he elsewhere distinguished carefully between knowledge of conclusions, of principles,[18] and of terms. His manner of distinguishing them corresponds to the traditional distinction between science (scientia), understanding (intellectus) and simple apprehension. According to this distinction we speak of the science of conclusions, the understanding of principles, and the apprehension of terms. The former two constitute the "second act or operation of the intellect" and the latter the "first act of the intellect."

Buridan, like the realistic philosophers, understood the second act of the intellect as the formation of judgments (*compositio* and *divisio*).[19] In regard to simple apprehension, however, the nominalist's conception differs from the realist's. Buridan regarded apprehension as the mental grasp of a universal term (*incomplexum*) rather than as the apprehension of a common nature.[20]

Buridan explicitly distinguished *intellectus* and *scientia* in the *Questions on the Nicomachean Ethics*. Understanding, he wrote, is the habit of special principles (*principia specialia*) that are *per se nota*, whereas science is the habit of conclusions, first doubtful of themselves and then demonstrated.[21] By mentioning "special principles," Buridan calls to mind a claim made in the previous question. Some had thought that there are only a few indemonstrable first principles, which are common to all the sciences. Rather, Buridan claims, there are many indemonstrable principles pertaining to special sciences. Indeed, they are as many as the demonstrable conclusions.[22]

Having established that Buridan regarded scientific knowledge, taken broadly, as an intellectual habit having as its immediate objects the terms and propositions of a demonstration and as its remote objects individual things and their properties, we must now consider the characteristics of science which distinguish it from other intellectual habits, such as opinion and faith. For the present we are not concerned with the difference between science and understanding or between speculative and theoretical knowledge, but rather we shall group together all kinds of knowledge which have any claim to be called scientific.

Buridan firmly accepted the four distinguishing characteristics of scientific knowledge as described by Aristotle: science is universal, necessary, certain and evident. These four properties serve to distinguish science from other kinds of assent. Yet each one had become problematic, either because of the epistemological difficulties associated with nominalism or because of the implications of the new emphasis in theology upon the divine omnipotence. Buridan's task was to account for the essential properties of scientific knowledge without giving up either his nominalism or his faith. Although not wholly successful--perhaps he had set himself an impossible task--his attempt to save Aristotelian science from contemporary skepticism is of considerable interest.

We have seen that Buridan regarded the knowledge of things as the end and purpose of all scientific knowledge. But, according to Aristotle's famous dictum, knowledge is of the universal. Can this proposition be reconciled with the opinion that science is preeminently knowledge of individual things? Buridan certainly thought so.

There is no question that Buridan believed that knowledge of individual sensible things was possible. In the Questions on De Caelo, Buridan argued against those who interpreted the second half of

Aristotle's dictum, that sensation is of the particular, as implying that there is no intellectual knowledge of the particular.[23] His argument is based upon the subordination of the power of sensation to the power of understanding.[24]

The major premise of the argument is that the object of an inferior power is also an object of the superior power to which the inferior power is subordinated, but not vice versa. The conclusion is that everything which can be sensed can also be understood, but not everything which can be understood can be sensed.[25] The second part of the conclusion is trivial and obvious; the first part asserts the knowability of individual things.

To hold that individual sensible things are knowable is not the same as to hold that they are scientifically knowable. In the argument just described, Buridan was concerned to prove that the individual sensible thing is an object of the intellect as well as of the sense faculty.

We have seen that he was willing to speak of knowledge of the individual as scientific because such individuals stand in some relation to scientific demonstration. Was Buridan speaking very loosely when he called such knowledge scientific? It is not evident that such knowledge is scientific in the sense intended by Aristotle when he characterized science as of the universal. The question remains: Is there scientific knowledge of individual things?

Buridan's answer is not simple; it involves both an affirmation and a denial. He clearly denied that there could be scientific knowledge of an individual in its individuality: "sciences do not descend to individual differences."[26] On the other hand, he claimed in the same work that the metaphysician descends not only to the consideration of species but even to individuals.[27] Although the two statements may seem at first sight to be contradictory, in fact they are not. In the first, Buridan denied that science descends to individual differences. In the second, he affirmed that a science (metaphysics) descends to individuals. The difference of wording is significant.

Knowledge of individual differences implies knowledge of what makes an individual thing precisely that individual. To know individuals in this manner would be to know, for example, Socrates' "Socrateity," that is, his individual nature and definition. Buridan denied that such knowledge was possible. "Socrates" is strictly undefinable.[28] The most one can do is give a descriptive definition of the term which picks out its significate but does not convey its individual nature.[29] Individuals <u>may</u> be defined, however, in so far as they are concrete instances of a universal term. Socrates himself may be defined as a "rational animal."[30]

In demonstrations as well as in definitions we may look either at the individual itself or at the singular term which signifies it. There is a difference between saying that something can be demonstrated about a singular thing and that a singular proposition can be demonstrated. A singular proposition has a singular term as its subject. Such a proposition makes a statement about one individual only.

Individuals may also be signified by universal terms, however, and they are knowable through universal demonstrations by means of these terms.

Buridan denied that singular propositions are demonstrable when they are formed as categorical affirmations.[31] We cannot demonstrate, for example, the proposition, "John Buridan is risible." On the other hand, Aristotle had said that it pertains to the metaphysician to know whether Socrates is the same as the sitting Socrates.[32] Buridan's explanation of the possibility of knowing such a singular proposition involved the conversion of the proposition from categorical to conditional or hypothetical form. (He did not think that this maneuver was necessary for universal categorical propositions, as we shall see.)

Buridan's position may be clarified by a further consideration of the proposition stated above, "John Buridan is risible." The reason this proposition is indemonstrable, according to Buridan's theory, is that the truth of a singular proposition depends on the existence of its subject's referent, and it is impossible to demonstrate the existence or non-existence of an individual.[33] If John Buridan has never existed, it is false to say, "John Buridan is risible."

On the other hand, if we convert the categorical proposition to a conditional proposition, we can indeed prove it. The demonstration of the conditional proposition, "If Buridan exists, he is risible," follows the same lines as the demonstration of the universal categorical proposition, "Every man is risible." Buridan accounted for the apparent demonstrability of such categorical singular propositions by seeing them all as disguised conditionals.[34] These are not genuine singular propositions, since it is impossible to know whether the predicate is actually predicable of the singular subject.

Individual things existing in the world are knowable by means of demonstration only as the significates of universal terms. For this reason, when Buridan claimed that individual things existing in the world are objects of demonstrative knowledge he described them as the significates of the terms used in the demonstration. One problem remained, however. It seemed that in certain cases singular terms did indeed appear in propositions admitted by all to be demonstrable and categorical. Such terms included "God," "world," and "sun," each of which has only one significate.

Buridan did not regard these as exceptions to the general rule that there are no singular, categorical and demonstrable propositions. Rather, he argued that such terms are not singular but common "according to their mode of imposition." That is, although "God" can signify only the one true God and (barring a miracle) "sun" can signify only the one existing sun, were there to exist (<u>per possibile vel impossible</u>) another God or another sun, these terms would be able to stand for them in a scientific proposition without a new imposition of meaning.[35] "God" and "sun," in other words, are not proper names but rather common names.

Buridan's argument for the indemonstrability of singular categorical propositions illustrates the good use to which a faithful

Aristotelian could put the new logic in the fourteenth century. As a nominalist, Buridan was firmly convinced that universals were terms, not entities. He could not attribute the universality of knowledge to common natures or essences, as realists did. Even the moderately realistic position, according to which the common nature was not existent in itself but only in concrete individuals, was unacceptable to him. Buridan believed that the only non-linguistic objects of knowledge were individual things having their own individual natures and properties.

As an Aristotelian, however, Buridan acknowledged that science was of the universal. By his skillful use of logic, he believed he had avoided the undesirable conclusion which seemed to follow from the combination of the nominalistic and the Aristotelian premises, that scientific knowledge was only of terms and not of things.

The existence and knowability of individuals was primary and could not be abandoned. Yet he could afford to argue for the indemonstrability of singular categorical propositions, because his argument did not prejudice the knowability of individual things. Since the universal terms in scientific demonstrations signified and stood for individuals, such individuals were knowable by means of the universal demonstration.

It is interesting to note that Buridan's defense of the characterization of science as of the universal and not of the particular was based not upon the intrinsic unknowability of the particular[36] but upon its contingence. It is because one cannot be absolutely sure that an individual exists and is what it appears to be that one cannot demonstrate anything about it in a categorical manner.[37] For Buridan, this skepticism remains merely theoretical and does not vitiate the confidence of the scientist in his science, as I shall show later.

The contingence of individuals may explain the restriction of science to the universal, as Buridan claimed, but such contingence gives rise to a further problem. Only concrete individuals exist, all of them contingent except God. If the truth of a universal affirmative categorical proposition depends on the existence of the things signified by the terms of the proposition, this truth must be time-dependent and so not necessary. That is, there may be some time at which none of the significates of the proposition exist; at such time the proposition will be false.

We have seen that the proposition "Buridan is risible" is contingent and so not demonstrable. But what of the proposition "Every man is risible."? This has the form of a universal affirmative proposition which might be demonstrated.[38] But does it have the necessity required of scientific knowledge?

Suppose we consider the proposition to have been enunciated prior to the creation of human beings. It seems that the proposition would then be false, because no human souls exist for which the subject could stand. Later, after the creation of Adam, the proposition would be true. The proposition, then, cannot be necessary, since it is at one time true and at another time false.

T. K. Scott has given an account of Buridan's solution to this problem based upon a text in the Questions on the Nicomachean Ethics, which partially resolves the difficulty. According to Scott, Buridan solved the problem of the necessity of scientific knowledge by reviving an old notion, natural supposition, which had gone out of fashion in the fourteenth century.[39] As Scott presents it, however, the solution is not completely immune from skeptical criticism. We shall consider possible objections to Buridan's solution presently, and suggest how he might answer them.

Book VI, Question 6 of the Questions on the Ethics concerns the eternity of the object of knowledge. How can the knowable be eternal if it is contingent? Buridan distinguishes two knowables in this text: the conclusion of a demonstration and the things its terms stand for. His account of the eternity of the conclusion is brief. It is not eternal "in its reality," that is, as a sentence being thought, spoken or written, but it is "eternal in its truth" if, whenever it is proposed, the conclusion is true.[40] The greater part of the question concerns the problem posed by the contingency of the individual knowable things.

Before proposing his own solution Buridan rejects several others. Some explanations he rejects emphatically, declaring "ista opinio non placet mihi." These include various realist solutions, which regard common natures or essences as the objects of knowledge, and also the opinion which he attributes to Aristotle and Averroes, that individual instances of the universals have always existed.[41] Buridan rejects the latter position on rational grounds, though he was no doubt mindful that it was contrary to the revealed doctrine of the creation of the universe ex nihilo.

Finally, Buridan considers and rejects the claim made by some nominalists that scientific knowledge can only be had of negative and of conditional propositions. According to this opinion, a negative proposition such as "a vacuum is not a being" is acceptable because its truth requires only that no vacuum be among the things for which "being" stands in the proposition. Conditionals are also acceptable because they do not assert the existence of any particular. Since every categorical can be converted to a conditional, it is tempting to base the necessity of apparently categorical scientific propositions upon this convertability. Scott identifies this as Ockham's solution.[42]

This opinion, as Buridan saw it, was not completely off the mark but was based upon a defective knowledge of logic. The logician should know that terms do not signify any determinate time.[43] In a scientific proposition, the verb "is" is in the present tense, but this has nothing to do with what the subject term stands for. According to Peter of Spain, the subject of a scientific proposition stands in "natural supposition," which is "the taking of a common term for everything of which it is of a nature to be predicated, as 'man' taken according to its nature has supposition for all men who are and who were and who will be."[44] Buridan makes this doctrine his own: "a term has natural supposition when it stands indifferently for all its supposita whether past, present or future. Demonstrative science uses this sort of supposition."[45]

In a categorical affirmation such as "Every man is risible," "man" has natural supposition. The truth of the proposition, therefore, depends upon there being some man, past, present or future, for which "man" stands.[46] Given at least one instance of man and given that risible can be predicated of every such instance, the proposition may be called aeternum verum, an eternal truth. On this view, the claim that a categorical affirmative is a shorthand version of a conditional reveals an imperfect understanding of the logic of suppositions.

Buridan freely admits that his resolution of the problem does not differ greatly from the other nominalist explanation.[47] It is interesting to speculate about why Buridan was so concerned to defend the demonstrability of universal categorical affirmations. Why did he not choose to go along with Ockham and regard all these as disguised conditionals? We have seen that he was not severely critical of Ockham's view, although he regarded it as a result of a defective understanding of logic. Were there not external motivations as well for Buridan's position?

The theologians of the fourteenth century, as is well known, were so eager to defend the divine omnipotence that they began to cast doubt upon the necessary character, and hence upon the certainty, of scientific knowledge. Few, perhaps, were led to skepticism pure and simple. The attitude of Nicholas of Autrecourt[48] was shared by few, certainly not by Buridan. Nevertheless, the contingence of all created things led many to approach scientific questions as hypothetical and to argue for various positions on the basis of imaginary cases.[49] With this in mind, Ockham's reduction of all scientific propositions to denials and conditionals is easily comprehended. In this manner he thought to preserve both necessary knowledge and God's power.

It is quite possible that, as a life-long Master of Arts, Buridan was concerned to vindicate the importance and independence of his faculty against the exaggerated claims of some theologians, who pretended to settle purely philosophical questions with theological arguments.[50] Buridan certainly acknowledged the superiority of theology to all other sciences. In one very interesting text, however, he explicitly set aside as absolutely superior the "theology founded upon the articles of faith"--which quite probably was not meant to include all the speculations and arguments of the theologians--and then argued for the superiority of metaphysics and of the Arts faculty, which taught it. He explained the inferior position of his faculty in the university hierarchy with an uncharacteristic note of sarcasm by pointing to the wealth of the professors of the higher faculties. He also noted the commonness of the Arts. In addition to the three philosophies, metaphysical, natural and moral, which contained the principles of the other sciences, the Arts faculty included such lower arts as grammar, logic, and rhetoric. The true superiority of the faculty of Arts came not from the trivium but from the three philosophies, above all, from metaphysics, the ruler of all other sciences.[51]

It is clear that Buridan was concerned to protect Aristotelian science from the corrosive effects of skepticism about human knowledge. He did not consider the question of the eternity of the knowable merely for its own sake. He saw that the necessity and certainty of scientific knowledge would fall if one eliminated categorical affirmative propositions from its scope. He could not simply ignore the problem raised by the nominalist theologians on the grounds of the divine omnipotence, yet he did not allow such considerations to disturb his thoughts as a philosopher. In this respect, as in so many others, Buridan resembles more nearly such thirteenth century Aristotelians as Albertus Magnus and St. Thomas Aquinas than his fellow nominalists of the fourteenth century.[52]

When we consider two objections which might be raised to Buridan's account of the eternity of the knowable, we shall find support for the claim that events possible by the divine power did not greatly disturb the Parisian professor. The first objection concerns the adequacy of his account of natural supposition as a justification for the eternal truth of the scientific conclusion. How can we be quite sure, says the first objector, that anything past, present or future corresponds to a term in the conclusion? The second objector grants the existence of some such individual but denies Buridan's implication that a proposition is necessary if it is eternally true. If he does not exactly deny that there may be necessary connections of cause and effect, this objector casts doubt upon our knowledge of them. These two objections correspond to what we may call the "Cartesian problem" and the "Humean problem." Both were raised, in certain qualified and limited forms, in the later middle ages.

Buridan might have removed the first difficulty easily by extending the supposita of a term having natural supposition to all supposita past, present, future or merely possible. Perhaps his failure to mention merely possible supposita was an oversight, for elsewhere he apparently includes them. We read in the Sophismata, "if I say 'non-being is known,' this name "being" stands indifferently for every being present, past or future or possible."[53] But it may be that Buridan thought the extension of natural supposition to merely possible supposita broadened scientific knowledge unnecessarily. An intentional restriction of natural supposition on Buridan's part would be an implicit criticism of the contemporary theologian's prediliction for guessing what God might have done. Buridan the natural scientist, I suggest, wanted to insist that knowledge of conclusions is for the sake of knowledge of actual things.

The Cartesian problem concerns the judgment that the objects of our senses exist outside our minds. Given that we have an apprehension of A, can we judge with certainty, usually if not always, that A exists? This question was not raised in an universal form in the fourteenth century, but William Ockham did consider whether we can have an intuitive cognition of something existing when in fact it does not exist. By intuitive cognition Ockham meant knowledge in virtue of which one can judge with evidence whether a thing exists or not.[54] For sensory objects, this knowledge consists in direct perception.

Ockham's reason for raising this question was theological. Since God is Almighty, He can bring about immediately what is normally brought about by secondary causes. Admitting this, one must admit at least in the abstract the possibility of the intuitive cognition of non-existents as existing.

Buridan never denied the possibility of naturally or supernaturally caused deception in particular cases. Such considerations did not disturb him as a scientist, however. The scientist is not concerned, at least not primarily, with occasional errors in particular judgments. The deception of the senses would have to be the rule rather than the exception to be of importance to the scientist. God, in short, would have to be Descartes' Evil Demon. This methodological rule does not necessarily imply the reduction of science to hypothetical knowledge. Given the proper assumptions about being and knowing, uncertainty in particular judgments may be reconciled with certainty in universal judgments. Buridan's attempted reconciliation will be considered shortly. What is immediately evident is that he was not troubled by the Evil Demon.

Buridan firmly believed that such names as "man" and "thunder" name real beings existing outside his own fancy, in the past if not presently. Granted that some names, "chaemera" or "vacuum," for instance, do not name really existing beings, they do describe complex notions constructed from really significant elements.[55] That _all_ names of perceptible objects should have no referents outside his mind either never occurred to him, or only as an hypothesis too absurd to mention.

The Humean problem, unlike the Cartesian, did seem to call for an explicit answer, for Buridan addressed it directly in the _Questions on the Physics_. Causality, Hume thought, is nothing other than the constant conjunction of two events. We _speak_ of necessity only when we are confident that no one has observed an exception to a given conjunction of a "cause" and its "effect." But constant conjunction alone does not in fact amount to necessity. How could Buridan argue from the truth of "A is B" (whenever A exists) to the necessity of "A is B."?

We may surmise Buridan's answer indirectly first, looking at a passage in _Ethics_, VI, 6. Speaking properly of the scientific conclusion, Buridan calls it eternal, necessary, impossible to be otherwise, ungenerated and incorruptible. His argument, if one may call it that, is simple. Science judges in the absence as well as in the presence of its object. This would be impossible if the knowable proposition were able to be false. Such a conclusion must necessarily be true. In short, Buridan deduces the necessity of this knowledge from its certainty. That we have such certain knowledge he considers evident, for of the premises of the argument he says, "haec omnia videntur michi nota per se."[56]

If a scientific conclusion is necessarily true, the subject and the predicate are bound together of necessity, and the premises of a valid scientific argument necessarily imply the conclusion. A certain variety of nominalism prevents the acceptance of such necessary connections. Nicholas of Autrecourt, who among all the scholastics held the most extreme position in this regard, taught that the only necessary conclusions which may be demonstrated are those reducible to the principle of non-contradiction. Accordingly, he denied that one natural fact can be demonstrated from another. In particular, he denied that we can infer the existence of substances from the perception of accidents. Not without reason, Autrecourt has been called "the medieval Hume."

Buridan rejected this position in Question 4 on the first book of the Physics. The arguments presented in this question have been set out by Moody and by Scott;[57] their work will not be duplicated here. It is interesting to note that the two scholars evaluate Buridan's position vis-à-vis Ockham and Autrecourt differently. Moody holds that Buridan defends Ockham against Autrecourt's skeptical attacks. Scott, with more plausibility, sees Buridan's attack on the "Humean" position as independent of any concern to support Ockham. Both agree that Buridan did not give full weight to Autrecourt's arguments. Scott wonders whether Buridan had a thorough acquaintance with Nicholas' writings.

Although this is not the place for a thorough philosophical evaluation of Buridan's arguments against the Humean variety of skepticism, a few simple considerations will show why he refused to admit that only tautological propositions are necessary. Buridan disagreed with the ordinary modern nominalist, of whom Locke as well as Hume may be taken as representative, on one crucial point. The modern nominalists reject the very notion of substance or substantial nature, seeing an individual thing as no more than a bundle of sensible qualities. Buridan's rejection of common natures should by no means be taken as a rejection of natures simply. He alludes frequently both to nature and to quiddity, conceiving them not as "abstract entities" but as concrete and individual. Such a nature is both determinate and knowable, as the name "quiddity" ("whatness") indicates. Finally (and this is the truly precarious step, for Buridan as for all nominalists), different things often have natures sufficiently alike to be grasped by one simple concept. This concept is the universal, about which the scientist claims to have scientific knowledge.

Buridan argues at length in Physics, I, 4 that we have simple concepts of substances. Some of these are singular and some universal.[58] These are not inferred from our experience, as Nicholas had claimed, but are given directly in experience (if singular) or are formed by the intellect in the act of abstraction. Of these, as of effects generally, Buridan says, "The effect bears a certain likeness to the cause, and can therefore represent the cause, in conjunction with the natural inclination of the intellect to truth."[59]

The likeness of image to nature, and the mind's inclination to truth, explain why causes can be known to exist by demonstration quia.[60] The image makes its cause present to the mind, which is able both to intuit its existence and to abstract an intellectual notion corresponding to the perceptible thing. Buridan had little regard for those who denied the natural abstractive power of the intellect. As Moody points out, he refers to those thinkers none too gently as "isti," "aliqui opinantes" and "illi decepti."[61] Buridan, we should note, did not regard substance as an esoteric notion, accessible only to the philosopher. To have the simple substantial concept "man" is to grasp that a man is a single, unified being, susceptible of gaining and losing certain characteristics (sunburn, good posture) while remaining one and the same man.

What is the significance of Buridan's acceptance of substances and (individual) natures? It is simply this: given a nature, certain determinate effects must follow, either invariably (as that the interior angles of a triangle equal two right angles), or for the most part (as that a mouse gives birth to a mouse), or whenever the circumstances are right (as that the sun is eclipsed when the moon comes between us and it). Necessary connections between cause and effect exist, and they are sometimes discoverable if we are sufficiently careful and diligent. Whatever complaints philosophers may make about this doctrine, it has always been a common one among natural scientists, except perhaps since the advent of Quantum Mechanics and Heisenberg's Uncertainty Principle.

Buridan's confidence in the necessity of the causal connections which underlie scientific knowledge is revealed in his discussion of the third and fourth characteristics of scientific knowledge, its certainty and evidence. These two characteristics, which are closely related, are bound to the necessity of the conclusions demonstrated by the science. It is the evidence of the scientific conclusion which causes the mind to assent to it without fear of the opposite being true, that is, with certainty. The evidence of the conclusion, however, is worth no more than the degree of necessity of the conclusion.

In the Questions on the Metaphysics, Buridan asks "whether it is possible to comprehend the truth about things?"[62] In this text he considers the claim which he elsewhere merely assumed: not only can we comprehend the truth, we can comprehend it with certainty. Certainty requires "firmness of assent" and "firmness of truth." The second property is considered first.

Firmness of truth is possible in two ways. Absolute firmness is possible in certain cases, since some propositions cannot possibly be false. Examples of such propositions are "God exists" and "The whole is greater than the part."[63] A certain firmness of truth is also possible on the supposition of the common course of nature. The truth of propositions known by natural science is firmly established, according to Buridan, notwithstanding the fact that God could falsify them.[64] To be significant for the necessity and certainty of science, divine intervention would have to be presumed to exist in the majority of cases (or at least quite often). Only so would the mind's power of abstraction and natural inclination toward truth fail to result in genuine knowledge of natural substances and events. As long as nature achieves her proper result in most cases, the firmness of truth of a scientific proposition is not impugned by the divine omnipotence.

Buridan's attitude was neither unprecedented nor irreverent. Physical as well as theological considerations lay behind it. Nature contains within herself contingent causes and effects, and these are no less, and no more, threatening to necessity in physics than God. Aristotle himself pointed the way towards a solution of the problem arising from the contingency of matter.

Aristotle believed that the same degree of certainty was not to be sought in every science.[65] Only those whose subjects are immaterial (metaphysics and mathematics) are rigorously certain. Yet he did not deny a certain qualified certainty to natural science. This certainty could not extend to judgments about contingent singulars, because the only necessity to be found in singulars is *ex suppositio finis*, that is, on the supposition that a given end is to be attained.[66] For example, one might argue that if an acorn is to grow into an oak, the acorn must fall to the ground and be moistened. One cannot know with certainty that a given acorn will grow into an oak, but one can know that determinant conditions are necessary for it to do so. Reasoning *ex suppositione*, then, gives no scientific knowledge of singulars. Natural science remains on the level of the universal, dealing only with what follows in general from the natures of things.

Aristotle only considered the implications of contingency within nature. His conception of reasoning ex suppositione finis was not proposed as a way of dealing with the possibility of divine intervention, nor did the early Aristotelian commentators use it for that purpose.[67] One suspects that, if queried about cases supernaturally possible, Robert Grosseteste or St. Thomas would reply that the natural philosopher as such knows nothing about this possibility and so has nothing to say about it. His universal propositions concern only what is within the power of nature. Supernaturally possible cases do not pertain to natural science. Buridan clearly held this opinion.[68]

Buridan understood and accepted the Aristotelian conception of reasoning about contingent matters on the supposition that nature attains its end.[69] Under pressure from the theologians, he broadened the notion to reasoning ex suppositione communis cursus naturae, the supposition of the common course of nature.[70] This understanding of physical reasoning points to the purely natural character of the physicist's arguments. If B follows from the nature of A in a determinate and necessary manner, given no natural or supernatural impediment, the conclusion "A is B" is "firm in truth." This is the necessity proper to natural science.[71]

Buridan has been accused of (or perhaps praised for) not taking the Catholic faith very seriously, and his easy rejection of the relevance of the divine omnipotence to scientific knowledge has been taken as a case in point.[72] The scholars who charge Buridan with heresy have not sufficiently considered the possibility that Buridan understood God's power differently than Ockham and many other fourteenth century theologians. What really is at issue is the proper conception of the divine attributes, especially God's power, wisdom and goodness, and their relation to one another.

It is reasonable to suppose that Buridan thought these attributes could not be isolated from one another. As a moral philosopher, Buridan was a rationalist rather than a voluntarist. Like St. Thomas, he based morality on reason and the good, not on arbitrarily exercised authority.[73] Buridan's attitude towards the theologians who turned God's omnipotence against science is quite understandable in light of his moral philosophy. Believing that God does not create the good but (since He _is_ the Good) that He is in some sense measured by it, Buridan naturally believed that arbitrary intervention in the world He created would be contrary to His goodness and wisdom. This belief, moreover, is only what we should call "common-sense Catholicism," which admits no disharmony among the divine attributes. It should hardly be used as evidence that Buridan did not take his faith seriously.

God's omnipotence, we may conclude, was no impediment in Buridan's mind to the firmness of truth required for scientific certainty. But certainty requires more than firmness of truth; firmness of assent is also required. This is where the evidence of scientific knowledge comes in. Firmness of assent is had whenever one adheres to a conclusion without fear that its opposite is true.[74] The evidence of scientific demonstration produces this firm assent. But there are other causes of firm assent. Buridan distinguishes three. The first is the will, the second, natural appearances, the third, evidence.

Firmness of assent based upon the will is the characteristic of faith, both of Christians and of heretics.[75] It is revealed by the willingness of the saints to die for the faith. The firmness of assent which comes from natural appearances and our reasoning about them is a characteristic of opinion. We may assent in this manner to true propositions and to false ones, and even to demonstrable ones.[76] What one man knows scientifically another man holds as an opinion, both, perhaps, with equal confidence. Evidence, finally, produces firm assent. But evidence is of two sorts, absolute or <u>secundum quid</u>. First principles, such as the principle of non-contradiction, are absolutely evident. The conclusions known by the natural and moral sciences are evident upon the assumption that the common course of nature is observed.[77]

Buridan may have differed from the most prominent scholastics of the thirteenth century in his conception of the objects of knowledge, but he firmly agreed with them on the universality, necessity, certainty and evidence of scientific knowledge. He saw that to make knowledge merely hypothetical was to reduce it to opinion. Hypotheses did indeed play a role in science, particularly in physics, as I shall explain later. The perfection of scientific knowledge was not attainable in every instance. But Buridan was firmly committed to the high ideal of scientific knowledge, the only knowledge really worthy of the name.

His explanation of the universality and necessity of science was intimately bound to his nominalistic logic, and so it was characteristically "modern." His defense of the evidence and certainty of science was completely in accord with the principles of the "doctors of old," whom Buridan often preferred to follow.[78] As a philosopher, Buridan did not feel called upon to defend his faith, though he certainly was not shy about affirming it when necessary. He was, however, very much concerned to defend the Aristotelian ideal of scientific knowledge against all those who cast doubts upon it. If his defense of the certainty of science has a certain sharpness about it, this was no doubt due to the strength and influence of the opposition.

We have seen that Buridan acknowledged several distinct kinds of cognitive activity. To each of these there corresponded a habit. Some of these he called scientific, although this name is equivocal. A distinction has to be made between the habit of terms (simple apprehension), the habit of principles (understanding), and the habit of conclusions (science proper). Only the third is produced by discursive reasoning. Buridan held that all three habits are able to put our minds in contact with existing things and to produce certain knowledge of them.

Buridan's understanding of certainty as firmness of truth joined to firmness of assent was quite perceptive. It acknowledged the difference between true certainty and the mere appearance of certainty which is founded upon firm assent alone. His analysis of certainty also acknowledged that there is more than one source of firm assent.

These distinctions make it easy to differentiate science from opinion, belief, and the virtue of faith.

Scientific knowledge differs from opinion and from the false beliefs of heretics, because the latter are not firm in truth. Lacking either truth or the necessity of truth, they cannot be certain. Opinion may err because appearances and human reasonings may be deceitful. Heretics err because they will to believe what is false. Faith, on the other hand, is certain, having firmness of truth because of its source (God, who reveals it) and firmness of assent on the part of the will of the believer. The certainty of faith differs from the certainty of science in the source of the certainty of its assent. Science, unlike faith, is evident; its demonstrations compel assent.

Every kind of knowledge which Buridan accepted as scientific fits into the Aristotelian mold, in theory at least. His conception of science was not overly simple, however. He admitted that not all sciences were equally scientific. They differ in many ways, not least in their evidence and certainty and in the necessity of their conclusions. Such differences among the sciences were important factors in their classification.

[1] William Wallace writes of Buridan in Causality and Scientific Explanation (Ann Arbor, Michigan, 1972), I, p. 104, that "in material logic he subscribed to the Aristotelian concept of science . . . and understood well its theory of demonstration. In fact, his understaning of how the natural sciences demonstrate *ex suppositione* . . . is one of the most balanced accounts in the fourteenth century." *Ex suppositione* means "on the supposition that the common course of nature is observed." Concerning *ex suppositione* demonstrations, see pp. 192-94.

[2] I am using this somewhat unsatisfying word to translate the Latin "*scibile*," which Buridan at times used to refer to the thing known--what he and others called elsewhere the object (or subject) of knowledge.

[3] There has been considerable controversy among medievalists over the meaning and usefulness of the characterization of someone as a nominalist. For a thorough account of the various senses in which "nominalism" has been used and a review of the current reevaluation of medieval nominalism, see William J. Courtenay, "Nominalism and Late Medieval Religion," in The Pursuit of Holiness in Late Medieval and Renaissance Religion, ed. Charles Trinkaus and Heiko A. Oberman (Leiden, 1974), pp. 26-59. That Buridan was a nominalist, in particular, has been called into question.

It may be true that the characterization of an epistemological theory such as Ockham's as nominalistic does it an injustice, at least if nominalism is taken to imply skepticism about knowledge of real things. But nominalism is indeed useful as a description of those metaphysical theories which reject natures common to more than one individual and deny abstract entities of every sort.

Whereas the moderate realism of, for example, St. Thomas Aquinas, may seem to border on nominalism in its rejection of any common *entity*, it does in fact admit and require a common nature, which is individuated (and so made existent) by matter.

Nominalism, in the sense in which I am using the term, admits nothing at all common to more than one individual, neither subsistent nor non-subsistent. Our use of common terms (genera and species) is attributed to the fact that things are similiar, despite the lack of any such thing as "similarity." In this sense Buridan certainly was a nominalist. The lack of any account of individuation is a good indication. Some (T.K. Scott, for instance, in the introduction to his translation of Buridan's Sophismata [Sophisms on Meaning and Truth (New York, 1966)], p. 13) claim that Buridan was a much more radical nominalist than Ockham.

However that may be, Buridan never used common natures or abstract entities as explanatory principles in his treatment of the classification of sciences--nor have I seen them elsewhere in his writings. What muddies the waters for some scholars, I believe, is this: Buridan disagreed with certain physical doctrines and theories which are commonly labeled "nominalist." I am thinking particularly of the Ockhamist account of motion. But this is not at all central to nominalism, understood as an epistemological theory.

Moreover, Buridan made much use of the terminology used by moderate realists. He did so, no doubt, because it is sound Aristotelian terminology and he considered himself a faithful Aristotelian! Buridan wrote about "quiddities" (often used by others as an alternate term for common natures), of rationes (which according to St. Thomas were common to many) and of abstraction (which traditionally implied the abstraction of a common nature or a ratio from many individuals). In no instance does Buridan say or imply that a quiddity or ratio is anything other than the singular possession of a singular thing. Only quidditative terms are common, and they are common predicates. Nor did he understand abstraction as a realist would. Yet it might be easy to be misled by Buridan's manner of expression in certain contexts, because he often preferred to use the language of the realists.

[4] It has frequently been noted in studies of scholastic logic that "proposition" was often used to describe what we would call a "sentence," that is, the concrete spoken, written or mental utterance. I will follow the medieval usage here. "Proposition" will normally be taken to mean a sentence unless the context requires otherwise.

[5] It will become clear in the course of this dissertation how much more faithful Buridan was to Aristotle in the classification of sciences than Ockham, who, in effect, gave up the game. In an entirely different area, James J. Walsh has shown how faithful an Aristotelian Buridan was as a moral philosopher in his acceptance of the ideal of a rational ethics, as opposed to the more typical authoritarian ethics of other nominalists. Walsh shows that even Ockham sometimes seems to admit a rational ethics, although this is hardly consistent with his usual view of morality. See "Nominalism and the Ethics: Some Remarks about Buridan's Commentary," J. Hist. Phil. 4 (1966), 1-13. Walsh has also dealt with Buridan as a moral philosopher in "Is Buridan a Skeptic about Free Will?" Vivarium 2 (1964), 50-61, and "Buridan and Seneca," J. Hist. Ideas 27 (1966), 23-40. There is little else available in English on Buridan's moral philosophy.

[6] To give a single example pertinent to the classification of sciences, Ockham explicitly rejected the Thomistic notion of the ratio or intelligible aspect, which Buridan used without comment. Concerning Ockham's rejection of Thomas's approach to the classification of the sciences, see Armand Maurer's "Ockham's Conception of the Unity of Science," Med. Stud. 20 (1958), 98-112.

On the other hand, Ockham also at times redefined and used traditional terms, as in the case of "object" and "subject" as applied to a science. But unlike Buridan, who used these terms more or less in the usual way, Ockham makes it clear that he was using them quite differently. See the prologue to his Expositio Super VIII Libros Physicorum, trans. Philotheus Boehner, in Philosophical Writings (Indianapolis, 1964), pp.9-11.

[7] *Questiones Super Octo Phisicorum Libros Aristotelis* [Cited hereafter as QP] (Paris, 1509; repr. Frankfurt, 1964), I,1, f.2v: "Notandum est faciliter quod scientia proprie dicta que vocatur demonstrativa est habitus per demonstrationem vel demonstrationes acquisitus."

[8] These categories, or "predicaments," are specified by the ten questions which, according to Aristotle, can be asked about a thing. They form the most universal classes (the *genera generalissima*) to which everything is reducible. They are: substance (*substantia*), quantity (*quantitas*), quality (*qualitas*), relation (*ad aliquid* or *relatio*), place (*ubi*), time (*quando*), position (*situs*), action (*actio*), passion (*passio*), and state (*habitus*). See Aristotle, *Categories*. All the categories but the first are called accidents. For the classification of qualities, which Aristotle did not intend to be exhaustive, see *Cat.*, 8.

[9] *De Anima*, II, 1, 412a22ff., trans. J. A. Smith, in *The Basic Works of Aristotle*, ed. Richard McKeon (New York, 1941), p. 555: "Now the word "actuality" [applied here to the soul] has two senses corresponding respectively to the possession of knowledge and the actual exercise of knowledge." According to Aristotle, both actual and habitual knowledge are "actualities," that is, perfections of the soul. Both make the soul more "actual" than its native condition of pure potentiality.

In *De An.*, II, 5, 417a21ff. (p. 565), Aristotle uses knowledge, or, more precisely, the knower, as an example of the way in which two different sorts of potentiality are distinguished from each other and from actuality: "We can speak of something as 'a knower' either (a) when we say that man is a knower, meaning that man falls within the class of beings that know or have knowledge, or (b) as when we are speaking of a man who possesses a knowledge of grammar; each of these is so called as having in him a certain potentiality, but there is a difference between their respective potentialities, the one (a) being a potential knower, because his kind or matter is such and such, the other (b), because he can in the absence of any external counteracting cause realize his knowledge in actual knowledge at will. This implies a third meaning of 'a knower' (c), one who is already realizing his knowledge--he is a knower in actuality and in the most proper sense is knowing, e.g. this A." The habitual knower is knower (b).

[10] Buridan insists in the *Questiones super decem Libros Ethicorum* [QNE] (Paris, 1513; repr. Frankfurt, 1968), VI, 1, that the habit of a science is not necessary to produce acts of that science. He notes, in fact, that the sharpest minds never form the habits of some conclusions, because they do not desire to think about a demonstration often enough to fix it in their minds. They grasp a conclusion quickly and easily by instruction but are too bored to assimilate it (ff. 116v-117r). Does this reflect Buridan's experience as a teacher?

[11] Although not totally unconcerned with pedagogy, Buridan and the other philosophers and theologians of the thirteenth and fourteenth centuries did not give any prominence in their writings to the notion of science as a discipline to be passed on from master to pupil. That it was something to be taught and learned was taken for granted.

[12] Modern discussions of the nature of science and the classification of sciences make use of both pedagogical and sociological criteria. The emphasis on the role of the scientific community in the definition of science is unmistakable.

[13] In _Cat._, 8, 11a6-31, Aristotle claims that although knowledge, taken generically, is a quality, it is also a relation, because it is knowledge _of something_--of an object, that is. The various branches of knowledge correspond to the different relations specified by these objects. He adds that although we never speak of a particular branch of knowledge as relative (we never say, for example, the grammar of morphology or of syntax), we do define the science in relative terms: grammar is the knowledge of morphology and of syntax. Although we do speak of the history of physics or the philosophy of biology, the "of" does not point to a relation in these phrases; it is rather a genitive of specification.

[14] There can be science of the possible as well as of the actual. See Buridan's _Sophismata_, Ch. V, where he considers the ampliation of supposition (Scott trans., pp. 144-157). By means of modal verbs the supposition of terms is ampliated (that is, extended) so that the terms stand for possible as well as actual individuals.

[15] I, 1, 2v: "Ad demostrationem autem plura concurrunt, scilicet premisse et conclusio et termini ex quibus constituunt premisse et conclusiones et res significate per illos terminos et de omnibus illis dicitur haberi scientia, licet non eodemmodo sed equivoce scilicet secundum diversas rationes attributas procedunt ad unam a qua nomen primo impositum est, nam proprie scientia demonstrativa dicitur esse de conclusione que demonstratur. Secundo etiam dicitur esse de premissis sciencta quia per eas conclusio demonstrative scita est. Tertio vero dicitur esse scientia de terminis significativis propterea quod ex eis constituta est conclusio demonstrativa scita vel etiam premisse per quas illa scitur. Quartomodo scientia demonstrativa dicitur esse de aliis rebus que non sunt propositiones neque termini significativi quia ille significantur per terminos ex quibus conclusio sive premisse demonstrationis sciuntur. Sic etiam et non aliter dicimus nos habere scientiam de celo et astris, de gravibus et levibus, de plantis et animalibus, de deo et intelligentiis, de sanitate et egritudie, de virtutibus et vitiis, et sic de aliis multis."

The original meaning of demonstrative science, from which the equivocal senses are derived, is knowledge of the demonstrated conclusion. Science of premises, terms and things is understood by reference to science of the demonstrated conclusion. "Science" is being taken here as a _pros hen_ equivocal term (equivocal by reference), although Buridan does not say so. Concerning this type of equivocation in Aristotle, see Joseph Owens, The Doctrine of Being in the Aristotelian Metaphysics (Toronto, 1963), pp. 118-123. It is significant that, when distinguishing the objects of demonstrative science, Buridan refers to science as the knowledge of a single demonstration rather than to science as a collective body of knowledge. Such a collective or "whole" science is also about something, as will be shown later.

It should be noted that elsewhere Buridan says that science is of three things: the demonstrated conclusion; the terms of which it is composed; and the things signified by these terms (QCM, I,1, p. 4). One reason why he omitted the premises from this list may be suggested: the conclusion, its terms and the significata of the terms belong together, the terms being components of the conclusion and the things signified by the terms standing in intimate relation to the conclusion. The premises, on the other hand, are separate and other than the conclusion. They are known by habits completely different from the habit of the conclusion, if they in turn are the conclusions of other demonstrations. Or, if they are axioms, the premises are grasped by some act other than an act of demonstrative science. The premises and conclusions do belong to the same science, however, if science is taken to mean a collective or whole science and not the science of one demonstration.

In QNE, VI, 6, Buridan distinguishes two meanings of "science," listing only the knowledge of conclusions and of things. No other sense is pertinent to the argument in this text.

[16] See the quotation in note 17. In this way and in no other, Buridan writes, do we have knowledge of things.

[17] QP, ibid. "Immo manifestum est quod non queremus habere scientiam de tribus primis modis nisi propter habere scientiam in isto quarto modo. Non enim curaret artifex de propositionibus et terminis nisi propter hoc crederet habere scientiam de rebus circa quas intendit agere et sibi utilia procurare."

It is enlightening to compare this text with the following one from Ockham (Prol. to Exp. super Phys., Philosophical Writings (Edinburg, 1959), p. 11: "Et ideo, proprie loquendo, scientia naturalis non est de rebus corruptibilibus et generabilibus neque de substantiis naturalibus nec de rebus mobilibus, quia tales res in nulla conclusione scita per scientiam naturalem subiiciuntur vel praedicantur. Sed, proprie loquendo, scientia naturalis est de intentionibus animae communibus talibus rebus et supponentibus praecise pro talibus rebus in multis propositionibus . . . " Although the doctrine may be the same as Buridan's in its essentials, the attitude is quite different.

[18] Premises may be principles or they may be conclusions of other demonstrations, so they may be subsumed under the two classes here distinguished from terms. Principles are distinguished from conclusions by being per se nota (known of themselves); proof of them is neither possible nor necessary.

[19] QNE, VI, 10. Here he argues that no complex principle (that is, no per se nota proposition) is evident in the absence of all prior concepts of propositions (complexa) or of terms (incomplexa): "quam semper oportet per primam intellectus operationem terminus simpliciter apprehendere priusquam per secundam operationem rationis eos componere vel dividere."

[20] It is interesting to note that Buridan calls the process by which the mind forms a universal concept abstraction--a term used by the realists. (See, for example, QP, I, 4, 5v-6r.) Buridan regards abstraction as the abstraction of a universal concept from the concepts of individuals ("abstrahendo fit conceptus universalis ex conceptu singulari") rather than as the abstraction of the universal from things, as a realist would.

Realists, of course, admitted that there is such a thing as the apprehension of terms and abstraction from them, but they saw this as pertinent only to rational sciences such as logic and grammar. Not so for Buridan. Among the objects of physics (and of all other sciences) are terms standing for individual things, as we have seen.

[21] See VI, 11, "Utrum sapientia sit intellectus et scientia," 128v: "Nam intellectus est habitus principiorum specialium per se notorum, scientia autem est habitus conclusionum ex se dubitarum prius et demonstratarum posterius." He makes use of this distinction in question 10, "utrum intellectus est virtus," as well.

[22] VI, 10, 126v: "Et non oportet dicere sicut aliqui dicunt quod talia principia que sunt indemonstrabilia sunt unum tamen aut duo aut pauca sicut illa que posita in quarto methaphysice, immo tot oportet esse principia indemonstrabilia vel plura quot sunt conclusiones demonstrabilia saltem quarum una non demonstratur per alia." Buridan here opposes those (such as Nicholas of Autrecourt) who tried to reduce all scientific demonstrations to the principle of non-contradiction or to a few such general principles, as well as those who did not admit that every special science has indemonstrable first principles proper to it.

[23] St. Thomas Aquinas and his followers rejected the possibility of human beings having intellectual knowledge of individuals as individuals. A quite sound argument for this position can be given on Aristotelian grounds. Since knowledge grasps the formal element of things, and matter of itself is unknowable, it follows that anything bound to the material nature of a thing is unknowable. St. Thomas held that individuality follows from matter rather than from form, and so the individual material being is unknowable in itself.

Duns Scotus and his followers opposed this view, because of their different understanding of individuation. An individual, according to Scotus, is made such by a formal principle, not a material one. The nominalists, by accepting the existence of individuals as the primary fact and by ceasing to be concerned with the reason for the existence of individuals, saw no problem in the intuitive knowledge of individuals as such. For a thorough account of this matter, see

Sebastian Day, Intuitive Cognition: A Key to the Significance of the Later Scholastics (St. Bonaventure, New York, 1947).

24 Buridan affirms the knowability of individual substances in QP, I, V, but the reason given is altogether different than the one given in QCM (see n. 25.) He argues that since a proposition can be grasped by the intellect, the parts into which it is divided (its terms) must be understood by the intellect as well. Knowledge of such terms implies knowledge of the individuals they conceive. This argument, unlike the one in QCM, depends upon the nominalistic doctrine that universal mental terms conceive individuals rather than common natures.

25 QCM, I, 1, p. 6, ll. 25-33: "Ad aliam dicendum est quod sensibilia bene sunt intelligibilia; et si sensus et intellectus ponantur potentiae distinctae, tamen sunt subordinatae, quoniam intellectus est potentialiter superior secundum ordinem ad obiecta. Potentiae autem sic subordinatae distinguuntur per obiecta non tali modo quin idem possit esse obiectum utriusque, sed tali modo quod omne obiectum unius est etiam obiectum alterius sed non e contrario. Et ita est in propositio, quia omne sensibile est intelligibile et non e contrario."

It is not clear to me where Buridan got his first premise. It would be unacceptable to many scholastics of the thirteenth century. On the other hand, it was a Neoplatonic commonplace that a higher power can do what a lower power can. Cf. Boethius, De Consolatione Philosophiae, V, pros. IV, ll. 92-109: "nam superior comprehendendi uis amplectitur inferiorem, inferior uero ad superiorem nullo modo consurgit. . . . Ratio quoque cum quid universale respicit, nec imaginatione nec sensibus utens imaginabilia uel sensibilia comprehendit." The application of the principle to the intellect in Boethius is suggestive of the direct or indirect influence of this earlier tradition upon Buridan.

26 In Metaphysicen Aristotelis Questiones [QM] (Paris, 1518; rpt. Frankfurt, 1964), IV, 2, 12v: "Item scientia non descendunt ad distinctiones individuales." (The title page of the reprinted edition gives the date incorrectly as 1588.)

27 QM, VI, 1, 33r: "Prima [conclusio] est quod metaphysica considerat entia non solum in generali sed etiam in speciali; hoc probatur per Aristotelem dicentem quod ad metaphysicam et non ad aliam scientiam pertinet considerare utrum sit idem socrates et socrates sedens vel etiam coruscus et coruscus musicus, et sic de aliis. Ecce igitur descensum metaphysicii ad valde specialia imo etiam ad singularia pro quanto contingit ea cadere sub arte."

The reason for the last phrase is not made clear here. Probably Burdian does not intend to use "ars" as a description of a kind of knowledge distinct from science. Such looseness of terminology is not without precedent in his works, nor is it uncommon in other scholastic discussions of science. In QP, I, 1, for example, Buridan refers to the metaphysician as an artifex!

28 QM, VII, 18, 53r, "Utrum singulare possit difiniri." In his reply to this question, Buridan distinguishes two ways in which something may be said to have a definition. The first is the definition of the term signifying the thing: "Unomodo est alicuius diffinitio tanquam termini convertabilis cum ipsa diffinitione cuius significatio explicatur per diffinitionem, sicut hec oratio animal rationale est difinitio huius termini homo." In this sense, no singular thing can be defined. That is to say, we cannot know essentially or quidditatively what "Socrates" means.

29 QM, VII, 20, 54r: "si ego cognosco sortem quem nunquam novisti et tu petis quid intelligo per sortem et ego respondeo tibi quod per sortem ego intelligo unum hominem orantem qui est magister in theologia et sic addendo quascunque circumstantias voluero adhuc non exprimo tibi conceptum singularem." That is to say, I cannot give you a concept of Socrates except by pointing him out or by recalling your own concept of him to memory.

30 The second way in which a thing may have a definition is in virtue of being something signified by a term having a definition: "alio modo est diffinitio alicuius rei significate per terminum difinitum vel per ipsam diffinitionem." This is to consider the thing in its concrete existence. In this sense an individual does indeed have a definition, but only in so far as it is a significate of a defined term. Socrates himself can only be defined in so far as he is a man.

31 Speaking formally, singular categorical propositions are indemonstrable because a definition, or something following from it, serves as the middle term in a scientific demonstration. Buridan argues in the _sed contra_ of question 18 from the impossibility of demonstrating anything of singulars to the impossibility of defining them. Cf. QP, I, 1, 13r: "Quando etiam dicitur quod non est scientia de singularibus intelligendum est quod propositiones singulares non sunt demonstrabiles, quod quomodo et quare sit verum debet videri septimo methaphisice."

32 This example comes from _Metaphysics_, IV, Ch. 2, 1004b2. Aristotle asks, who will enquire into this if not the metaphysician? Buridan generally agrees, though he is not always clear about where logic ends and metaphysics begins. (See below, p. 259) _Cf._ the following text from _Sophismata_, Ch. 1 (Scott translation, p. 81): "I say that Socrates-loving-God is Socrates if Socrates loves God. But if Socrates does not love God, then Socrates-loving-God is nothing. And similarly, Socrates-hating-God is Socrates, if Socrates hates God." This is from a work on logic and semantics, but we may not infer that Buridan's conclusion is not a metaphysical one.

[33] According to Buridan's theory of truth-conditions for categorical propositions, "Every true particular affirmative is true because the subject and predicate stand for the same thing or things." (Sophisms on Meaning and Truth, p. 93.) As Scott puts it in his article, "John Buridan on the Objects of Demonstrative Science," Speculum 40 (1965), p. 661, Buridan takes an extremely nominalistic view of a proposition. If its terms have no definite referents, the proposition is false.

Since "is" is a verb in the present tense, "immortal" stands for all presently existing immortal things. If Buridan exists now or has ever existed on this earth, he now has an immortal soul. (A slightly different interpretation of "is" would allow for the future existence of Buridan as a sufficient condition for the truth of our proposition. This has no bearing on the present argument, however.) Since his soul is one of the things for which the predicate stands, the proposition is true, in accordance with the truth condition stated above. On the other hand, if Buridan has never existed, the statement is false, because Buridan's soul is not one of those things for which "immortal" stands in the proposition. See Sophisms, Ch. V, for an account of how verb tenses and modals modify supposition and hence affect the truth of propositions.

Buridan could also account for the falsity of the proposition were it true that no human is immortal. In that case, the predicate would stand for no souls whatever.

[34] QM, VI, 1, 33r: "Ecce igitur descensus metaphysici ad valde specialia immo etiam ad singularia. Unde quantum ad hoc notandum est quod nulla scientia habet scire cathegorematice utrum est idem sortes et sortes sedens, quia non est scibile proprie quod sortes est cum hoc sit contingens, sed sub condicione metaphysicus valde bene habet scire si sortes est, et si ipse sedet, utrum est idem sortes et sortes sedens: sic etiam bene est scientia de singularibus." Compare QP, I, 1, 2v, "Respondetur," etc.

[35] QM, VII, 20, 54r: "dico ergo primo quod bene certum est quod multi sunt termini quarum quilibet pro unica re supponit et non est possibile stante eius significatione quod pluribus supponat, sic iste termius deus secundam suam significationem propriam nunquam potest pro pluribus supponere quia impossibile esse plures deos esse, et ita etiam iste terminus sol vel ista terminus luna non pro pluribus supponere nisi fiat miraculum quia non est possibile per naturam quod sit alius sol vel alia luna vel alius munda etc. Et tamen dicti termini non sunt termini singulares, immo magis sunt termini communes quantum est ex modo sue impositionis, quia non repugnet illis terminis ex modo sue significationis supponere pro pluribus. Si enim per possibile vel impossibile esset alius deus vel altera sol vel altera luna predicti termini sine nova impositione supponeret pro iis qui nunc sunt."

Buridan argues the same point in QCM, I, 1, pp. 5-6, where he makes the contrast between such terms and a singular term such as "Socrates" clearer. "Socrates" stands for one determinate individual in such a way that, should a thousand other men similar to him be created, "Socrates" would not stand for them unless a new meaning was imposed upon it.

Buridan argued in this manner in the De Caelo in order to refute an objection to the possibility of a science of the world. He did not dispute that science is of the universal.

36 For Buridan, the individual is certainly knowable in the sense that, if we have had sensory experience of it, we have a simple singular concept of it. See QM, VII, 20. Here he is concerned to show that we do not have any such simple concepts of things we have not experienced, although we may indeed give them singular names.

37 Is it only because one cannot know demonstratively that an individual exists that one cannot demonstrate anything of it categorically? Yes, if we consider the individual as a thing signified by a universal term. But, considering the individual in its individuality, nothing can be demonstrated of it because it is undefinable.

38 "Every man is risible" was commonly taken by the schoolmen as an example of a demonstrable proposition.

39 "John Buridan on Demonstrative Science," pp. 669-670. Many accounts of the theory of supposition exist. See, for example, Ph. Boehner, Medieval Logic (Manchester, 1952); E. A. Moody, The Logic of William of Ockham (New York, 1935); Truth and Consequence in Medieval Logic (Amsterdam, 1953), and Scott's introduction to Buridan's Sophisms. For a brief account of supposition, see Appendix I B.

40 QNE VI, 6, 122rA.

41 Scott, "John Buridan on Demonstrative Science," p. 666. It was indeed Aristotle's opinion that there has been an eternal succession of beings in each species. Buridan also attributes this view to Averroes. Scott adds that this opinion "might as easily have belonged to Thomas Aquinas." This is difficult to imagine, since it is Catholic dogma that the universe was created in time. (He did hold that one cannot prove by reason that the world had a beginning in time.) St. Thomas' approach to the necessity of science was quite different; in some respects, it was similar to Buridan's, though not in all. The eternity of the object of science was tied to the eternity of the divine ideas, according to Thomas.

42 Scott, art. cit., p. 668.

43 QA, III, 5, 25r: "Videtur enim mihi quod nomina quae significant res, nullum consignificando tempus determinatum, significant indifferenter res praesens, praeteritas et futuras . . .

unde possum apud intellectum componere inter conceptum rei et conceptum temporis . . . ut dicendo 'Caesar fuit,' 'Caesar erit.'"

44 Summulae Logicales, 6.04, trans. Scott, p. 670.

45 QNE, VI, 6, 122v: " . . . naturalis autem est quando [terminus] supponit indifferenter pro omnibus suppositis sive sunt presentia sive preterita sive futura."

46 QNE, VI, 6, 123r: "concederem cum opinione predicta [Ockham's] quod si termini propositionis vel alter eorum pro nullo supponeret neque presente neque preterito neque futuro, propositio cathegoria affirmitiva non posset esse vera."

47 QNE, loc. cit.: "forte hec opinio et illa eandem intendebunt sententiam" (123r). Buridan admits in this text that every universal proposition known in a science can be reduced to a conjunction of singular propositions, each of which is conditional. (For example, "Every man is risible" reduces to "If A is a man, A is risible," and "If B is a man, B is risible," etc.) But he thinks it much better, and more logical, to hold that a science contains categorical propositions whose subjects have suppositio naturalis, even though it is possible to convert all these to conditionals if one wants. In some cases it would be awkward to do so. (For example, "The sun is hot" would become "If the sun exists, the sun is hot," and "God is the first cause of motion" would become "If God exists, he is the first cause of motion."

Some apparently categorical conclusions, however, must be reduced to conditional form if they are to be made acceptable, on Buridan's view. A good example is found in Aristotle's laws of motion. These would hold true if ideal conditions obtained (as by the divine power they might), but in reality they do not. See Edward Grant's article, "Scientific Thought in Fourteenth-Century Paris: Jean Buridan and Nicole Oresme," in Machaut's World: Science and Art in the 14th Century, ed. M. P. Cosman and B. Chandler (New York, 1978), p. 120, n. 23.

48 Autrecourt pushed the argument from the possibility of divine intervention to such an extreme that scientific knowledge became for him a matter of opinion. Only the objects of the five senses and of one's own psychological operations were knowable with evident certitude. For an account of Autrecourt's views, see Julius Weinberg, Nicholas of Autrecourt (Princeton, 1948); for a briefer account, see Gilson's History of Christian Philosophy in the Middle Ages (New York, 1955), 505-511. For a comparison with Buridan, see Moody, "Ockham, Buridan and Nicholas of Autrecourt," Fr. Stud. 7 (1947), 113-146. This article stirred up a controversy about the relationship between Buridan and Ockham. This is now being reassessed. See, for example, Scott's reply to Moody, "Nicholas of Autrecourt, Buridan and Ockhamism," J. Hist. Phil. 9 (1971), 15-41.

49 See Edward Grant, Physical Science in the Middle Ages (New York, 1971), pp. 26-35. This approach to scientific argument was fostered by the Condemnation of 1277. Although Buridan sometimes cites the Parisian articles to make a point, he was fundamentally out of harmony with the uses to which the theologians put them, at least when they used them to undermine the foundations of traditional Aristotelian science.

50 For an evaluation of the importance of Buridan's status as a Master of Arts, see Grant, "Scientific Thought in Fourteenth-Century Paris." The contrast in attitude between Buridan and the theologian Oresme is clearly explained in this article. The distinction between God's absolute and ordained power, which the nominalists made so much of, has attracted considerable attention. For more on this important topic, see Courtenay, "Nominalism and Late Medieval Thought: A Bibliographical Essay," Theol. Stud. 33 (1972), pp. 716-734.

51 QM, I, 3, f. 4r: "Ad primam quando arguitur quod ipsa [metaphysica] non est principalissima, dico quod verum est si comparetur ad theologiam fundatam super articulos fidei; sed illa circumscripta est omnium aliarum scientiarum principalissima. Tota enim scientia legum et decretorum subiicitur morali scientie sive morali philosophie et ei subalternatur, nisi pro quanto decreta et decretales accipiunt aliquid ex theologia. Medicina autem ex toto subalternatur naturali philosophie, ideo ille non merentur dici scientie principales. Quare autem nostra facultas sit infima, potest dici quod hoc est propter divitas eorum qui alias profitentur et quia nostra facultas est valde communis. Continet enim grammaticam, logicam, rhetoricam, et ratione harum ipsa non meretur dici principalis, sed cum illis artibus ipsa etiam continet naturalem philosophiam secundum quam est principalis medicine, et moralem philosophiam secundum quam est principalis legum, et metaphysicam secundum quam est principalis simpliciter." Buridan may be asserting the superiority of the Arts faculty over the faculty of Theology too, but he does not come right out and say so.

52 William Wallace has taken an interest in showing how Buridan's account of the certitude of human knowledge is quite in line with St. Thomas'. See "Buridan, Ockham, Aquinas: Science in the Middle Ages," Thomist, 40 (1976), 479-81. I, too, see a certain similarity between Buridan's position and Aquinas'. As a theologian, however, St. Thomas was more interested than Buridan in the sciences as handmaids of theology. Buridan did not concern himself with the sciences as handmaids. Rather, he subordinated all other sciences to metaphysics and concerned himself with vindicating that science as the pinnacle of human knowledge. This is not to say that Buridan objected to the theologians' use of human sciences nor that he denied the absolute superiority of Sacred Theology. I believe that in this matter we see more a difference of interest between Buridan and Aquinas than a real difference of opinion.

53 Sophisms, p. 152. Buridan does not mention natural supposition in this text, but it is most likely that he had it in mind. He gives a full account of natural supposition in the Tractatus de Suppositionibus (ed. M. E. Reina, Riv. crit. di stor. della filo., 12 (1957), 175-208; 323-352.) One of the occasions for the use of natural supposition is in propositions containing a word such as "understand," "know," and so on. The example in the Sophismata is of this sort. Another occasion is in scientific propositions. (See Ch. III, p.206.)

Buridan also neglects to mention possibiles in his definition of natural supposition in this text. We might note, however, that what primarily concerns him is the distinction between terms which connote a definite time and terms which do not. In other words, he is interested in tense, not mood.

54 Ockham, Prol. Ord., Q. 1, in Philosophical Works, ed. Boehner, pp. 25-30.

55 Sophisms, pp. 72-77.

56 QNE, VI, 6, 122rA.

57 Moody, "Ockham, Buridan, and Nicholas of Autrecourt," pp. 134-142. Scott, "Nicholas of Autrecourt, Buridan and Ockhamism," pp. 31-41.

58 I, 4, 5r-v. Buridan distinguishes four ways in which the mind forms simple concepts: (1) objectively: an impression of an external object in the faculty of sense serves as an object of the common sense, forming a notitia in that faculty; the notitia in the common sense then serves as an object of the intellect, giving rise to an intellectual notitia. By this means a simple concept of a singular is formed. (2) elicitively: this mode pertains to the vis aestimativae, shared by men and animals. This power forms a non-sensible intention, as of friendship or hostility, from perceived accidents. (3) abstractively: Because of the importance of this mode for scientific knowledge, I shall quote Buridan: "habeo primo conceptum confuse et simul representantes substantiam et accidens ut cum percipio album; non enim solam albedinem video sed album; et tamen postea percipio idem moueri et mutari de albo in nigrum judicio hoc esse aliud ab albedine, et tunc intellectus naturaliter habet virtutem dividendi illam confusionem et intelligendi substantiam abstractive ab accidente et accidens abstractive a substantia et potest utriusque formare simplicem conceptum, et sic etiam abstrahendo fit conceptus universalis ex conceptu singulari." (4) The fourth mode is the forming of one simple concept from two simple concepts joined by the copula. Buridan argues that the mental propositions corresponding to "a is b" and "a is not b" are simple, when a and b are simple.

[59] This phrase is to be found in QM, II, 1, 9rB: "Ad aliam dico quod effectus sciuntur per causam propter quid, quia causa est notior etiam nobis quam propter quid effectus est. Similiter causa scitur per effectum quantum ad quia est, quia effectus gerit quandam similitudinem cause, ideo potest causam representare una cum naturali inclinatione intellectus ad veritatem."

[60] Concerning demonstration quia and propter quid, see Aristotle, Posterior Analytics, I, 13, and his commentators.

[61] Moody, art. cit., p. 136, referring to QP, I, 4.

[62] II, 1, 8r-9v.

[63] 8v: "modo firmitas veritatis est possibilis, uno modo simpliciter ut in hac propositione deus est quod nullo casu falsificari potest."

[64] QM, II, 1, 8r: "sed etiam est firmitas veritatis ex suppositione communis cursus nature et sic esset firma veritas quod celum movet, quod ignis est calidus et sic de aliis propositionibus et conclusionibus scientie naturalis, non obstante quod deus posset sic facere ignem frigidum et sic falsificat ista omnes ignis est calidus."

[65] Metaphysics, II, 3.

[66] For a clear exposition of demonstration ex suppositione finis, see St. Thomas Aquinas, In Post An., I, lect. 42.

[67] Wallace discusses the traditional understanding of ex suppositio reasoning in Causality and Scientific Explanation, I, pp. 75-80, 102, 104, 143.

[68] This point is clearly established in QP, II, 13, 39r-40v, a long and difficult question. Given that there is an order of nature (and if not there could be no natural philosophy) it is necessary that God act through secondary causes--not always, of course, but whenever natural activities are occurring. This point, I think, is evident.

[69] QP, II, 13 seems to establish this point.

[70] The extended (or modified) notion is apparent in QM, II, 1. Buridan had yet a third notion of ex suppositione reasoning. Both mathematics and physics argue on the supposition that their first principles are true. It does seem then that physics and mathematics had a hypothetical character for Buridan, but we must note his opinion that metaphysics can establish these principles, at least to some extent. Buridan here applys Aristotle's statement that no science establishes the truth of its own first principles.

[71] 9v: "Valde mali dicunt volentes interimere scientias naturales et morales eo quod in pluribus eorum principiis et conclusionibus non est evidentia simplex sed possunt falsificari per casus supernaturaliter possibiles quia non requiritur ad tales scientias evidentia simpliciter sed sufficiunt predicti evidentia secundum quid sive ex suppositione. Ideo bene dicit Aristoteles secundo huius quod non in omnibus scientiis mathematica acribologia est expetenda."

[72] Scott, art. cit., pp. 35-36. Admittedly, Scott's argument rests on other grounds as well: "Throughout his work, he is concerned to develop those philosophical positions that he thinks would result from the work of a reason that was unaware of the Faith and its truths." Scott's example is Buridan's discussion of being and the nine categories of accidents. Buridan is said to pay lip service to the explanation which he thinks follows from the doctrine of transsubstantiation (namely that accidents have a mode of being proper to them) and then to develop the contrary position, which he attributes to Aristotle. But Calvin Nomore shows in an unpublished paper ("Buridan's Ontology," second draft) that Buridan believed in the reality of certain accidents for purely natural reasons, as well as for reasons of faith. For example, his understanding of motion depends upon its reality. (The interested reader should consult the following texts: QP, I, 8; II, 7; QM, V, 8.)

One should probably not read too much into Buridan's almost purely non-theological approach to philosophical problems, keeping in mind his status as a Master of Arts and his primary duty as an expounder of the Aristotelian philosophy. His disagreements with the Philosopher for reasons of faith need not be seen as insincere merely because he elaborates Aristotle's position and shows that unaided reason inclines one to it.

[73] James Walsh, "Nominalism and the Ethics: Some remarks about Buridan's Commentary," J. Hist. Phil. IV (1966), no. 1, 1-13. Walsh is not certain about Ockham's position on this issue. He may in fact have agreed (more or less) with Buridan, but many of his readers have seen him as an ethical positivist.

[74] 8v: "firmitas assensus est quo nos adheremus et assentimus propositioni absque formidine ad oppositum."

[75] 8v: "uno modo [firmitas assensus] ex voluntate sine [text reads 'sive'] apparentia naturali et sic christiani assentiunt et adherunt firmiter articulis fidei catholice et etiam heretici adherent suis falsis opinionibus intamen quam volunt prius mori quam negari et sic experientia sanctorum qui pro fide christiani mori voluerunt." The Catholic faith differs from science in that it is certain but not evident; science is both.

[76] 8v: "Secundo modo firmitas provenit nobis ex apparentiis naturalibus per aliquas rationes et isto modo adhuc est possibile quod firmiter assentire non solum veritati, immo etiam falsitati. Multi enim credentes et habentes falsas opiniones credunt habere firmam scientiam."

77 8v: "Tertio modo firmitas assensus provenit ex evidentia propositionis simpliciter quando ex natura sensus vel intellectus homo cogitur sine necessitate [sic] ad assentiendum propositioni ita quod non potest dissentire . . . sed alio modo accipitur evidentiam secundum quid vel ex suppositione ut prius dicebatur quod observantur in entibus communis cursus nature."

78 QNE, Proemium, 2r: "In hoc autem opusculo propter mean inexperientiam et ineptitudinem mei iudicii sententiis et auctoribus doctorum antiquorum magis quam novis rationibus etiam quarumcunque mihi apparentibus adherebo. Pluries enim me inveni deceptum rationibus noviter emergentibus, antiquorum autem sententiis nunquam specialiter in moralibus."

Chapter Four: Buridan's Defense of the Aristotelian Division of Science

Part I: The Aristotelian Controversies of the Thirteenth and Fourteenth Centuries

Aristotle's division of knowledge was adopted almost universally in the thirteenth and fourteenth centuries, but we do not find in the scholastic texts an absolute uniformity of doctrine. The Philosopher did not resolve every question, nor was his meaning always easy to grasp. Moslem commentaries, moreover, accompanied the Latin translations of the Aristotelian texts, and these did not agree among themselves. Not suprisingly, controversies arose in the west from the study of Aristotle's writings on the division of knowledge.

The most important points of controversy concerned the fundamental principles of Aristotle's division. An adequate division requires that each science be a unified whole having a distinct character. The following questions must be answered: What is necessary for the unity of a science? How are the sciences to be distinguished from one another? To these general questions the scholastics added more particular ones concerning the subjects of various sciences; concerning subalternation and other relations among sciences; concerning the nature and role of logic; and concerning the hierarchy of the sciences. These problems, both the general and the particular, interested Buridan deeply.

In the previous chapter we considered certain difficulties which arise for the nominalist classifier who accepts the ancient ideal of science, and how Buridan attempted to resolve them. In the next chapter, we shall consider Buridan's approach to some of the problems of detail, which the Aristotelian classifier must face. Our task at present is to examine Buridan's account of the fundamental principles of classification and his defense of the Aristotelian division of the speculative sciences in its broadest outlines. His defense was not an academic exercise but was seriously meant as an answer to a real difficulty. This fact becomes apparent when we consider the state of the question of the division of knowledge in the fourteenth century. A brief account of the Aristotelian controversies of the thirteenth and fourteenth centuries will therefore be in order.

I have distinguished two questions of principle: what gives a science its unity, and what distinguishes it from all other sciences? These questions are closely related. I distinguish them only for the sake of clarity. The schoolmen generally agreed that the same principle makes a thing one in kind and gives it its distinct character. The subject of a science seems to serve as its unifying principle, but the exact nature of the subject was a matter for debate. One source of controversy was the difference between the nominalists and the realists concerning natures and universals. Another and even more important source was the disagreement of the terminists and the "ancient logicians" concerning the objects of scientific knowledge.

The controversy between the realists and the nominalists explains an important difference in scholastic accounts of the unity and distinction of sciences. For the Aristotelian realists, a simple resolution of the problem is possible. According to these philosophers, a science has as its object a single nature, either a genus or species or at least a real ratio cognoscendi.[1] In virtue of this nature the science is one and distinct. The science of man, for example, is unified and characterized by its object, human nature. The nominalists could not resolve the problem of the unity of a science so easily. Ockham doubted whether a unique classification on the basis of objects could be made. Others tried to solve the problem using a non-Aristotelian tool, the terminist logic. Terminism suggested to Buridan and others a means to avoid the fragmentation of the sciences that resulted from the denial of common natures.

The terminists, followers and developers of the logical doctrines of Peter of Spain, are named for their method of logical analysis.[2] Logic begins with a consideration of the properties of terms, according to these thinkers, and propositions are to be understood and judged by considering their primary elements. Terminism is particularly congenial to nominalists, since it allows one to reduce all universal statements to particular statements. The method is also compatible with realism, since it does not entail the rejection of common natures. Most logicians of the fourteenth century, whether realists or nominalists, accepted terminism.[3]

Terminism, whether of the realist or of the nominalist variety, forces an approach to the unification of science quite unlike Aristotle's. Whereas Aristotle and his thirteenth century followers regarded one science as a single habit having a single object,[4] the terminists multiplied the objects of a single science. Reviving an old notion of the concept as the mind's word,[5] the terminists explained the scientific proposition as a statement in the mental language common to all men. Since the terminists regarded these mental propositions as the immediate objects of knowledge, a science embracing many truths necessarily had many objects.

As a result of their view of the objects of science, the terminists were unable to account for the unity of a science by pointing to the unity of the scientific habit. Where there are many objects, there must be many habits. The unity of a science had to be effected by the unification of a set of mental propositions. Buridan believed he had discovered a satisfactory method for constructing a unified science from many propositions and that, on the most general level, his method would produce the three Aristotelian speculative sciences, metaphysics, physics and mathematics.

To provide a clearer understanding of the state of the discussion of classification in Buridan's day, I shall describe the classificatory doctrines of Thomas Aquinas, John Duns Scotus and William Ockham. I will not consider the details of their divisions in this chapter but only their approaches to the unification and division of sciences. Aquinas I shall discuss very briefly, since his doctrines are well known and have often been treated in books and scholarly journals. The positions of Ockham and especially of Scotus are less known, and more space will be devoted to them here. I hope eventually to publish a technical and detailed presentation of their views. I have chosen these three men in part because of the availablity of their works and in part because they represent the various philosophical schools involved in the debate over the principles of classification. Scotus and Aquinas were realists, Ockham a nominalist; Aquinas followed the ancient logic of Aristotle, Scotus and Ockham were terminists.

According to St. Thomas, whose doctrine on this point we may take as typical of the thirteenth century scholastics, a science such as physics is a single habit.[6] The better we know the science, the more perfect our habit, but whether we know a little physics or a great deal our habit of physics is one thing. Habits, like the faculties of the soul in which they inhere, have objects. The objects of the various sciences (which St. Thomas calls formal objects, to distinguish them from the material objects of the sciences, such as stones and stars and mammals) are formal constituents (*rationes cognoscendi*) capable of being grasped by the intellect. Each science comprehends its material objects *sub ratione obiecti formalis*. The formal object is expressed in the well-known "*qua*" formula. Physics, for example, understands material beings *qua* mobile, while the divine science comprehends things *qua* revealed by God. The formal object serves as the subject of the science, making it one and giving it its distinct character.

Aquinas' greatest contribution to the subsequent discussion of the division of knowledge was his clear account of the role of the _ratio cognoscendi_ as a principle of distinction among sciences. There would no longer be any confusion about conforming the Aristotelian division of knowledge to a Neoplatonic division of being. Henceforth every division which claimed to be natural and objectively valid made use of some principle corresponding to, although not necessarily the same as, St. Thomas' formal object. But Aquinas' doctrine concerning the habit and its unifying role was as generally rejected in the fourteenth century as his distinction between formal and material objects was accepted.

We find the first major departure from the unification of a science via the unity of the habit in the work of Duns Scotus. Scotus' writings are of great interest and importance for the history of the classification of knowledge. I believe that they represent the last turning point in the medieval discussion, from the approach of the "ancient logicians" to the approach of the terminists.[7] Scotus' explanation of the principles of classification provide us with a realist's counterpoint to the doctrine of Ockham and Buridan, with which nominalist doctrine it has a considerable affinity. Ockham's treatment, moreover, is best seen against the Scotist background, since he took the Subtle Doctor's position as the starting point for his critique of the traditional notion of classification by subject.

Although Scotus, like Aquinas, considered the division of knowledge in terms of a division of habits, he envisioned the underlying principles of the division quite differently. Whereas Aquinas looked to the nature of the habit itself, and to its object, Scotus looked rather to the known conclusions of the science and to the logical connections between premises and conclusions. For Scotus and for the scholastics who followed him, a unified whole had to be constructed from a set of propositions, each one of which had a distinct reality of its own.

The new approach to the division of knowledge, in its fully developed form, was founded upon the identification of the primary and immediate objects of knowledge with mental beings of a linguistic nature: terms and propositions. All thought came to be seen as expressions of mental language, whose grammar was logic and whose syntax was remarkably like Latin.[8] To characterize a science was to mark off that part of the mind's language which constituted it. Although this program of classification via the analysis of mental language does not appear fully developed in the writings of Duns Scotus, the seeds from which it grew are present in his work.

While Aquinas developed the insights of *Physics*, II[9] in a fruitful way, Scotus drew his primary inspiration from *Posterior Analytics*, I, 13. Having accepted the importance of the *ratio cognoscendi*, Scotus tried to develop the doctrine presented in the *Analytics*, according to which one science is the knowledge of one subject genus. This is the Aristotelian teaching upon which the Subtle doctor erected his classification.

Scotus' conception of the subject of a science was determined by two factors. First, the subject must serve as the object of knowledge, that is, as the thing primarily known by the science. Secondly, since it is a genus, the subject must serve as the logical subject of propositions. In the former role the subject grounds the reality of our knowledge; in the latter, it is Scotus' explanatory principle for the unity of a science. Because he understood the subject to have this dual character, Scotus sometimes called the subject genus of a science the "primary subject," and sometimes the "primary object." I shall use the latter name, which Scotus seems to have preferred.[10]

Let us first consider the primary object as the object of knowledge. Scotus agreed with Aristotle that the object of knowledge is a formal characteristic of the known thing. The object, then, is an external cause of our knowledge of the thing. The intellect itself is both active and passive. As active, it abstracts universal forms from the sensations of particulars. As passive, the intellect receives into itself these forms, which make the intellect like the known thing. So far, this is ordinary Aristotelian doctrine.

Scotus' understanding of the exact nature of the object of knowledge, of the concept (that is, the object as it exists in the intellect) and of the intellect which grasps it, was not ordinary, but quite original. Scotus must be called a realist, but his realism is neither that of the Platonists nor that of St. Thomas. It is in fact a sort of midway point between the two. The Platonic doctrine is well known. I shall describe briefly, and all too inadequately, Aquinas' doctrine, so that the unique element in Scotus' position may be noted.[11]

For simplicity's sake, we shall consider only one kind of knowable form, the essential nature, or "quiddity," of the known thing, and I shall use the standard scholastic example, humanity. Humanity, or human nature, is the nature which answers to the essential definition of man, "rational animal." According to Aquinas, the nature of man, which is common to all men, has a two-fold existence: in individual men, and in the intellect which understands man. The nature exists in the individual and in the intellect in two different modes. In the individual the nature exists as the substantial form, in the mind it exists as a universal concept. The nature and the concept are one in form but not one in every respect, since the mind does not become what it knows in a material sense. The nature, moreover, has no being of its own, distinct from its being in matter and in intellects.

Scotus' understanding of the common nature was more nearly Platonic, though he agreed with St. Thomas that natures do not exist in an ideal world of their own, apart from creatures and all knowing minds. He did think that natures, and forms generally, have a proper being, distinct from the being of the things which possess them. Scotus' metaphysical doctrine admits a plurality of being within the essential nature of each individual thing. Thus Socrates is a composite of several beings, animality and rationality and finally his unique "Socraeity."[12]

It is time now to see how this metaphysical doctrine bears on the problem of the unification of a science. The essential premise is the familiar statement that being converts with unity: whatever is, is one. If every form has a being of its own, the form in the known thing and the form in the knowing intellect are one and the same being. Moreover, if many forms are united in one creature, as in our example of Socrates, the concepts by which we conceive him must also form a unity. The unity of a science which grasps many forms is effected by the unity of the forms themselves in a composite being.

To clarify this point, let us take as an example the science of nature. Physics studies mobiles, according to Scotus and to the scholastics generally. Mobile things, of course, possess mobility. But mobility implies other characteristics, to each of which corresponds a form. For example, every mobile is swift or slow, so mobility implies swiftness or slowness. For Scotus, the unification of forms such as these in being amounts to a unification of their concepts in the mind which knows them. One science is simply the knowledge of many forms related in being.

We have now to see what the primary object of a science is, and why it may be called the primary subject. In the _Reportata Parisiensis_ Scotus defines the primary object of a science (which he also calls the _per se_ object) as that object which contains primarily and virtually a concept of all the truths of the science.[13] If we can understand this definition, we will be able to grasp Scotus' conception of a unified science.

Scotus defines the primary object on the conceptual level, not on the level of being. We have seen that the concept is one in being with the nature or form. Following St. Augustine, Scotus also identified the concept as the mind's word, a natural likeness to the known thing common to all men. But Scotus went beyond St. Augustine by identifying concepts as natural signs having an essentially linguistic nature, and by drawing out some of the consequences of this view. One such consequence is that the relation between the concept and the thing it conceives is a relation of signification.[14]

Two authentic works, Super Universalibus Porphyrii Questiones and Predicamenta[15] testify to Scotus' belief that concepts function as words in a mental language. The spoken word, wrote Scotus, is not the first sign of the the thing; the concept is. The spoken word merely signifies what is signified first by the concept. Although he did not develop a detailed theory of mental language, Scotus did at least indicate that predicates, syllogisms, and in short every component of logic exist in the language of the mind.[16] Given this conception, it is easy to see how a science can be regarded as a collection of mental propositions having logical order and unity. Scotus' explicit account of the unity of a science was in fact logical.

Once we focus upon concepts and consider them as words in mental language, it is no longer necessary to look to the nature of the habit to see how a science is unified. As a collection of written propositions can be logically ordered into a whole, with conclusions following from definitions and axioms, and posterior from prior conclusions,[17] so too can unity be effected in the language of the mind. Concepts and the sentences formed from them, when gathered together in a logical order, become one science.

Scotus thought that a unified collection of terms and propositions, whether written, spoken or mental, has a single principle of unity. On the conceptual level, the primary object is the unifying principle. The primary object unifies by containing the truths of the science "primarily and virtually." Scotus tried to understand virtual and primary containment both on the level of external being and on the conceptual level, but his application of this notion to the unification of a science was carried out on the level of concepts. As we have seen, unity and being transfer from one realm to the other, according to Scotus, so it is enough to explain the structure of a science in conceptual terms.

What, then, is virtual containment? One concept virtually contains another if it is within the power (virtus) of the former to produce a cognition of the other.[18] For example, the concept of triangle virtually contains the concept of isoceles, because the concept of triangle has the power to make the notion of a triangle having two equal sides present to the mind. But virtual containment goes further, for it includes the containment of propositions as well as of simple concepts. The concept triangle has the power to bring to the mind the proposition, "The three angles of every triangle equal two right angles." If one really grasps the essential nature of triangle, one knows this proposition at least virtually. If he has not yet seen this truth, what is necessary for him to see it is already present in his intellect.

Having understood virtual containment, we may easily grasp primary containment. One thing is primary among many if they depend upon it but it does not depend upon them.[19] Of all the concepts related as containing and contained, only one is not itself contained. This is the primary object. Scotus thought, for example, that all the truths of the science of triangles are contained in the simple concept of triangle, just as all the properties of triangles are contained in the nature of triangle. This science, presumably, forms a part of a more universal science of magnitude (geometry), the primary object of which virtually contains the concept triangle.

In the science, knowledge of conclusions reduces to knowledge of premises, and knowledge of premises to knowledge of their subject terms. Finally, the knowledge of all these subjects are reduced to the knowledge of one subject which contains them all. In this way the entire science is knit together as a deductive chain or, alternately, as the explication of a primary nature and of all that follows from it, either immediately or remotely. In Scotus' science, the Thomistic unity of habit is replaced by a unity of order[20] among the primary and secondary objects of the science. The primary object is the ordering principle; it also serves to distinguish one science from another.

Scotus' principles of classification are the result of an interesting fusion of realistic metaphysics and terminist logic.

Unlike St. Thomas and many of the scholastics of the thirteenth century, Scotus believed that a science contained many habits, each having its own distinct object.[21] Scotus thought, however, that the habits form an ordered whole because their separate objects form a whole. The unity of the objects, in turn, he traced back to the unity of forms subordinate to one common nature.

Like Scotus, the nominalists saw a whole science as a composite of many habits, each having as its object a term or proposition. The Subtle Doctor's account of how the many are made one was, of course, unacceptable to them. In the second part of this chapter we shall consider Buridan's solution. Let us turn first to William of Ockham, who was in a sense the connecting link between Scotus and Buridan. Ockham's starting point was a critique of the Scotist principles of classification, and Buridan's defense, if not aimed at Ockham personally, had as it target those who accepted his view of the traditional Aristotelian classification.

In the Prologue to his Exposition of the Eight Books of the Physics William of Ockham called into question the logical foundation of the traditional divisions of knowledge. He did not seem to object to the notion that some sciences are speculative and some practical, or that metaphysics, physics and mathematics are speculative sciences. He was willing to leave the traditional names of the disciplines intact. His objection was more fundamental. Basing himself upon the principles of nominalistic logic and semantics, Ockham concluded that a division of science could not adequately be made by assigning a unique subject to each science.[22]

All terminists necessarily believed that the subjects of the sciences were mental objects. Ockham, however, went further in his reevaluation of the Aristotelian conception of science by denying that a science has one subject. The consequence of this denial is the destruction of the traditional explanation of the classification of the sciences. A science became, for Ockham, a collection of propositions lacking an objectively definable character and having no assignable bounds.[23]

According to Aristotle, the essential properties of the subject-genus of a science are revealed by demonstration. From Ockham's point of view, it is misleading to talk of a subject-genus. He prefers to redefine the subject of a science, taking it merely as the subject term of a single proposition.[24] "It is meaningless," he remarks, "to ask, 'What is the subject of logic or of the philosophy of nature, or of metaphysics, or of ethics?'" One might as well ask, "Who is king of the world?"

For Ockham, a "whole science" such as physics is an aggregate of propositions. If a given aggregate has only one subject, this is purely accidental, since it is due to the fact that all the propositions gathered together happen to have the same subject term.[25] But like so many of the schoolmen, Ockham was unwilling to say that those who try to assign a primary subject to a whole science were simply wrong. A science may in fact have one or more primary subjects, each of which stands first with respect to some kind of priority. Thus being is a primary subject of metaphysics as regards priority of predication, and God is its primary subject in the order of nobility.[26]

The notion of a primary subject, then was useless as a principle of unity in a whole science, at least if one is looking for a unique and objectively valid solution. Ockham, it seems, eliminated the possibility of such a solution by the redefinition of "subject." But he offered specific criticisms as well of the solutions proposed by Aquinas and Scotus. His criticisms of the Thomistic formal object are easily imagined.[27] Rejecting common natures, he inevitably rejected the formal object as a unifying principle of a science. Nor could he accept the view that a whole science is a single habit. The terminist view of the object of scientific knowledge made this explanation absurd.

In the prologue to his Exposition of the Physics,[28] Ockham refers critically to Scotus' attempt to unify many scientific habits by means of a primary subject virtually containing all the truths of the science. Although he does not refer to Scotus by name, it seems clear that Ockham has his opinion in mind when he argues that the subject term of a proposition is not able to virtually contain the conclusions of a science. In his Ordinatio on the Sentences, he takes up Scotus' position at greater length, quoting the Subtle Doctor's words and refuting them point by point.[29]

Ockham's arguments are too lengthy and too specialized to consider here. In the *Physics* he merely declared the absurdity of the notion that one subject virtually contains every other part of the science. In the *Ordinatio*, he presents several arguments to show that (1) it is not in the nature of a subject of a proposition to virtually contain the predicate, and (2) it is not the nature of the subject to virtually contain the attribute named by the predicate.[30] These arguments have to do with a single proposition. But if the subject of a proposition does not virtually contain its attribute, then *a fortiori* the subject of a science in a broader sense does not virtually contain all the conclusions belonging to it.

Ockham realized the implications of his argument for the unity of a science and the division of knowledge, as we can see from his replies to three puzzles (*dubia*) he raises against his own conclusions. The first *dubia* repeats the argument of the *Exposition of the Physics*. How can it be, he asks, that sciences such as metaphysics and mathematics have one subject, when each one consists of many propositions having various subjects? His reply is this: strictly speaking, a science such as metaphysics has no one subject, though various subjects may be called first because of some kind of priority. In his reply to the second *dubia* (What is the subject of the habit by which the subject and predicate of a demonstration are known?) he seems to admit that one habit may embrace a single demonstration, but no more. In the final *dubium* Ockham asks how there can be distinct sciences about the same subject under the same *ratio*. He replies that there can be distinct sciences of one subject because of the diversity of predicates predicable of it. This is merely to say that more than one conclusion may have the same term as subject. Ockham decisively rejects the view that sciences are distinguished by their different modes of consideration, saying, for example, that metaphysics treats a thing "in so far as it is a being" and natural philosophy treats it "in so far as it is a mobile," and so on. This manner of speaking mistakenly supposes that there are distinct _rationes_ in the same subject.

Ockham's reply to this manner of distinguishing sciences is important for our understanding of his view. Ockham replaces the supposed diversity of _rationes_ within a subject with a diversity of predicates predicable of it. Furthermore, he assumes that one can somehow classify subjects and predicates in such a way that one science is distinguishable from others.[31] The same point is explicitly made in the _Exposition of the Physics_. The science of nature is distinguished from all others either by its subject or by its predicates, Ockham states, and he adds an intriguing comment: "Just how this has to be understood will be better explained, perhaps, when we shall deal with the exposition of the _Metaphysics_."[32] Unfortunately, this work is not extant, if Ockham ever wrote it.

We may form a partial conjecture of his method from a number of surviving texts. Ockham sometimes distinguished between real and rational sciences.[33] This most general division, between sciences which grasp notions standing for things and sciences which grasp notions standing for other notions,[34] might be made on the basis of subject terms. How the various rational and real sciences are to be distinguished is not clear. It may well be that Ockham did not think a unique solution possible. He nowhere shows a zealous desire to vindicate Aristotle's division of speculative science into three general sciences, metaphysics, mathematics and physics. In this respect he differs from Jean Buridan, who applied his skill in the terminist logic to the problem of the unity and diversity of the sciences, hoping to explain Aristotle's division without admitting the existence of common natures.

[1] Despite the doctrine of the Posterior Analytics that one science has one subject genus, Aristotle's division of science cannot be explained by a division of substantial natures, as we saw in Chapter One. The subject of mathematics, for example, is not a kind of substance. Such considerations led Aquinas and others to distinguish in creatures various rationes cognoscendi, or formal aspects under which they can be known. Note that these are real formal constituents of the things in question. Although common to many they lack the completeness of a nature in the strict sense.

[2] For more information on terminism, see Lambert de Rijk, Logica, Modernorum: A Contribution to the History of Early Terminist Logic (Assen, 1962, 1967), in two volumes.

[3] A notable exception is Raymond Lull (ca.1235-1316), whose logic is neither Aristotelian nor terminist.

[4] This point is not as clear in Aristotle as in his interpreters but see Cat., 7-8.

[5] St. Augustine may be taken as an authority for this view; see De Trinitate, Book XV, Ch. 10.

[6] Most of these views may be found in Summa Theologiae, I, Q. 1, art. 1-7. Armand Maurer discusses St. Thomas' account of the scientific habit in "The Unity of A Science: St. Thomas and the Nominalists," in St. Thomas Aquinas 1274 - 1974: Commemorative Studies, ed. Maurer et al., (Toronto, 1974), II, 269-91; and in "Ockham's Conception of the Unity of Science," Med. Stud. 20 (1958), pp. 98-112.

[7] I cannot present all my evidence for the claim made here; it needs to be argued in a separate paper. That Scotus originated this approach would be hard to prove, but I challenge the reader to find an earlier instance of it. I suspect that the transference of the object of knowledge from the realm of natures to the realm of mental language came easy to Scotus because he believed in the real (and not merely formal) identity between the form in the thing and the concept of it in the mind.

[8] Mental language held a great fascination for medieval logicians. Many questions were raised about its grammar and syntax. Do syncategorematic terms (prepositions, conjunctions, etc.) exist in mental language? Does this language have the same parts of speech as spoken language? Do mental verbs have tense and mood, and do mental nouns have case, number and gender? Ockham, Buridan, Gregory of Rimini, Peter of Ailly, and numerous others discussed these and similar questions.

[9] In this chapter Aristotle explains the difference between the physicist's and the mathematician's way of considering bodies.

[10] In the Lectura on the Sentences, one of his earliest works, Scotus asks "Whether God is the primary subject of theology?" In his Ordinatio this question has become "Whether God is the primary object of theology?" The conclusion and arguments are much the same in the two works.

E. D. O'Connor argues persuasively in "The Scientific Character of Theology according to Scotus," (De Doctrina Ioannis Duns Scoti, Acta congr. Scot. int. (Rome, 1968), III, 9ff.) that for Scotus "object" and "subject" mean practically the same thing when he is writing about a science. The identity has to be qualified in the case of theology, as O'Connor explains on pp. 11-12, but this point is irrelevant to our concern here.

[11] For St. Thomas' understanding of the common nature, the reader should above all consult his De Ente et Essentia. The secondary literature is extensive. Most helpful for the comparison of Aquinas and Scotus is Joseph Owens, "Common Nature: A Point of comparison between Thomistic and Scotistic Metaphysics," Med. Stud. 19 (1957), pp. 1-14. Texts available in English bearing on Scotus' view may be found in God and Creatures: The Quodlibetal Questions, ed. Felix Alluntis and Alan Wolter (Princeton, 1975). See also selection V in Wolter's collection of Scotus' Philosophical Writings (Indianapolis, 1962).

[12] I use this as an example of the form Scotus called "haecceity," or "thisness." The "haecceity" is the form which makes an individual to be this individual.

[13] Prol., Q. I, n.5, ed. Luke Wadding (London, 1639), p.3: ". . . illud est per se obiectum alicuius scientiae, quod continet virtualiter, et primo notitam omnium veritatum illius scientiae."

[14] Although Scotus did not originate this view of the relation of concept to thing, he was the first to apply it to the problem of the unification of a science, as far as I can tell. He does not say that he is doing so; rather, that concepts are linguistic signs is an unstated assumption that underlies his treatment of the problem.

[15] These two works are published together with others in In Universis Aristotelis Logicam Quaestiones (Venice, 1591).

[16] Pred., Q.1, f.48v: "Ad questionem dici potest quia iste liber non est de decem vocibus ut de primo subiecto, nec aliqua pars logicae est de voce, quia omnes passiones syllogismi, et omnes partes eius possunt sibi inesse secundum esse quod habent in mente, etiam si non proferantur, ut inductive patet, sed est de aliquo priore, quod respectu vocis significativae tantum habent rationem significati."

[17] This was of course the ideal! It did not seem to bother Scotus that this was rarely if ever realized in any science as it actually was. Presumably he thought that such a structure was latent in every science, and each one needed its Euclid to bring it out.

[18] Alluntis and Wolter, God and Creatures, "Virtually," p.538: "One thing is said to contain another virtually if it can produce it, for example, as a cause or principle. Scotus also uses the word in a special sense, namely, when two distinct formalities are found in one and the same really identical thing, one of the two formalities can be said to virtually contain the other."

[19] Ordinatio, Opera Omnia, editio Vaticana, I (1950), Prol., 97: "Expono quod dixi 'primo virtualiter,' quia illud est primum quod non dependet ab alio sed alia ab ipso; ita igitur 'primo continere' est non dependere ab aliis in continendo sed alia ab ipso."

[20] Report. Paris., Prol., Q. 1, n. 5: "cognoscibilia autem cuiuscunque scientiae habent ordinem essentialem inter se in cognoscibilitate, quia conclusiones cognoscuntur ex principiis. Patet ex dictis. Principia tandem si sunt immediata, cognoscuntur ex terminis, sicut dictum est, sed et terminus ipsius principii cognoscitur ex ratione subiecti, quia principia cognita sunt per se secundo modo; ergo subiectum cadit in definitione principii ex 7. Metaph. et in isto tandem ordine etiam statur ad aliquod subiectum simpliciter, quod est subiectum principiorum vel principii ex cuius cognitione cognoscuntur omnia pertinenta ad scientiam."

For a formal definition of essential order, see Scotus' Tractatus de Primo Principio, ed. and trans. Evan Roche (St. Bonaventure, NY, 1949), pp. 4-5.

Wolter explains the logical notions of essential containment and virtual containment in Philosophical Writings, pp. 167-8, n.5: "According to scholastic usage, if the predicate of a necessary or per se nota proposition is part of the essential definition of the subject, the latter is said to 'contain the predicate essentially' and the predicate is said to be predicated according to the first mode of per se predication. If the predicate, however, is an attribute or a property . . . it is said to be 'contained virtually in the subject' of which it is predicated necessarily and according to the second mode of per se predication." The modes of essential predication are explained by Aristotle in Post. An., I, 4 (73a35-b24).

[21] Although this claim is essentially correct, it does perhaps oversimplify Scotus' position. See Quest. in Meta., L. VI, Q. 1.

[22] Exp. super viii Lib. Physicorum, in Philosophical Writings, A Selection: William of Ockham [abbreviated hereafter as PW], trans. Philotheus Boehner (Indianapolis, Indiana, 1964), pp. 7-11.

[23] Ockham did accept the speculative/practical division as objectively valid. Practical sciences are de operibus nostris, speculative sciences are not (Expositio in Libros Artis Logicae, Prooemium, ed. E. A. Moody (St. Bonaventure, New York, 1965), pp. 5-6). He groups logic with the sciences rather than with the arts, because "ista scientia, saltem principaliter, tradit notitiam conceptuum vel intentionum per animam fabricatarum, non extra se quomodo fabricantur res artificiales, sed intra se" (p. 5). Since it deals with concepts

rather than with external things, it is called rational science, the others real sciences.

To sum up: for Ockham the distinctions between the arts and sciences, and between real and rational sciences, are sharp and clear. The distinctions among the real sciences are not.

24 Prol. Expositio super viii Libros Physicorum, PW, p. 10 See also Summa Logicae, I, 30.

25 PW, p. 9.

26 PW, p. 10.

27 Ockham discusses the views of Thomas and Henry in the prologue to his Ordinatio, Q VIII, "Utrum habitus theologiae sit realiter unus secundum numerum?" See Opera Theologica, I, Scriptum in Librum Primum Sententiarum Ordinatio, ed. Gedeon Gál and Stephanus Brown (St. Bonaventure, New York, 1967).

28 PW, p. 9. See also Opera Philosophica, I, Summa Logicae, ed. Philotheus Boehner et al. (St. Bonaventure, New York, 1974), L. I, 32; L. III-2, 2.

29 In Q. IX of the Ordinatio prologue Ockham considers Duns Scotus' opinion that the subject of a science virtually contains all the conclusions of that science.

30 Ord., prol. Q. IX, p. 229.

31 PW, p. 15.

32 PW, p, 15.

33 For example, Ord., I, D. 2, Q. IV; Exp. Lib. Art. Log., Prooem.; Prol., Exp. super Phys.

34 PW, p. 12.

Chapter Four, Part II: Buridan's Account of the Aristotelian Division of Science

The terminists, among whom we must number all the fourteenth century nominalists, believed that the subjects of the sciences are mental objects. This is unquestionably a departure from Aristotle's understanding of scientific knowledge. Ockham, as we have seen, went even further in his reevaluation of the Aristotelian conception of science by denying that a science has one subject. One consequence of this denial is the destruction of the traditional explanation of the classification of the sciences. A science lacking a subject seems to be a mere aggregate of propositions, having no distinctive character. Ockham's opinion was simply unthinkable to Buridan. As a faithful follower of Aristotle, he held that every science had a subject-genus which served as its unifying principle and provided a criterion for judging whether or not a conclusion or demonstration belonged to that science.[1] Not content with a bare assertion, Buridan explained how the subject genus fulfilled this function. Thus he provided what Ockham, by design or chance, did not: a genuinely nominalistic account of the Aristotelian division of knowledge.

Buridan's defense of the Aristotelian division of speculative knowledge may be broken into two parts for the sake of convenience. The first and fundamental part is his argument for the feasibility of a division based upon subjects; the second is the justification in particular of the three-fold division of speculative philosophy into metaphysics, mathematics and physics. Buridan did not proceed so systematically, of course. The quaestiones format makes any kind of large scale organization, other than that imposed by the work being commented upon, almost impossible. But he did attempt to vindicate the traditional classification on the level of principles and of detail, using modern and ancient premises and arguments.

The problem which the fourteenth century philosophers faced was to construct one science from many habits in such a way that it had a definable character and boundaries. Various solutions were attempted which were not agreeable to a strict nominalist. Duns Scotus, whose approach we have already considered, saw a science as a long chain of deductive reasoning explicating the attributes of the primary subject. Peter Auriole thought of a science after the fashion of a house; it was made up of many parts which were unified by a "form of the whole" (forma totalis).[2] These explanations may have influenced Buridan to some degree, but he, like Ockham, rejected as a matter of principle any abstract universal entities, whether essences or forms of the whole.

The difference between Buridan's and Ockham's reactions to Aristotle's division reveals a difference between their starting points and hence between their basic dispositions. Ockham began with the assumption that the subject of a science can only be a subject of predication. Since a whole science contained many conclusions having many different subjects as well as predicates, no one subject could be assigned to a whole science. He was willing to concede that a few terms could be called primary subjects of a science in virtue of different kinds of primacy, but none of these served to unify the science.[3] The restriction of the subject to the subject of predication was crucially important to Ockham. He hoped by this means to refute the realists' notion that the subjects of the sciences were universal entities. The unity of a science apparently did not concern him.

Taking it for granted that a whole science was in some sense one thing, Buridan explained that the subject genus alone could serve as the unifying principle. Accordingly, he challenged Ockham's assumption that the subject of a science, taken in the context of the division of knowledge, was the subject of predication in individual propositions. His refutation of this claim is found in Question 4, Book 4 of the Questions on the Metaphysics. Agreeing with Ockham that terms, not entities, were the subjects of the sciences, he held that the subject need not be the subject of predication in every conclusion of the science.

Buridan defined the subject of a science as a "subject of attributes" (subiectum in ordine ad passionem)[4] rather than as a subject of predication. An attribute (passio) is something predicable of the subject as a property or essential accident. Although the difference between the two kinds of subject is not made very clear, it seems to be as follows. Every proposition has its own subject of predication, which is its grammatical subject. But a subject of attributes has a dual character. On the one hand, it is to be understood as a term used in a proposition (he says of it: "subiectum enim et passio vocantur duo termini pro eodem supponentes"); on the other, it is not limited to one proposition and to one attribute. The subject of attributes seems to be a subject term considered apart from any particular proposition it might occur in.

This distinction satisfactorily eliminated Ockham's position, in Buridan's mind, as a mistake based upon a confusion of language. Of course a whole science had no one subject of predication, since it was made up of propositions having many subject terms. Nothing prevented it from having a subject in some other, less restricted sense. The subject of attribution, as Buridan understood it, was able to serve both as the unifying principle of a science and the source of its distinction from all others.

Buridan explained the unifying function of the subject of attribution by means of an analogy. A whole science is like an army having one general. Just as every part of the army bears a relation to the general and is attributed to him, so everything in the science is related and attributed to its subject. Not every part of the army bears the same relation to the general, nor is everything in the science attributed to the subject in the same way. Buridan thought that every aggregate which is not one thing merely by spatial arrangement (as a bundle of sticks) is unified by some such principle.[5]

The unification of a science had to be accomplished at the level of terms, not of premises and conclusions. The subject was a term, and so too were the things attributed to it. In the Questions on the Metaphysics Buridan enumerated several modes of attribution to the subject.[6] Most obviously, attributes (passiones) are attributed to it; so too are attributes of these attributes. ("Motion" is an attribute of "natural body" and "speed" is an attribute of "motion.") But the parts of the subject, and the attributes of the parts, are also attributed to it, as are its principles or causes and its contrary or opposite. The subject is able to bind conclusions using all such terms into a unified whole, since they all bear some reference to that one concept.

Buridan's position has now been established: a science requires an unique subject as a principle of unity. He argues further that this subject, and nothing else, could serve as the principle of distinction among sciences. This point will become clear in our consideration of his defense of the three-fold Aristotelian division. For the present we may merely note that the subject of a science determines and is determined by its contents. If the subjects of the sciences are known, a new conclusion or argument can easily be classified. One asks, to which subject are its terms attributed? Conversely, the subjects of the sciences should be determinable from representative samples of their contents. Buridan describes the criterion exactly: the subject is "the most general genus considered in the science which does not transcend the boundaries of the science, and which appears in the role of subject to the primary principles and attributes considered in the science."[7] Buridan uses this criterion to determine the subjects of the three speculative sciences.

The limitation "not transcending the boundaries of the science" is necessary because some terms appearing in the primary premises may be more universal in signification than the subject itself. Some of these are shared by several sciences. As we shall see, Buridan acknowledged that a science may receive definitions from a superior and more universal science. The common notions, or axioms, moreover, contain terms transcending the bounds of the special sciences.

The subject of a science and its boundaries were, on Buridan's account, mutually determined. Since neither could be taken as obvious, independent arguments were required to establish the Aristotelian division of knowledge. Two tasks had to be accomplished in this regard. It was necessary to show that the three speculative sciences admitted by tradition were actually distinct. The second task was to show that these three sciences exhausted speculative philosophy. No other science could exist at the same level of universality.

Buridan granted the existence of metaphysics, physics and mathematics as an obvious fact, but he did not think it obvious that these sciences were rigorously distinct. The most obvious procedure would be to distinguish sciences by means of the objects they consider. Buridan thought that all things were considered by all the sciences.[8] The classification of the sciences could not be accomplished by a classification of material objects. From this consideration Buridan concluded that the division of the speculative sciences had to be made on the conceptual level (_ex parte rationum sive conceptuum apud animam existentium_).[9] This presented several possibilities. Sciences might be distinguished on the basis of the conclusions they demonstrated, of the premises they used, or of the terms which occured in them.

The suggestion that the sciences differ because they demonstrate different conclusions was persuasive but ultimately unsatisfactory. While it was true that most conclusions could be assigned unambiguously to one science, this was not always the case. Buridan illustrated this point with the example, "The earth is a sphere." Mathematics (that is, mathematical astronomy) demonstrates this conclusion through the celestial appearances, and physics demonstrates it through the tendency of heavy matter to move to the center of the universe.[10] Mathematics cannot be altogether distinct from physics solely in virtue of the conclusions it contains. Premises would not serve to distinguish the two sciences either. For example, both physics and mathematics use the axiom, "The whole is greater than the part," as a premise.

If the division of the sciences cannot be made using premises or conclusions, one is left with the thesis that the sciences are distinguished by the terms they use. This cannot be correct in an unqualified way, of course. Sciences sharing premises and conclusions also share terms. Buridan's explanation of the division of sciences by means of terms was rather subtle, and to understand it thoroughly we shall have to digress briefly into terminist logic. Nevertheless, he presents his thesis in a manner accessible to anyone familiar with the Aristotelian divisions of the thirteenth century.

Buridan thought that the classifier must look not only to the terms used but also to the way terms are used. He would first of all discover that metaphysics differs from the two "special" sciences in comprehensiveness. All three consider all things, in the sense that they use terms standing for all things, but metaphysics alone forms premises and conclusions from all terms. Physics and mathematics do not use all terms, nor do these sciences use terms in the same way as metaphysics. Physics and mathematics for the most part use different terms. The terms they have in common they use differently.[11] The three sciences, in short, are able to consider the same things in different ways, but the considerations of the metaphysician are the most extensive.

To say that different sciences consider the same things in different ways was to use a familiar way of describing the distinction of sciences. The statement is reminiscent of thirteenth-century Aristotelianism. Buridan was not adverse to using such language. We read in the Questions on the De Caelo[12] that sciences are diverse because "although they consider the same things they do not consider them in the same way nor according to the same rationes."

Buridan developed this claim in the Questions on the Physics and the Questions on the Metaphysics at considerable length, integrating it with his account of attribution to the subject genus. The fundamental difference between metaphyics and the special sciences was that the former use absolute or "quidditative" terms and the latter use "connotative" or "respective" terms as the subjects of their propositions.[13] Buridan did not invent the distinction between absolute and connotative terms. He may have borrowed it from Ockham, whose account of connotation was not perfectly clear.[14] Buridan's account was more careful, and he put the notion of connotation to more uses than had Ockham. De Rijk[15], Scott[16] and Maieru[17] have provided valuable descriptions and plausible interpretations of Buridan's doctrine of connotation, but no one, to my knowledge, has remarked upon his application of the doctrine to the division of the sciences.

For Buridan as for Ockham, connotation was a kind of signification of terms. Ockham described connotative terms as those which signify some things primarily and other things secondarily.[18] Concrete terms (adjectives) are connotative. White, for example, primarily signifies white things and secondarily the term "whiteness." Abstract nouns (such as "fatherhood") which do not denote entities are likewise connotative.[19] When used in propositions, connotative terms supposit for their primary significates only.[20] They connote, or make oblique reference to, their secondary significates.

Buridan admitted Ockham's division of terms into absolute and connotative, but he modified it in the direction of greater complexity. Absolute terms, for Buridan as well as for Ockham, supposit for everything they signify in personal supposition. These terms signify real entities, that is, actually existing individuals. Such things, and they alone, have quidditative (real) definitions (<u>diffinitiones exprimens quid rei</u>).[21] An absolute term can be called a "quiddity" because it was a simple concept conceiving the "<u>quid est</u>" (the definition) of a thing or things.[22] Buridan actually preferred to use the name "quiddity" in his discussion of the division of knowledge.

Connotative terms signify something for which they are not able to supposit. Buridan's position seems to be that every abstract name in the nine categories of accident which does not signify a real, separable accident (one capable of existing without a subject) is connotative. The abstract names of separable accidents, on the other hand, are "simpliciter absolutum a connotatione."[23] "Whiteness," according to Buridan, is an absolute name and may be called a "quiddity."

To discover what concepts (or mental terms) are quidditative, one need only discover which are truly simple. Buridan was not always sure about particular cases,[24] but he did think he knew what kinds of things are _able_ to be conceived by such concepts. All substances can, and so too can the separable accidents: (1) colors and other affective qualities; (2) shapes; (3) quantities (at least some of them). He also regarded local motions as absolute.[25] Only the abstract names of such accidents are absolute; all concrete names (adjectives) are connotative. Thus "white" and "round" are connotative, "whiteness" and "rotundity" are absolute.[26] All names in the other categories, whether abstract or concrete, he regarded as connotative.

According to Buridan, metaphysics alone considers the quiddities of things. This science alone deals with things according to their real definitions, conceiving them by means of simple concepts. He pressed this point very far. Metaphysics deals with _everything_ in terms of what it is. It is the metaphysician, not the mathematician as such, who understands a triangle as a plane continuous quantity enclosed by three sides. Only a metaphysician knows what a plane continuous quantity is.[27]

One may not say that the special sciences consider quiddities as such, because they do not concern themselves with the real definitions of things. (If they make use of such definitions at all they must borrow them from metaphysics.[28]) Buridan is willing to say that quiddities are considered in the special sciences, because they do sometimes use terms which in themselves are quidditative. They use, for example, the terms "stone" and "figure," but they do not use them quidditatively. That is, physics does not consider "stone *qua* stone," nor does geometry ask what kind of thing a figure is. The special sciences, Buridan says, do not consider things according to purely quidditative reasons (*rationes simpliciter quidditivae*).[29] To express his point more simply, the mind concentrates on some limited aspect of things when it considers them in a special science.[30]

When used in a physical proposition, "stone" signifies individual stones in a special way; it signifies them as mobile objects.[31] The physicist *defines* a stone by referring to its peculiar kind of mobility,[32] perhaps as a natural thing having a passive principle of motion. This is not the proper, quidditative definition of a stone; it leaves out what is essential, the stone's "stoneyness". Physics defines and understands stones and other natural things only in terms of the one concept to which everything in physics is attributed, the subject "*ens mobile*." This explains the meaning of Buridan's comment that nothing is considered in a science but what is conceived according to the *ratio* according to which it is attributed to the primary subject.

We have here an explanation of attribution which is based squarely upon Buridan's logical theories. The interpretation of _ratio_ as a concept by means of which something is conceived, either simply and quidditatively or according to non-essential characteristics, makes Buridan's description of the process of attribution more comprehensible and more exact. Although he only hints at the logical underpinnings of his account of attribution in the _Questions on the Physics_ and the _Metaphysics_, he leaves enough clues to direct the interested reader back to his treatises on logic.

Buridan, as we have seen, wanted to explain the distinction among the sciences on the basis of terms. The preceding considerations imply that the distinction was finally based upon a difference between modes of definition and demonstration. Metaphysical definitions are based upon the natures of things, that is, upon the universal concepts which conceive many individual things simply and absolutely, not only generically but specifically.[33] For this reason, Buridan says that metaphysics considers things in their primary and principal causes.[34] All the special characteristics of this science--its certainty, its nobility, its "simplicity" and its "self-finality"--derive from its quidditative mode of definition and demonstration.

Physics and mathematics, in their pure forms, deal only with descriptive, or nominal, definitions of things.[35] Such definitions indicate not what things are but how they may be conceived or named. Definitions of this kind are based upon inferences (_coniecturationes_) from sensation.[36] Buridan believed that this mode of definition was appropriate to the special sciences and quite sufficient for the degree of evidence and certainty which they possessed. Descriptive definitions, as well as quidditative ones, were the instruments of genuine and reliable knowledge about the world. Nevertheless, one could not say that mathematics or physics consider things in their full reality.

This point is confirmed in the Questions on the Metaphysics, I, 4, "Whether metaphysics is the most certain science." Buridan remarks in this question that every science except metaphysics leaves behind doubts concerning even its principal and best known objects! Left on its own, a special science could not do better.[37] Special sciences do sometimes borrow quidditative definitions from metaphysics. Physics, for example, might demonstrate that the celestial motions necessitate an unmoved mover using the definition of motion provided by metaphysics, "the act of the potential in so far as it is potential." Such demonstrations, however, were not characteristic of the science.

In the end, the reason why other sciences besides metaphysics are necessary is that it is not always possible to define things quidditatively. Men understand most things by means of complex, non-quidditative concepts. Even when the real definition is known, a thing has many characteristics whose connection with their real definitions are obscure or unknown. Knowledge based upon the quiddities of things is just too limited in scope to satisfy an inquisitive scientist. Although Buridan does not say so, considerations of this sort must have influenced his acceptance of sciences based upon descriptive definitions, which do not measure up to the strictest requirements of scientific knowledge. Only metaphysics, and those parts of physics and mathematics which metaphysics establishes, can claim to be sciences in the strictest sense.[38]

Having seen now how the subject unifies a science by serving as one principle to which everything considered in the science is attributed, and that metaphysics, mathematics and physics differ in the way they use terms and form definitions, it remains to be shown that this method of distinguishing sciences will produce the three-fold Aristotelian division.

We have already considered why the two special sciences are necessary as a supplement to the superior, but limited, knowledge of the metaphysician. That they are different in kind from metaphysics is easily seen. But why are physics and mathematics distinct bodies of knowledge? Buridan explained the difference between these two sciences purely on the basis of the _rationes_ through which they define and demonstrate. Physics uses the terms whose definitions include motion. Mathematics uses terms defined with reference to measure or quantity. When mathematics and physics demonstrate the same conclusion, they do so through different middle terms, reducible to the two different primary subjects.[39] Motion and quantity are two distinct realities. Since neither of the two subjects "mobile" and "quantum" is reducible to the other, they must serve as subjects of two distinct whole sciences.

It is harder to see why only three whole sciences should exist. Since the same thing can be conceived by many distinct rationes and given different descriptive definitions, surely it can be studied by several different sciences? Buridan did not deny that many such sciences could be distinguished, but he did maintain that only the three Aristotelian sciences had a general character.[40] The reason he gave was that all terms in all the ten categories can be reduced to these three terms: ens, mobile and quantum. Since he regarded the categories as an exhaustive classification of terms, Buridan had only to argue that the terms in each category (or each one of its major subdivisions) were considered in at least one of the three speculative sciences.

Buridan's analysis of the categories is set out in the Questions on the Metaphysics, VI, 2.[41] Briefly, his explanation of the reduction of the categories to the three speculative sciences goes as follows: substances are treated primarily in metaphysics, though they are considered by means of non-quidditative concepts in the other sciences. Quantities and the fourth species of quality (figure) pertain to mathematics. Qualities of the other three species pertain to the science of motion, though he says that those of the third species (affective qualities--colors, tastes and the like) belong to metaphysics as far as their ratio essendi is concerned. Of relations, some pertain to mathematics and some to physics. Action and passion, of course, are physical concepts, as are where (ubi) and when (quando). Position (situs) sometimes is purely of mathematical interest but sometimes it pertains to physics, being reduced to place (locus = ubi).

Finally, habitus, which refers to one's possessions, pertains to practical rather than to speculative science. Having gone through all the categories, Buridan concludes that the general speculative sciences are only these three.

One further problem remains, however, in regard to the science of metaphysics. It seems that the theory of attribution to one primary subject cannot explain why metaphysics is one science. The difficulty is that "being," the primary subject of metaphysics, is an equivocal name, meaning something different when applied to each category. If the subject is not one, how can the science be one? Buridan admits that metaphysics is not tied together by its subject in the same way as the other sciences. Metaphysics nonetheless is one science, because all its subjects may be reduced to one principle: accidents reduce to substance, material substance to immaterial, immaterial substances to God. This does not imply that God is the subject of metaphysics, as Buridan explains a few pages later. The reduction of subject terms to a primary subject term is quite different from the reduction of things to God.[42] Rather, God is signified by the primary subject, ens, because He is the primary instance of being. In this fashion Buridan neatly solves the old problem of whether the subject of metaphysics is God or ens by divorcing the "center of unity" of the science from its "center of attribution." In this fashion both God and being can be seen as central to this science.

Most readers, I think, will grant that Buridan's arguments for the exhaustiveness of the Aristotelian division leave something to be desired. In the texts I have discussed thus far, he has not answered those who wanted to include ethics and logic among the speculative sciences. Certain questions also remain concerning the claim that mathematics and physics are rigorously distinct. To argue, finally, for a method of classifying sciences on the grounds that it divides all terms into an exhaustive set of mutually exclusive classes is not the same as to justify it as the best method of classification. Despite these shortcomings, Buridan did succeed in providing a comprehensible and consistent interpretation of the traditional division from a nominalistic point of view. But his acceptance of the Aristotelian division is far less interesting than his arguments for it. He showed that a nominalist need not abandon the program of classification merely because he rejected the realist's explanations of the principles of division. (Of course his understanding of what he is doing will be quite different!)

Buridan's treatment of the three speculative sciences is interesting in other respects as well. One significant feature is the unique status which he assigned to metaphysics. Other philosophers agreed that metaphysics was different from and superior to the special sciences, and even that it was the science of quiddities, but Buridan's understanding of metaphysics as the science which considers all things by means of simple specific concepts[43] is unusual, to say the least. His opinion certainly reflects the esteem in which he held the Faculty of Arts and, especially, its ruling science. The implications of this exaltation of metaphysics will become clearer when we consider the hierarchy of the sciences in the next chapter.

1 Buridan admitted that not every conclusion could be assigned to one science only. Nevertheless, if we take the conclusion together with the means by which it is known, it does belong to one science. See below, n. 10.

2 Concerning Peter Auriole, see Paul V. Spade, "The Unity of a Science According to Peter Auriole," Franciscan Studies 32 (1972), pp. 203-217.

3 Prooem. Exp. super Phys., PW, pp. 9-11.

4 QM, IV, 4, 15rA. See also QP, I, 2.

5 QP, I, 2, 3rB.

6 QM, IV, 4, 15rB; cf. QP, I, 3, 4vA.

7 QM, IV, 4, 15rB.

8 Most notably, see QP, I, 1: "Utrum scientia naturalis sit scientia de omnibus rebus?"; QM, IV, 3: "Utrum metaphysica considerans omnes entes sit una scientia?"

9 QM, VI, 1, 33vB.

10 QP, I, 3, 4rB: "etiam si consideratur in scientia naturalis de imaginibus et figuris hoc non est precise secundum rationem magnitudinis et figure mensure vel mensurabilis sed prout tales magnitudines expediunt vel impediunt ad tales motus vel operationes." Buridan would have to say, it seems to me, that metaphysics and physics sometimes use the same spoken and written words, but not the same mental terms. As explained below, rationes are concepts and concepts are mental terms, and the two sciences conceive things by means of different rationes.

12 Iohannis Buridani Quaestiones super Libris Quattuor De Caelo et Mundo, ed. E. A. Moody (1942), I, 1. This paragraph is worth quoting in full as a supplement to the evidence presented from the Questions on the Physics and the Metaphysics.

"Sed tunc est dubitatio quo modo dictae scientiae, cum de eiisdem rebus considerent, possunt dici diversae. Respondendum est quod hoc est quod licet considerent de eisdem rebus, tamen non considerant illis eodem modo nec secundum easdem rationes; et in sexto Metaphysicae debet videri, et visum est, quo modo de omnibus differenter considerant metaphysica, physica et mathematica. Unde repetendo sub compendio, metaphysica considerat tamquam de subiecto primo de isto termino 'ens' vel 'res' vel 'aliquid,' et consequenter considerat de omnibus aliis terminis ea ratione qua habent ad dictos terminos attributionem. Physica autem considerat tamquam de subiecto primo de iste termino 'motus' vel 'mobile,' et de aliis ea ratione qua habent ad illos terminos attributionem. Mathematica autem considerat tamquam de subiecto primo de iste termino 'quantum' vel 'quantitas,' prout ei attribuitur ratio mensurae vel mensurabilis, et de aliis habentibus attributionem ad illos terminos secundum praedictas rationes."

[13] One must add "as subjects" because all predicates whatsoever of scientific propositions are connotative. See QM, IV, 4, 15rA-B. The reason is that all scientific predicates are adjectives (or phrases using names in oblique cases) and such are always connotative.

[14] Some of the puzzles about Ockham's doctrine of connotation are revealed in Loux's prefatory essay to his translation of the Summa Logicae, "The Ontology of William of Ockham." An important difference between absolute and connotative terms, on Ockham's view, is that the latter have nominal definitions and the latter do not. (See Summa Logicae, I, 10, trans. Loux, pp.69-71. Buridan's understanding of nominal and real definitions is quite different from Ockham's, but he too sees a difference between the definitions given to the two kinds of terms.

[15] "On Buridan's Doctrine of Connotation" in The Logic of John Buridan, Opuscula Graecolatina No. 9 (Copenhagen, November, 1975), pp. 91-100.

[16] Introduction to Sophisms on Meaning and Truth, pp.42-49.

[17] "Significatio et Connotatio chez Buridan," in The Logic of John Buridan, pp.101-114.

[18] Summa Logica, I, 10, trans. Loux, p.71.

[19] Loc. cit. Ockham uses as an example "solid", without, however, committing himself on whether or not solid is an entity.

[20] Summa Logicae, I, 63, p.189. Strictly speaking, this is true only when the term has personal supposition.

[21] QM, VII, 5, 44v. Concerning quidditative definition, see Sophisms, Ch. I, Scott, pp.77-78. See also Summula de Dialectica, Tract. VIII.

[22] That Buridan regarded absolute concepts as simple is clear from QM, VII, 5. We learn in Sophisms, Ch. 1 (Scott, p. 73) that there can be a simple concept of whiteness. "Quiddity" was regarded by Buridan as that which the real definition signified: "qui considerat diffinitiones rerum ipse considerat quidditates earum." (QM, VI, 1. Although this passage is quoted from one of the initial objections, Buridan assumes its truth in his reply.)

[23] QM VII, 5. Two puzzling texts must be addressed, in light of this claim. In QM, VI, 2, Buridan associates non-connotative terms with terms in the category of substance; and in QM, IV, 4, 15rB he

calls "motus" connotative, even though he regards local motions as real entities (see note 25 below).

To the first, it might be said that substantives are the paradigm case of absolute terms. It is not so obvious that some accidental terms are absolute, and Buridan simply does not care to bring them up in the text at hand. To the second, it seems likely that he calls "motus" connotative because it names all species of motion indifferently, and he regards only local motions as real.

24 A thing may have a real definiton yet not be knowable to us as such. When Buridan says that certain quiddities--man, brute, stone--are considered in metaphysics according to quidditative reasons, he is speaking absolutely, not relative to human knowledge. Compare QP, I, 5, 7r: "lapis non potest scire perfecte nisi demonstrate sint omnes conclusiones demonstrabiles quarum aliquis terminorum supponit pro illo lapide vel significat illum lapidem; et sic ego cerdo quod nunquam homo nisi fuerit deus vel beatus in patria, de quibus nichil dico modo."

25 That whiteness (and by a like argument, all affective qualities) are absolute, see QM, IV, 1, 17r. In QP, I, 8 we learn that magnitudes are absolute. That shapes are absolute with respect to substance (though not really distinct from quantity) see QP, II, 3. Buridan thought that Aristotle did not hold this view of quantities and qualities but that the doctrine of transubstantiation required it. We would too hastily conclude that <u>only</u> reasons of faith lead Buridan to accept this view. (See Ch. Three, n. 73.) He saw certain advantages in this position as a physicist. An argument is given from the behavior of gases for the reality of magnitude in QP I, 8. For the reality of motion, see QP, III, 7. Buridan's philosophical reasons for admitting the reality of motion are detailed by Anneliese Maier in "The Nature of Motion," in <u>On the Threshold of Exact Science</u>, ed. and trans. Steven D. Sargent (Philadelphia, 1982), pp. 21-39.

26 That all concrete names are connotative, see QM, IV, 6, 17vA.

27 QM, VI, 1, 33rB. Buridan illustrates at length, "for the sake of the juniors," the metaphysican's way of establishing the principles of mathematics, in QM, I, 4, 5vA.

28 QM, VI, 1, 33rB: "nulla specialis scientia considerat quidditates rerum secundum rationes simpliciter quidditativum nisi forte hoc sit supponendo a superiori scientia." He thought, for example, that physics considered the quiddities of man and of God (<u>loc. cit.</u>, reply to objection).

29 QM, VI, 1, 33rB.

30 The most complete treatment may be found in QP, I, 3, "Utrum ens mobile sit subiectum totius scientie naturalis?" See also QP, II, 6, 34rB; QM, VI, 2, 34rA.

[31] This restricting of the mind involves the use of terms, not in their complete signification, but with some part of their signification put in abeyance. We have here, I think, an instance of what Buridan and contemporary terminists called "appellation of the reason." I explain this phrase and speculate on its role in Buridan's classificatory theory in Appendix I.3.

[32] QP, I, 3, 4rA: "Physicus non habet scire quid homo est substancialiter sed quibus motibus et operationibus et quo modo et per que membra et per quales virtutes ipsa sit innatus mouere et moueri, agere et pati."

[33] QM, VI, 1, 33rA. As Buridan explains here, metaphysics descends not only to species but even to individuals, albeit hypothetically.

[34] QP, VIII, 1, 119rB: "credo quod commentator inepte reprehendit avicennam dicentem quod ad metaphysicum pertineat primum principium in quolibet genere cause."

[35] QM, VI, 1, 33rB: "Ad aliam dicendum est quod passiones pertinentes ad motus et mensuras rerum non oportet demonstrentur de subiectis suis per rationes simpliciter quiditativas; sed sufficit quod per descriptiones communes declarantes quid nominis que accepte sunt in ordine ad operationes uel mensuras; ideo hec bene pertinet ad scientias speciales." In QM, VII, 5, Buridan distinguishes nominal and causal definitions. The latter is the definition of an effect by means of its cause. These are not quidditative definitions. The special sciences use causal definitions when they can; they are in fact more powerful for natural demonstration than are quidditative definitions.

[36] QM, VI, 1, 33rA.

[37] 5r-v.

[38] It seems odd that Buridan should apply these remarks to mathematics as well as to physics. Aristotle thought that mathematics is at least as certain as metaphysics. Does mathematics deal with descriptive definitions? Perhaps, if one thinks of mathematical definitions as descriptive of the <u>physical</u> subjects whose accidents they are. Buridan may also have in mind the sciences subalternated to mathematics, such as optics and astronomy. These do for the most part have this conjectural and descriptive character.

[39] Buridan argues in QM, IV, 2, 13vB that there can be more than one scientific demonstration of one conclusion, distinguished by their different middle terms.

[40] Buridan did allow for mixed sciences, the <u>scientiae mediae</u>, which partook both of mathematics and physics. These sciences, which shall be considered in more detail in the next chapter, were not on the

same level of generality as the two "parent" sciences, and so they did not form part of the primary division of sciences.

41 34rA-B. I must note here that this text occasionally reads "metaphysica" where "mathematica" is clearly correct. In almost all cases the correction is easily supplied.

42 QM, IV, 3, 14vA; IV, 5, 16r-v.

43 Simple concepts are not arrived at by reasoning (*cf.* Ch. Three, n.58) but by a simple act of understanding. Buridan surely did not intend to say that metaphysics demonstrates these simple concepts. Presumably, his point was that it is the metaphysician considered as the man of wisdom who knows them. The relation of science to wisdom will be considered in the next chapter.

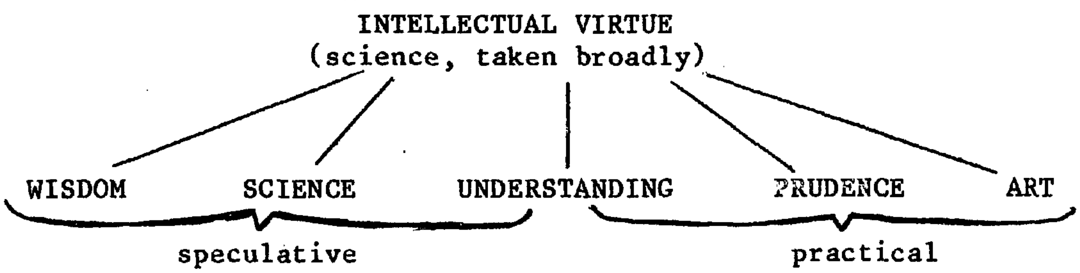
Chapter Five: Buridan's *Arbor Scientiarum*

Questions concerning the subjects of the sciences, remarks Buridan in the first book of his *Questiones super octo Libros Physicorum*,[1] pertain not to physics but to logic or metaphysics. Nevertheless, he continues, it is proper for the auditors of every science to know from the beginning the subject of their inquiry, from the unity of which the whole science receives its unity. The distinction and division of the sciences is, in short, a matter of importance to the educator. By this comment Buridan places himself squarely in the tradition of medieval pedagogy.[2] Although his approach is far more sophisticated than that of the earlier *introductiones ad artes*, his ultimate aim is essentially the same: to teach his pupils the proper starting point for their studies and to indicate the relation of their science to the whole body of knowledge.

Buridan's discussions of the problems of classification are found in his presentations to students of particular sciences. We must not be surprised that we nowhere find a complete statement of his views. Buridan's *arbor scientiarum* has the appearance rather of a thicket than of a tree. We must gather our information where we can. The picture which emerges is complex, but not incoherent. Buridan applies his principles of classification with a laudable consistency.

My method in this chapter will be to present Buridan's tree of sciences piecemeal, beginning with the most general scheme and descending to the more particular. I shall not adhere rigidly to one

Figure 5.1: The Division of Intellectual Virtue



quaestio or even to one book as I consider each version or part of his classification. A discussion of one point in the Questions on the Physics may illumine a distinction in the Questions on the Nicomachean Ethics. Since we find a remarkable consistency in Buridan's treatment of the arbor scientiarum, the difficult question of the order of composition of his writings is not a crucial one.[3] I shall try to examine the parts in light of the whole, explaining the rationale of each division and the various relations among the sciences, as the occasion requires. I shall also take up certain puzzles which Buridan raises about the classification of the sciences, and I will point out others which he omits. I shall consider Buridan's ranking of the sciences and arts according to dignity. Finally, I shall compare his use of the traditional elements of classification to the approaches of some other of the later scholastics.

Aristotle's Nicomachean Ethics supplied Buridan with his most general division of cognitive habits. Intellectual virtue, the counterpart of moral virtue, is a habit perfecting man as a knower. According to Aristotle, these virtues fall into five general kinds: wisdom, science, understanding, prudence and art.[4]

Buridan explains that wisdom is the name Aristotle gives to the science of the highest and most universal causes. As distinguished from wisdom, science is the knowledge of secondary and specialized causes. Wisdom is also called science because it is certain and evident knowledge of necessary matters obtained by demonstration.[5]

Intellectus, or understanding, is the comprehension of terms. For Buridan as for Aristotle, this is the habit by which we can grasp the genera and the species of things. Genus and species, as the reader will recall, are mental terms. Mental terms are natural likenesses of things which, representing them in their more or less general features, are able to signify and to supposit for these things in mental propositions. The universals are not sensory images but intellectual notions abstracted by the mind from sensations.[6]

Wisdom and science are speculative habits, since they are for the sake of contemplation. Understanding has a double character. Some terms are possessed for contemplation or for use in speculative sciences, but others are possessed for utility. We might take as an example of the latter the notion of a hammer. Sciences which form arguments using such notions as these are called practical, and they are divided into two parts, prudence and art.[7] These are called scientific in a broad sense, to distinguish them from opinion.

Speculative and practical habits are dispositions of what Buridan and the other scholastics called the speculative and practical intellects. Buridan explains that these are not two distinct intellects but one intellect considered in two ways.[8] When engaged in speculation the intellect is called speculative, but practical when it is engaged in acting morally or making.

Some philosophers thought that the speculative intellect dealt with universals and the practical intellect with particulars, but Buridan rejects this claim as faulty in both members. Speculative science, as we have seen, descends to the knowledge of particulars. Art and prudence are able to ascend to the consideration of universals.[9]

Others explained the difference between speculative and practical knowledge by saying that speculation is about necessary matters and practical knowledge is about contingent matters. As the reader might expect, Buridan found this explanation too simple.[10] Everything created is contingent in its being, though not always contingent in its relations to other beings. The speculative sciences deal with all created beings, so we cannot say, without qualification, that they are concerned with necessary matters.

Buridan decides that the practical sciences deal with contingent matters which are subject to human control. Both art and prudence enable us to judge about changeable matters within our power. The sculptor may or may not shape this piece of bronze into a statue; the soldier may or may not run away from battle. The practical intellect grasps singulars of this sort, both as singulars and in their universal aspects. Buridan admits that it can ascend to a consideration of necessary matters, but only for the sake of works. The truly distinctive mark of the practical intellect is that it reasons for the sake of acting and making.

The speculative intellect reasons about matters which are necessary in an extended sense. Truly necessary matters, such as the Pythagorean theorem, are objects of the speculative intellect, but so are matters necessary only with respect to us, whether invariable or variable. Anything having a nature and natural properties unalterable by man is understood by speculation.

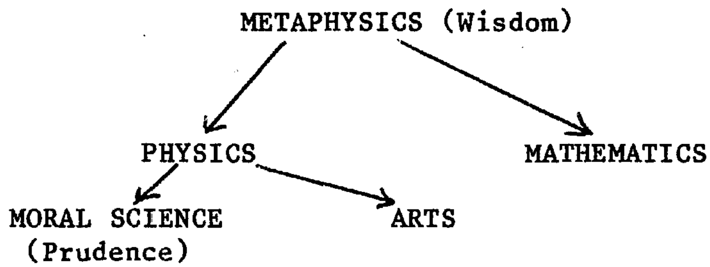
We must not think that man and human things have no place in speculative science. Man himself can be subjected to theoretical scrutiny. Even man-made devices have a place in the speculative sciences. The speculative intellect, comments Buridan, sometimes descends to contingents such as these to learn from them, since they are images of natural things. Buridan probably had in mind mechanical devices such as the planetarium, which could be used to instruct young astronomers about the motions of the planets. Contingent things within human power have a place in speculation only insofar as they are directed to the contemplation of truth.

Thus far we have considered prudence and art together, as kinds of practical knowledge. That they are distinct intellectual habits seems clear, but it is not so easy to detect the difference. Buridan follows Aristotle in saying that prudence concerns action and art concerns making, but he sees that some puzzles result from this characterization of the two practical habits.[11]

The common view of acting and making, which Buridan considers and doubts, is that making is an activity which "passes over into exterior matter," as the actions of a carpenter pass into wood. An action, on the other hand, is an activity which remains within the agent. Thinking and willing are Buridan's examples of actions. The reason for his doubt is that some acts of virtue (which come in some way under prudence) may be said to pass into external matter: an act of bravery, for instance, produces an effect outside the agent; fear or wounds are produced in the enemy. In addition, the arts involve interior acts of thinking and willing. Nor can one simply say that art produces something for use and prudence is for the sake of the act itself. The art of playing the cithara, Buridan remarks, exists for its own sake rather than for use.

Buridan thinks that the views presented may be accepted if we say that action is primarily an interior motion which may have exterior consequences, and making is the producing of exterior things, which nevertheless involves interior motions. He rejects a move which some had made to deal with the troublesome fine arts.[12] These classifiers divided art into active and factive parts, distinguishing manufactive arts such as carpentry from the arts which exist solely for the sake of pleasure. Remarking that names are given <u>ad placitum</u>, Buridan says that the moderns may distinguish as they please, but as an interpreter of Aristotle, he will be content with the other account of

Figure 5.2: The Subalternation of the Special Sciences to Metaphysics (Subalternations are indicated by arrows.)



art. Aristotle connects action with prudence and making (factio) with art, and so will he. This remark clearly reveals Buridan's inclination and purpose. He was more interested in expounding Aristotle's doctrine, which he no doubt regarded as fundamentally correct, than in perfecting the division of knowledge in all its details.

In Chapter Three we considered Buridan's arguments that there are three speculative sciences that are general in scope. All other sciences, according to Buridan, are reducible to them in one way or another. The three are not equally general, however. Metaphysics alone is the universal science. The other two are subordinate to metaphysics, receiving from it their first principles. The schoolmen called the relation which obtains between a science which supplies principles and one which receives them "subalternation." The notion of subalternation, which comes from the Posterior Analytics,[13] was commonly used to explain the relation of derivative mathematical sciences to general arithmetic. Buridan uses subalternation to explain how the most general of the sciences are related to one another and to some of the specialized branches of knowledge.

Subaltern[14] sciences, according to Buridan, do not consider different things, they consider the same things by means of different concepts. Buridan's understanding of how the subjects of the subaltern sciences are related makes this point clear. The subject of the subalternating (more universal) science is a general term predicable of the subject of the subalternated science.[15] "Magnitude," for example, is the subject of geometry, and "mobile magnitude" of astronomy. Although Buridan's description of the relation of the two subjects was probably suggested by Aristotle's statement in the Posterior Analytics that, of the two subject genera, one is a part of the other, his conception of the relation of the two subjects was more flexible.

Buridan did not think that the relation of the subjects had to be a relation of genus to species. The same things, he says, may be considered by the two sciences under different names, of which one is abstract and the other a contracted or "concreted" form of the first.[16] His example is the pair, arithmetic and music. The abstract name "number" is the subject of the first, and the contracted name "audible number" is the subject of the second.

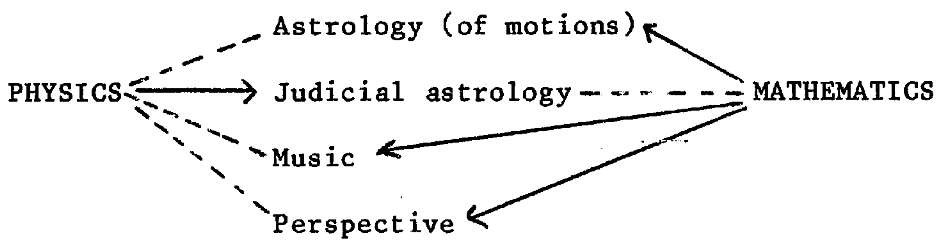
Our consideration of the two special sciences, physics and mathematics, enables us to understand Buridan's intention here. The subalternated science will consider the same things as the subalternating science, but under a different ratio. The two rationes are the two subjects. They are not necessarily related as genus and species, because the contracting qualifier of the more general ratio need not be a specific difference in the same category. The example given is a case in point. Audible number is not a species of number. They are related as an absolute to a connotative term, or as a connotative term to one yet more connotative. The science which considers things under connotative concepts is not able to stand on its own. Connotative terms must be reduced to absolute terms, as accidents are reduced to substances. If a science has a connotative term for its subject, it will have to receive principles from a science having an absolute term for its subject.

The science of absolute terms, as we have seen, is metaphysics. Buridan teaches that all the arts and sciences are subalternated to metaphysics,[17] which considers all things sub ratio entis, conceiving them by means of both general and specific notions. Metaphysics gives to physics, for example, the general principle that every natural agent acts for an end. To moral science, metaphysics gives the definition of man. The principles of every science, as we have seen, have a hypothetical character unless they are made firm by metaphysics. The metaphysician alone is a knower in the truest sense of the word. This is not to say that there is no perfect knowledge of the natural world or of mathematics. Rather, the perfect physicist or the perfect mathematician will also be a metaphysician. The habit by which he holds the first principles of his special science will be a metaphysical habit. Because of its universality and primacy, Buridan identifies metaphysics with Wisdom.[18]

Physics and mathematics are not related to one another by subalternation, but each subalternates other branches of knowledge to itself. The practical sciences, which deal with changeable things within our power, are subalternated to physics, the science of mobile being.[19] Not speculative in themselves, they do sometimes use speculative premises, and some of these they receive from physics. (They also receive principles from metaphysics, of course.) Only he who understands the motions proper to living creatures can have a complete understanding of virtue and vice. The doctor, if he is to be an *artifex* and not just a man of experience, must have a theoretical understanding of the human body. All the arts and prudence, which Buridan identifies with moral science,[20] will be subalternated to physics, since all consider mobile being under a more restricted *ratio*.

Both mathematics and physics subalternate to themselves a group of sciences traditionally called the *scientiae mediae*, or intermediate sciences. The more important of these are shown in Figure 5.3. The principal subalternations are indicated by solid arrows and the secondary subalternations by dotted lines.

Figure 5.3: The Intermediate Sciences



Sciences such as astrology and perspective are not purely natural, because they use mathematical premises. They are not purely mathematical, because their conclusions concern natural things.[21] The schoolmen debated whether these sciences were primarily natural or mathematical. St. Thomas held that they were essentially natural, but the Commentator held the other view. Buridan sided with Averroes on this matter.

Buridan sets out both positions and sketches the arguments for them in the Questions on the Physics, II, 6. St. Thomas argues that the intermediate sciences ought to be named for their ends, as are the practical and speculative sciences. The intermediate sciences give knowledge of natural things, and the knowledge produced is the end of the science. Averroes holds that sciences ought to be named for their principles. Since the principles of these sciences are mainly mathematical, the sciences themselves are mathematical.[22]

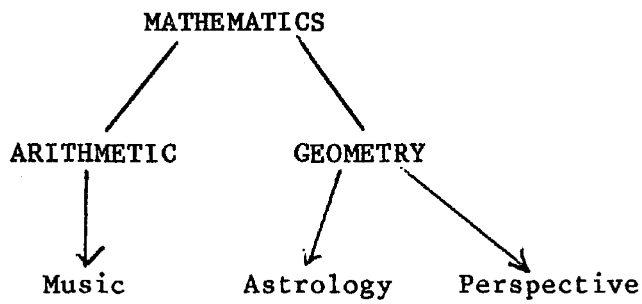
Buridan uses as an example of a natural conclusion which can be proved through mathematical premises the proposition, "The earth is spherical." Premises are to be considered mathematical if the middle term is mathematical, since the middle is the cause for the inherence of the predicate in the subject. Astrology uses a mathematical middle to prove the proposition, namely the aspects of the stars. These aspects, which are angles or positions, have a mathematical character.

The intermediate sciences, then, are primarily subalternated to mathematics. Their subjects indicate this relationship. The subject of astronomy is mobile magnitude; music's subject is audible number; the subject of perspective is visible line. Buridan also thinks that these sciences sometimes receive principles from natural science; some may even be more natural than mathematical, for example, judicial (predictive) astrology. Even the others will have a secondary subalternation to physics.

One reason Buridan gives for considering the intermediate sciences as mathematical is that they are commonly reputed to be so.[23] In another text he divides mathematics into arithmetic, geometry, astronomy and music.[24] Buridan accepts the popular opinion, which goes back to antiquity, that the quadrivium is the primary division of the speculative science of mathematics. Although they are commonly named among the arts, they do not properly belong to that division of intellectual virtue.

As the subjects of the intermediate sciences suggest, they are not simply subalternated to mathematics as a whole. Mathematics has parts, and these lesser mathematical sciences are subalternated to the appropriate parts of _mathematica totalis._ These relationships are shown in Figure 5.4. Buridan suggests, although he does not say, that

Figure 5.4: The Mathematical Sciences



geometry is subalternated to arithmetic.[25] Geometry, he says, has a connection with arithmetic and presupposes it. Triangle, for example, cannot be understood unless three is understood. The subjects of these sciences, however, are not related as the subjects of subaltern sciences ought to be. Number is not predicable of continuous quantity, or magnitude. Perhaps it is significant that Buridan does not call the relation between arithmetic and geometry subalternation. Subalternation seems to require not only a borrowing of premises but also a definite relation between the subjects, whereby one adds a restrictive qualifier to the other.

Buridan's understanding of the relation between the two major parts of mathematics may not be resolvable with certainty. But we must try to determine more exactly the relation of the parts to the whole. Buridan regards this relation as something different from subalternation. To discover its nature, let us consider first the knowledge of a single demonstration.

As we saw in Chapter Three, Buridan regarded the habit of one conclusion as a partial science. This fact provides an important clue to the relation of part to whole. A single demonstration is made up of two premises and a conclusion. Each, according to Buridan and the other terminists, is grasped by a single habit. When joined together, however, these habits are not a formless aggregate. Since each part plays a unique role in the argument, together they form an ordered whole. The scholastics called a whole made up of ordered and non-interchangeable parts an integral whole (<u>totum integrale</u>). As the name implies, each part has a unity and a distinct character of its own. A living organism is a good example of an integral whole.

According to Buridan, a science consisting of a set of ordered habits is an integral whole.[26] Many levels of organization are possible. The lowest is the individual demonstration, and the highest is a grand synthesis of as many propositions as can be unified by one subject, to which everything considered in the science is attributed. Buridan uses the sciences of arithmetic and geometry to show that different levels are possible.[27] Both sciences are wholes in their own right. One who knows all of arithmetic without knowing geometry can be called a perfect arithmetician, but not a perfect mathematician. The whole of mathematics is an aggregate of all arithmetical and geometrical demonstrations, unified by the subject <u>ens quantum</u>, or <u>mensurabile</u>.

Buridan calls the subject of the whole science a <u>totum universale</u>, or genus. In one text Buridan says that the whole science ought to contain as many partial sciences as the subject-genus contains species.[28] As we shall see, this cannot be strictly true. The number of partial sciences can exceed the number of species falling under the genus. But we do see here one important point: the subjects of partial sciences are generally species of the subject of the whole.[29] Geometry, for example, has parts dealing with lines, surfaces and solids.

Unfortunately, this conception of the relation of whole and partial sciences is too simple. Buridan indicates one complication when he explains that the subject of a partial science is either a subjective part (that is, a species) or an integral part of the subject of the whole.[30] The case of the science of the soul, contained in De Anima, forced him to add the latter possibility. The soul is an integral part, not a species, of animal, yet the science of the soul is clearly a part of the science of animals. Buridan thus allows the integral part of a species to serve as the subject of a particular science. A certain flexibility in the relation of subjects is also required if individual habits are to be allowed as partial sciences. The subjects of these habits, as we have seen, may be attributed to the primary subject in a number of ways.

Our analysis of partial and whole sciences seems to suggest that all the special sciences are parts of metaphysics. Everything considered in the sciences and in the arts is a part of being. But Buridan emphatically denies that the other sciences are parts of metaphysics.[31] His reason is that metaphysics and the other sciences consider the same things under different _rationes_. It should be noted that the _rationes_ which characterize the special sciences are fundamentally different from the quidditative _rationes_ used by metaphysics. The fact that metaphysics uses abstract terms answering to these quiddities prevents the other sciences from being parts of metaphysics.

We may conclude from these remarks that two subaltern sciences are not related as part and whole. Other considerations confirm this point. Possession of a whole science presupposes possession of all its parts. but the possession of the science of arithmetic by no means presupposes the possession of the science of music. The arithmetician must know the even and the odd, and all the species and properties of numbers, if his science is perfect. He need not know about harmonies. As we shall see, however, several sciences related by subalternation may together form a whole.

Buridan gives some indication of the partial sciences falling under each of the three general speculative sciences. The parts of mathematics have already been considered. The parts of metaphysics include the science of sensible substance, the science of separated substance, and the science of accidents.[32] Buridan works out the structure of physics in the most detail. Figure 5.5 shows the major subdivisions of this branch of philosophy.[33] Buridan numbers nine major parts, which descend from the most general to the most specific. The natural books in the Aristotelian corpus provide the basic structure of the division.

Figure 5.5: The Parts of Natural Philosophy

1. General Physics (contained in the *Physics*)
2. The science of beings mobile *ad ubi* (*De Caelo et Mundo*)
3. The general science of beings movable *ad formam* (*De Generatione et Corruptione*
4. The science of the attributes of generable and corruptible things as they are alterable in the primary qualities (*Meteorology*)

The remaining parts deal with the so-called Perfect mixtures:[34]

5. The science of inanimate mixtures (books by Albertus and Avicenna *de mineralibus*)
6. The general science of the soul (*De Anima*)
   Sciences of the operations and attributes common to body and soul (the *Parva Naturalia*)
8. Sciences of the different species of animal, descending to the lowest kinds
9. Sciences of the different species of plants

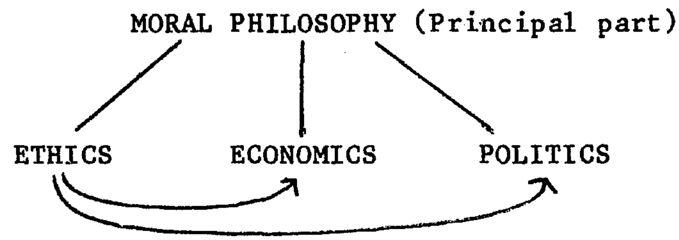
Buridan's list of the parts of natural philosophy closely resembles John of Jandun's and Marsilius of Inghen's. The unique feature of Buridan's list is his inclusion of the most specific species of animals and plants. These, of necessity, are mentioned only generally, but by including them Buridan emphasizes that the science of each kind of creature is an integral whole.

It is most interesting to compare Buridan's division to that of his pupil, Marsilius of Inghen (Figure 2.7). Marsilius is content to list the general sciences of animals and plants, but in the arrangement of Aristotle's books his list resembles his master's. A significant difference may be noted, however. Buridan's method of contraction, illustrated so beautifully by Marsilius' list, produces sciences in subalternation to the original science. Buridan himself does not apply this method uniformly in his division of physics. The fact that he distinguishes some of the partial sciences under *physica totalis* by means of subjects which are *species* of mobile being suggests that he did not regard all the partial natural sciences as subalternated to general physics.

It is interesting to note that Buridan regards the general science of physics as a part of *physica totalis*. These two sciences, part and whole, have the same subject, mobile being. The reason why the two sciences are not the same is that the partial science considers mobile being under general *rationes* only, while the whole of physics considers them by means of special as well as general notions. Whole physics is the aggregate of all the partial physical sciences, tied together by the term "mobile being," to which everything considered in the science has attribution.

Further down the tree, we find another science which deals only with general notions, the science handed on in *De Generatione et Corruptione*. This science considers things changeable in form *qua* changeable in form; its scope is the whole sublunary world of changeable beings. The subject of this part is a subjective part of the subject of the whole. The succeeding sciences presumably bear some relation to this science, since each one deals with mutable creatures. The science of the *Meteorology* is subalternated to the science of the *De Generatione*, since it contains the same things under a more restricted *ratio*.[35] The remaining parts could be joined to these two sciences to form a sub-science of beings mutable in form, considered by means of both general and special notions. Buridan's

Figure 5.6: Moral Philosophy and its Parts[36]



tools of subalternation and division into parts make possible a complex scheme of sciences, with many levels of organization.

Buridan uses these same tools to organize the practical as well as the speculative sciences. He divides Moral Philosophy, which is subalternated to Physics, into three parts. This threefold division, which once again had its roots in the books of Aristotle, was very common in the tradition. It is not apparent whether his opinion that these parts (shown in Figure 5.6) are related to one another by subalternation was also common. Further research into the thirteenth- and fourteenth-century classifiers is needed to settle this point.

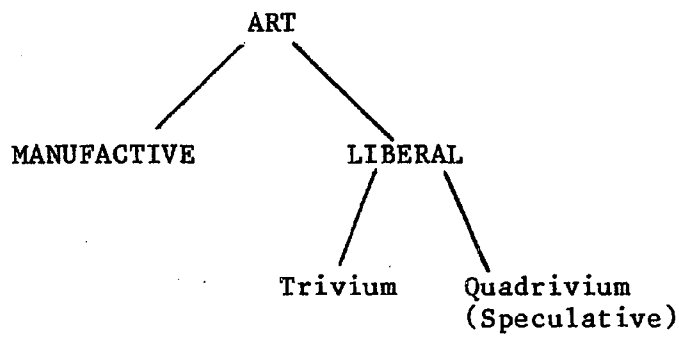
Moral science is an aggregate of its three parts, as physics is an aggregate of its parts. Neither <u>scientia totalis</u> has an existence independent of its subdivisions. The case of moral science clearly reveals that subaltern sciences may combine as parts of a whole. Two of the moral sciences are subalternated to the third but are not parts of it; rather, all three are parts of a larger whole.

The principal, or doctrinal, part of moral philosophy treats the virtues, habits, dispositions and operations of the rational soul, not merely for the sake of contemplation, but for the sake of acting well.[37] Ethics deals with the principles of morals and with the virtues which every man ought to exercise. The second part, economics, considers man as domestic, investigating the virtues proper to each member of the household. The third part, politics, instructs man how to live as part of a commonwealth. Man is the subject of each part, but each considers him according to a different ratio. Beyond mentioning that the science of laws and decretals is subordinated to moral science[38] (to politics?), Buridan goes no farther in the classification of principal moral sciences.

It is now time to consider the significance of the description "principal part." Buridan, like John of Jandun, divides all sciences into two categories, principal (Jandun's non-organic) and instrumental. This distinction is as general as the distinction between speculative and practical knowledge. It would be better to describe principal and instrumental parts as kinds of knowledge, since the two can hardly be parts of a whole in the technical sense described above.

The distinctions between speculative and practical, and between principal and instrumental, provide three major classes of knowledge: principal speculative, principal practical, and instrumental (practical). The principal sciences have as their objects terms standing for things; logic, the instrumental science, studies the terms themselves, and the arguments formed from them.[39] Grammar, which

Figure 5.7: The Primary Divisions of Art[40]



like logic is an art (see Figure 5.7), probably belongs in the instrumental part of knowledge.

Logic serves all the arts and sciences, but Buridan thought that the moral sciences need a special logic because they deal with the rational soul as subject to innate appetites which can lead astray the judgment of reason.[41] This logic has two parts, handed on in the books of the *Rhetoric* and the *Poetics*. The other arts and sciences do not need this moral logic; what he calls "logic *simpliciter*" suffices for them. Buridan's understanding of logic, its parts and its place in the classification of the sciences, is shown in Figure 5.8. I have constructed this picture on the basis of several texts, since he nowhere gives us the whole picture.

We have seen how Buridan ordered the sciences by means of subalternation and the relation of part to whole. He also arranged the sciences and arts in order of dignity. Sacred Theology, which he did not treat, holds the first place. Buridan intimates that not all the speculations of the theologians enjoy this exalted rank; only the faith itself, and theological knowledge supernaturally infused,[42] stand as the best and most worthy science.

Among the remaining intellectual habits, metaphysics is the best and noblest. The major rival considered by Buridan is prudence.[43] He decides in favor of metaphysics, primarily because metaphysics is an end and prudence is a means. A man cannot be a metaphysician, Buridan notes, unless he is a prudent man.[44] Prudence is for the sake of contemplation, not vice versa.

Leaving aside Sacred Theology, Buridan identifies metaphysics as Wisdom. Wisdom, as we have seen, is the knowledge of the highest causes of things. Buridan elaborates by listing the following criteria which wisdom must satisfy: among intellectual virtues it is the most universal; the most difficult for us to attain; the easiest, most evident and certain in itself;[45] most of all the knowledge of causes; most for its own sake; it supports the other sciences more than it is supported by them.[46] Metaphysics alone satisfies all these requirements. Metaphysics is the most universal, because it considers all things according to the most general _ratio_, _secundum quod entes_. It considers the highest causes, since it deals with God and the separated substances. It is most difficult to us, because its primary objects are farthest from sense. But it deals with what is most intelligible in itself, so it is the most certain and easiest.

Figure 5.8: The Parts of Logic and Their Place in Buridan's Classification

	SPECULATIVE	PRACTICAL	
principal parts of knowledge	SPECULATIVE SCIENCES	ART	MORAL SCIENCE (Prudence)
instrumental parts of knowledge		WHOLE LOGIC (Logica or dialectica docens) includes: Logic *simpliciter*, which includes: *Categories*, *De Interp.*, *Prior An.*, *Posterior An.* Moral Logic, which includes: *Rhetoric* and *Poetics*	

(Concerning this point Buridan notes that it is easier to have an imperfect grasp of the other sciences than of metaphysics, but it is easier to possess metaphysical truth perfectly than to possess another science perfectly. The latter depends upon the former.[47]) We have seen how metaphysics establishes the principles of the other sciences.

The knowledge which has just been described is surely the most desirable for its own sake. Metaphysics, then, is wisdom.

Among the other principal sciences, physics holds first place. The physicist considers more causes than the mathematician. Mathematics deals with formal causes only, but the physicist's consideration embraces all four causes.[48] The science of the soul is the noblest physical science, since it studies the creature which is the noblest, after the separated substances.[49] Buridan's remarks about moral science show that his ranking of the sciences is not established on the simple level of whole sciences. Moral science, both in its speculative principles and in the habit of prudent action which it generates, ranks higher than the sciences of animals, plants and minerals, and higher than arithmetic and geometry.[50]

Sciences and arts may differ in nobility, but all are good and honorable, according to Buridan.[51] This includes the forbidden arts, which are forbidden not because they are evil but because men make bad use of them. If the laws prohibit certain books, because they are misused or because they contain errors, not because of true science contained in them.[52] In the <u>Politics</u> Buridan explains the contents of the magical arts. The reputed effects of magic are (1) the production of new things, (2) the conversion or mutation of the natures of things, (3) divination of the future, (4) revelation of hidden things.[53] Buridan is skeptical about the first two, although he thinks that devils can produce the illusion of creation or of mutation of creatures. He does think that divination and the revelation of hidden things are possible, when natural causes are involved, but not with certainty. The astrologer, for example, can predict a rainy season from the aspects of the stars. The art of the astrologer and of the other diviners is good, and can be practiced honorably, but only if the practitioner does not claim more for his art than it deserves.

If all the sciences, from the lowest to the highest, are good, the science which reflects on the nature and the order of the sciences must be preeminently good. The science of the sciences deserves to be called Wisdom because it judges and orders, but is judged and ordered by none (Aristotle, Metaphysics, I, 2). A primary duty of the teacher is to produce order in the minds of his students. This Buridan attempted to do in his many discussions of the division of knowledge.

The wise man builds on the past. We have seen that Buridan based his classification upon the doctrines of his ancient and medieval predecessors. Aristotle was his mentor, but he learned from others as well. All the finer subdivisions of the universal sciences came to Buridan having passed through many hands.

The wise man builds on the past but is not slavishly bound by it. Buridan tried to improve the doctrine he received. His contribution to the division of moral science is particularly worthy of note. To characterize rhetoric and poetics as moral logic is so obviously apt, one wonders why no one had thought of it before. His discussion of the relations among the parts of moral science, and between moral science and prudence, is enlightening. More generally, Buridan's extensive use of subalternation (carefully distinguished from the relation of part to whole) is a real development of the classificatory tradition.

Buridan's greatest contribution to the classification of the sciences does not lie in the details of his arbor scientiarum, however interesting they may be. His most significant achievement was his explanation and justification of the Aristotelian classification. We find in Buridan's writings an account of the unity and diversity of the sciences which is radically different from the explanations of the thirteenth century Aristotelians. As a nominalist and a terminist logician, Buridan was forced to invent a new explanation for the traditional division of knowledge.

Taking their starting point from Aristotle, the realist classifiers of the thirteenth century supposed that every science is a unified whole having a distinctive nature. The science itself was said to be an intellectual habit, that is, a disposition or "virtue" which makes its possessor knowledgeable about a subject. The subject, which was identified with the "formal object" of the habit, gave the science its unity and its specific character. The logical doctrine of terminism casts doubt upon this explanation, but nominalism renders it impossible.

Terminism, the logical method of analysis by the reduction of propositions to terms, leads naturally if not inevitably to the notion that the object of scientific knowledge is a mental proposition. Having accepted this hypothesis, the terminist will distinguish "partial sciences," or propositions, from the whole, or generic, science. The latter he will see as a collection of propositions, each one grasped by a distinct mental habit. If the science consists in many habits, it is impossible to point to the habit itself as the source of the science's unity.

Terminism, in the hands of a realist, does not preclude the organic unity of a whole science. Duns Scotus was able to locate the unity of a science in a primary subject which was at once an essence common to many individuals and a universal term. The primary subject, which served as the logical and grammatical subject of the axioms of the science, in some manner contained all the other subject terms belonging to the science. Scotus presumed that the primary essence likewise contained all the other natures considered in the science. For Scotus, the primary subject was the "glue" holding the science together.

Nominalism, the doctrine that individuals alone are real, and that universal concepts do not answer to common natures or formal reasons (_rationes_), obviously is incompatible with the Scotist explanation of the unity of science. Lacking a metaphysical glue, some at least of the fourteenth century nominalists rejected the notion that a generic science is a unified whole. William of Ockham presented the definitive nominalist critique of the Scotist hypothesis and concluded that a generic science is nothing but an aggregation of partial sciences having no real unity and no distinct boundaries.

Jean Buridan, though a nominalist, was not content to accept the result of the Ockhamist critique. His solution to the nominalists' difficulty was the result of a clever application of terminist logical and semantical principles. According to Buridan, each science has as its primary and unifying subject a unique term, which he characterized as "the most general term not exceeding the bounds of the science." The subject term of every proposition belonging to the science is either the same as or in some way related to the primary subject. Buridan explained the possible relations of the subordinate subjects to the primary subject, showing how each of the former depends upon the latter.

Examining the ten categories of Aristotelian logic, Buridan argued for the Philosopher's doctrine that the speculative sciences are three: metaphysics, mathematics and physics. Explaining that the three primary subjects, being, quantum (magnitude), and mobile, embrace all possible names, Buridan concluded that no other general science of a speculative character is possible. Finally, Buridan assigned all absolute terms (those which name real beings) to metaphysics, thereby establishing the superiority of this science in the hierarchy of the sciences.

The study of metaphysics was the goal and pinnacle of Buridan's beloved Faculty of Arts. Although his Faculty stood lowest in the University's hierarchy, Buridan refused to regard it as second to any. The arts comprised both the lowest and the highest of studies, but the theology of Sacred Scripture alone ranked higher than metaphysics. By no means rejecting the Faith, Buridan granted to metaphysics an absolute sovereignty over all philosophical studies, whether of the human or of the divine.

[1] QP, I, 2, 3rB.

[2] Lacking in Buridan's treatment, and in the later scholastic discussions generally, are questions of incidental or historical interest. Buridan and the others no doubt took as well known many topics of the traditional introductiones ad artes. For more information on these handbooks, the reader should consult R. W. Hunt, "The Introductions to the 'Artes' in the Twelfth Century," in Studia Mediaevalia in honorem admodum Reverendi Patris Raymundi Josephi Martin (Brussels, 1948), pp. 85-112.

[3] Edmond Faral, in "Jean Buridan, maître ès arts de l'Université de la Paris," Hist. litt. Fran., XXXVIII (1949), pp. 494-495, describes the chronology of Buridan's works, as far as it may be determined. He remarks, "Les ecrits de Buridan, a l'exception de deux opuscules, ne se laissent pas dater avec precision; et il est presque aussi impossible d'en determiner l'ordre de sucession."

[4] Nicomachean Ethics, VI, 3, 1139b24-27.

[5] QM, I, 2, 4rA: "Notandum est quod aliquando scientia etiam demonstrativa capitur large pro omni habitu demonstrativo, et sic scientia non distinguitur contra sapientiam, contra artem, contra prudentiam; immo tam sapientia quam ars vel prudentia est dicto modo scientia. Alio modo capitur scientia proprissime sive strictissime, et tunc in sexto ethicorum distinguitur contra sapientiam, artem et prudentiam. Ars enim et prudentia sunt habitus practici, sapientia vero et scientia sunt habitus speculativi. Sed differunt quia sapientia est considerativa causarum primarum et primorum principiorum; scientia vero versatur circa causas inferiores et posteriores, sicut habet videri in sexto physicorum."

[6] Following the earlier scholastic tradition, Buridan calls these notions the intelligible species of things. Cf. QDA, III, 1, 22r-v.

[7] On prudence and art, see QNE, VI, 7.

[8] QNE, VI, 4, 120rA; QM, I, 1, 3vB; QNE, VI, 3.

[9] Buridan considers these opinions and gives his own view in QNE, VI, 17, 131r-v; see also QNE, VI, 4, 120v-121r.

[10] QNE, VI, 17, 131rB; VI, 4, 120rA-B.

[11] This matter is treated in QNE, VI, 7, "Utrum actio et factio contra invicem distinguantur?"

[12] I have not been able to discover which authors Buridan had in mind. Generally, the fine arts were not clearly distinguished from the mechanical and liberal arts by the medieval classifiers. The scholastics seem to have had little interest in them.

13 Posterior Analytics, I, 13.

14 Subaltern sciences are two sciences related by subalternation. The science giving principles is called "subalternating," the other, "subalternated."

15 Cf. QP, I, 3, 4rB.

16 QM, VI, 3, 34vB: "Dicitur quod hoc non obstante (that number or quantity is the subject of mathematics) quod idem sub nomine contracti vel concreti sit subiectum in scientia subalternata cuius abstractum potest esse subiectum in subalternanti." The names mentioned here are mental terms, or concepts. A contracted or concreted name is one restricted by the addition of a qualifier. The "abstractum" is the name without the qualifier.

17 QP, I, 4, 4rB: "Sicut metaphysica propter communitatem suae considerationis subalternat sibi quodammodo omnes alias scientias sic etiam quodammodo scientia naturalis subalternat sibi moralem prudentiam et alias artes, quia subiectum physice predicatur de subiectis illarum, tamen propter diversum modum considerandi de eis prudentia et artes exeunt a scientia naturali."

18 See pp. 280-282.

19 See the quotation in note 15. The relation of the practical sciences to physics is also seen in Buridan's explanation of the way the generic sciences divide the terms in the ten categories. See above, pp. 251-52.

20 Buridan holds that moral science is a part of prudence, to be exact. QNE, VI, 17, 131vA: "Videtur mihi quod habitus acquisitus ex doctrina librorum legum decretorum et universaliter librorum moralium pertinet ad prudentiam. Ita quod prudentia si sit perfecta continet in se habitum illum vel consimilem tanquam partem." He admits that the books of moral science contain principles held by a speculative habit, and even speculative conclusions, provided they are proved through practical middles. The character of the middle terms, as we have seen, determines the character of the science.

21 QP, II, 6, 34vA.

22 Buridan argues that in a science, the principles rather than the conclusions have the nature of ends. Agreeing with St. Thomas that sciences should be named for their ends, he calls the intermediate sciences primarily mathematical. He refers us vaguely to another part of the book for justification of his position. To follow through this argument would be difficult and would take us too far afield. The key to his position lies, I think, in the next question, in which Buridan lays out his understanding of final causality.

[23] QP, 34vA: "communiter et simpliciter loquendo conceduntur esse de numero scientiarum mathematicalium, non de numero scientiarum naturalium."

[24] QM, VI, 2, 33vB.

[25] QM, IV, 3, 14vA: "Ad aliam potest dici quod geometria et arithmetica possunt dici una scientia secundum aggregationem quia aliquomodo geometria habet connexionem cum arithmetica et supponit arithmeticam, unde figuras denominat a numeris, et isto modo qui esset perfectus arithmeticus sine geometria, ipse non diceretur perfectus mathematicus, quia non haberet illam mathematicam universaliter integratam. Et tamen non obstante ego dico quod etiam arithmetica per se sine geometria potest dici una scientia unitate aggregationis et ordinis, et geometria esset alia scientia, quantum in talibus aggregationibus continget accipere maximum congregationem, et alias minores qui sunt partes illius maxime congregationis."

[26] QM, IV, 2, 14rB: "Sed postea etiam oportet dicere quod aliquando etiam hoc nomen geometria significat unum totum integrale scilicet integratum ex omnibus habitibus particularibus conclusionem partialium demonstratarum in libris geometriae." To possess geometry perfectly, we must possess this <u>totum integrale</u>.

[27] See the quotation in note 25.

[28] QM, IV, 3, 14rB: Sic igitur possum concludere quod hoc nomen metaphysica prout est unum totum universale est unum genus continens tot species sub se quot deberent esse scientiae partiales." A <u>totum universale</u> is a logical universal, a one said of many.

[29] QM, IV, 5, 16rB: "Ad eandem scientiam pertinet determinare de toto universali et de suis partibus subiectivis, sicut apparet quod geometria considerans magnitudinem considerat lineam, superficiam et corpus et considerat tam lineam rectam quam curvam, et sic physica considerans de ente mobili in communi considerat etiam in speciali animalia et plantas et celum et terram, igitur similiter metaphysica considerans ens in communi et substantiam et quantitatem et ad aliquid debet etiam considerare in speciali et plantas et quidditates istorum." A subjective part is a species.

[30] QDA, I, 1, 1rB: "Ad aliam dicendum est quod non oportet quamlibet partem alicuius scientie totalis accipere pro subiecto proprie partem subiectivum subiecti proprii illius scientie totalis; immo aliqua pars scientie naturalis considerabit de aliqua parte integrali entis mobilis, et alia pars considerabit de passionis entis mobilis ut de motu vel de tempore, et ideo non sequitur si hec scientia esse pars totalis scientie naturalis quod eius subiectum proprium ponatur directe tamquam pars subiectiva subiecto proprio scientie naturalis totalis, sed sufficit quod sit pars integralis."

[31] QM, IV, 5, 16rB: "Ad aliam dicendum est quod alie scientie non sunt partes ipsius metaphysice quia quamvis considerant de

partibus subiectivis subiecti entis, hoc tamen non est secundum illas rationes secundum quas partinet ad metaphysicam."

[32] QM, IV, 3, 14rA: "Tamen metaphysica non erit considerans entia secundum illam rationem tantum, immo etiam secundum rationes speciales. Considerat enim accidentia distincte a substantiis et substantias sensibilis distincte a separatis." See also IV, 5, 16rB.

[33] The primary source for this scheme, in which Buridan numbers the parts as shown, is the prologue to his Questions on the De Generatione et Corruptione (see Appendix 2). Other sources for this division are QP, I, 3, 4vA; QDC, I, 1; Moody, pp. 4-5.

[34] Partial sciences of imperfect mixtures, such as vapors, are contained in the Meteorology.

[35] This is my inference. Buridan does not say it.

[36] This schema comes from QNE, Prologue.

[37] QNE, Prologue.

[38] QM, I, 2, 4rB.

[39] Buridan, unlike several of his contemporaries, does not divide sciences into scientiae reales (having as their objects "first intentions") and scientiae rationales (having "second intentions" as objects). First intentions are concepts signifying things, and second intentions are concepts signifying other concepts. Nevertheless, he does consider the objects of logic to be arguments and their components, which are second intentions. See the text quoted in note 43. In QM, IV, 4, 15vA, Buridan gives "dialectical argument" as the subject of dialectics.

[40] QM, VI, 2, 33vB: "Notandum quod artes quedam sunt mechanice vel manufactive et de ille est scientia practica, et illas faciunt laici, quemadmodum sunt artes sutorie et cuprie. Alie sunt artes liberales, que vocantur liberales ex eo impedite quod liberant intellectus introductos a curis secularibus et mundalibus. Et tales sunt septem, scilicet grammatica, logica, rhetorica, musica, astrologiam, geometria et arithmetica, et illarum prime tres sunt practice scientie. Vocantur autem practice pro tanto quod sic instituunt hominem ad sermocinandum et orationem congruam proferendos et ad materiam inveniendam; docent enim unde possunt (sic?) sermo latinatus inveniri et significata vocabulorum dictionum et orationum et propositionum. Alie autem quattuor sunt speculative artes vel de illis traditur scientia speculativa pro tanto, quia speculantur causas altissimas rerum ordines, essentias rerum vel quasi omnia."

[41] QNE, Prologue.

[42] QM, I, 1, 3rA.

43 Loc. cit.

44 QM, I, 1, 3vB. Actually, Buridan is cautious here, reporting this opinion as Aristotle's; I think he shared it. "Et quando tu dicis possibile est metaphysicum esse malum, Aristotelis ut credo id negasset. Unde licet aliquis sciat multas conclusiones metaphysicales, tamen si esset iniustus aut malus hoc esset propter ignorantiam principalium conclusionum, immo propter errores contra illas conclusiones."

45 The claim that is is most difficult to us and easiest in itself is based upon Aristotle's famous distinction between what is better known to us (sensible singulars) and what is clearer and better known in itself (the universal).

46 See QM, I, 2, "Utrum metaphysica sit sapientia?"

47 QM, I, 4, 5rB.

48 QM, I, 2, 4rA. Buridan does not rank physics and mathematics explicitly, but he clearly thinks that physics approaches nearer to wisdom, because it considers all four causes. Mathematics considers only one, the formal. In the reply, we learn that metaphysics also considers all four causes.

49 QDA, I, 4, 2vA.

50 Remarking first that it is nobler to act virtuously than merely to speculate about the virtues, he says in the Prologue to the QNE: "Etsi ab operibus speculationes de ipsis virtutibus animae, et earum operationibus praescinderemus, adhuc esset speculatio talis multo nobilior, et magis intellectum perficiens interius, quam speculatio de mineralibus, vel de plantis aut animalibus, aut quam speculatio Geometriae vel Arithmeticae."

Does this not contradict the claim that moral science pertains to prudence, which is practical? I think not, because as Buridan explains in VI, 17 of the QNE, moral science uses as principles speculative conclusions. The science of the soul and its virtues (a part of the whole of physics) gives these principles to moral science. Buridan is saying that not only moral science in action (prudence) but also the speculative matter contained in the books of moral science are superior to the physical sciences dealing with creatures inferior to man.

51 This is the burden of QDA I, 2 and 3.

52 QDA, I, 2, 1vB: "Ad alia potest dici quod forte leges non prohibent scientes veras, sed prohibent libros in quibus falsi errores continentur, et si leges prohibeant addiscere aliquas veras scientias, hoc non est propter maliciam scientiarum sed propter maliciam volentium mali uti illis."

53 Quaestiones super octo Libros Politicorum Aristotelis, V, 13 (Paris 1513; repr. Frankfurt, 1969).

APPENDIX I: Signification, Supposition, Connotation and Appellation

1. Signification

a. First, the notion of signification, as Buridan understood it, must be explained. Signification is a property or function of terms, more exactly, of categorematic terms such as "horse," "green" and "similar." The so-called syncategorematic terms (those not falling within the ten categories) do not signify in the strict sense of the word. Examples of syncategorematic terms are "if," "some," "not."

b. To signify, then, is to "establish an intellectual notion (<u>constituere intellectum</u>) of something." A term signifies what it brings to mind when heard or read, not by association but as its own proper notion (<u>Sophisms</u>, trans. Scott, p. 67).

c. Terms exist on three levels, according to Buridan and the terminist logicians generally: written, spoken and mental. Signification must be considered on each level.

The written word, Buridan says, <u>immediately signifies</u> a spoken word. The spoken word, in turn, immediately signifies a mental word, that is, a concept (<u>Sophisms</u>, pp. 70-71). The written word signifies the concept remotely. But what does a concept signify? It must signify what it conceives, which Buridan understands to be individual existing things. (Among these things are individual terms and concepts; thus my concept of species conceives certain universal concepts.) The significata of concepts are <u>ultimately signified</u> by the spoken and written words.

d. That the relation of concept to thing conceived is a relation of signification is an interesting idea, but one foreign to most modern philosophers. Yet it has an old and honorable pedigree, going back at least to St. Augustine, who characterized the concept as the inner word (*De Trinitate*, XV, 2). Unlike the words of human languages, these, being natural rather than conventional, are common to all men. Produce the same interior word in the mind of a Frenchman and an Indian and they will contemplate the same reality. This word brings into the mind, in some fashion, the things which it naturally signifies.

e. Just as vocal expressions can be simple or complex, so too may concepts. A simple concept conceives a simple object (*Quest. in Meta.*, VI, 5). Substances and separable accidents may be conceived by simple concepts. All fictions, and all complex constructions existing only through their simple parts (for example, "white man" and "snubness,") cannot be conceived by simple concepts (*Sophisms*, p. 76). It is important to note that the vocal name might be simple and the mental name complex, or vice versa. Buridan gives as an example of the former the name "Iliad" (*Sophisms*, p. 76). On the other hand, the concept of man is simple, but the name "highest of the animals" is complex.

f. One might expect that Buridan, because of his nominalist doctrines, would hold that all universals are complex concepts, but this is not the case. He did admit concepts which are simple and yet universal, conceiving many things. (He gives "whiteness" as an example, Sophisms, p. 73.) Unlike the realists, he did not think that it conceives a simple universal or common nature really shared by many individuals (Quest. De An., I, 5). Rather, the universal concept conceives the individuals falling under it, though in a vague way. The universal has to be similiar to all its individuals (leaving out all merely individual features) and has to be dissimiliar to all individuals different in kind. But not every concept conceiving many individuals is a simple universal. Only if the concept cannot be broken down into simpler components does it qualify as simple. Unfortuntely, Buridan did not teach us how to discriminate simple from complex concepts. It seems clear that he believed our store of simple concepts was scanty (Quest. Phys., I, 5). It is only the wise man, the metaphysician, who knows quiddities (another name for these simple notions), and his knowledge falls far short of God's.

g. Names signifying the two kinds of concepts have different kinds of definitions. Names signifying complex concepts have nominal definitions, that is, descriptions which are synonymous with them and which explain the meaning of the word imposed to signify the concept (Quest. Meta., VII, 5). Even non-existent things have nominal definitions. "Vacuum," a fictitious complex concept, has as its nominal definition "place not filled with body" (*Sophisms*, 68-70; 80-81). "Vacuum," Buridan says, signifies everything signified by "place not filled with body," that is, it signifies everything signified by the categorematic terms place, filled and body. Buridan emphatically rejected the view that a proposition has some signification of its own distinct from the significations of its parts.

A word signifying a simple concept has a simply quidditative definition or a causal definition (*Sophisms*, p. 78; *Quest. Meta.*, VII, 5). A simply quidditative definition expresses the essential nature of a thing, and nothing else. The definition is not synomymous with the definitum, however. For example, the definition "rational animal" signifies all rational beings and all animals; but "man" signifies men only. The definition makes a claim about the relation of men to mortals, rationals and animals, and this claim may be true or false. Simply quidditative definitions, unlike nominal definitions, convey knowledge of created beings.

Causal definitions, which are "much more perfect and noble and more powerful for demonstrating" than simply quidditative definitions, not only express the quiddity (*quid est*) but also the *ex quo* or *a quo*, the causes of the inherence of an attribute in its subject. (*Cf. Posterior Analytics*, II, 8.) Attributes, whether conceived by simple or by complex concepts, may have causal definitions. Buridan thinks that connotative concepts may have quidditative definitions (expressions stating the genus and some determining characteristic), but not *simple* quidditative definitions).

2. Supposition

a. If sentences had to be explained purely on the basis of the signification of their terms, we would be unable to interpret the statement, "Animal has three syllables." This sentence is not only meaningful but true. Its subject cannot be understood as standing for the thing or thing it signifies; clearly, animal stands for itself, that is, for the spoken or written name, "animal."

Sentences of this sort cause logicians to distinguish various suppositions of terms. "Suppositio" is from "sub-ponere," to put below; the fundamental notion seems to be that different things can be put under the same word. We shall see presently what kinds of things these are, according to Buridan. I refrain from defining supposition formally, as that would be a difficult task, and unnecessary for our purposes. It suffices to describe the kinds of supposition admitted by the scholastics.

b. The first point to be noted is that terms have supposition only in sentences (Sophisms, p. 100). "Animal" taken alone signifies but it does not supposit. Secondly, both subject and predicate supposit, understanding subject and predicate logically rather than grammatically. The copula does not supposit.

c. The difference between the use of animal in "animal has three syllables" and "animal is sentient" is a difference of supposition.

The terminist logicians usually called the first material and the second personal supposition (Sophisms, p. 100). Personal supposition is the taking of a term for the singulars it directly signifies. (I add the qualification directly, since it is possible to signify obliquely something which the term cannot stand for. This will be explained in the next section.) Thus animal stands for either animal nature (according to the realists) or for individual animals (according to the nominalists) in the second sentence. The first sentence illustrates material supposition, the taking of the term for itself.

Most of the terminist logicians (perhaps all of them except Buridan; see Scott, Sophisms, p. 31, n. 57) admitted a third kind of supposition, which they called simple. This supposition is the taking of a spoken or written term to stand for a nature or real universal (according to the realists) or for universal concepts (according to the nominalists). Buridan treats this as simply another case of material supposition, presumably because the concept is simply another kind of word. Most probably he regarded simple supposition as misleading and unnecessary as well, since it so easily suggests the realistic interpretation. He thus defines material supposition as the taking of a term "not for its ultimate significate or significates but for itself or something like itself" (Sophisms, p. 101). The ultimate significates are the individuals called to mind by a term.

d. Buridan makes a second general distinction among suppositions, calling some accidental and others natural (Summula de Dialectica, Tract. de Suppositionibus, ed. Reina). In natural supposition, which may occur only in sentences of the present tense, the tense of the copula is ignored. Thus in "man is an animal," man, suppositing naturally, stands for all past, present and future men. This is the supposition used in scientific statements. In acccidental supposition, which has to do with what is contingent and particular, the tense of the copula must be taken into account in determining supposition. In a sentence of the present tense, the terms stand for present singulars only. The occurrence of a past or future tense verb is said to ampliate (i.e. increase) the supposition of the terms. The position of the term in question is crucial, however. If placed before the verb, its supposition embraces singulars existing during the time of the verb as well as for present singulars. Terms occurring after the verb are not ampliated. In "A Greek was a philosopher," Greek stands for past and present Greeks, but philosopher stands only for past philosophers. The sentence can therefore be expounded as "someone who is or was a Greek was a philosopher."

Other rules for the ampliation or restriction of supposition exist, but we need not take them up here. Nor shall we consider how quantifiers and negations affect supposition, since that is a complex matter beyond the scope of this simple introduction. The interested reader may consult Scott's introduction to his translation of the Sophismata, or better yet, Buridan and the other terminist logicians. We now turn to connotation and appellation, notions which are crucial to our understanding of Buridan's doctrine of classification.

3. Connotation and Appellation

a. Buridan frequently says of a term that it appellates or connotes something or the other. Connotation is a name familiar to modern logicians; appellation is not. The two are closely allied in Buridan's logical theory, but they are not identical. Each is a kind of signification, but they differ in at least two respects. Terms may appellate only within propositions, while a connotative term always connotes. We learn from Buridan's disciple, Marsilius of Inghen (_Treatise on the Properties of Terms_, ed. E. Bos (Dordrecht, 1983), p. 137), that terms appellate only in propositions, and Buridan's usage is consistent with the claim. He writes in the _Summula de Dialectica_ (_Tract. de Appellationibus_; ed. by De Rijk, "Buridan's Theory of Connotation," p. 92, my translation): "every term connoting something other than that for which it supposits is called appellative and it appellates that which it connotes as something accidental to that for which it supposits (per modum adiacentis ei pro quo supponit)." Clearly, connotation is prior to appellation. Secondly, appellation is a broader notion than connotation, as I shall show presently.

Buridan does not have much to say about connotation, no doubt because he regards it as well understood. According to common usage, the connotation of a term is that part of its signification which brings to mind things which the term _cannot_ supposit for. "Caucasian," for example, signifies a man belonging to the white race. If put into a sentence it will supposit for a man or men. It cannot supposit for whiteness or the other formal characteristics of white men. These "formal significates" are the connotations of the term.

b. Some terms are connotative and some are absolute. Names of substances are absolute (Quest. Meta., VI, 2). Abstract names in the categories which do not name quiddities are always connotative, as are all concrete names. Buridan uses the familiar Aristotelian example of the snub nose to illustrate this point. "Snub" stands for snub noses and it signifies both the noses and their curvature. "Snubness," on the other hand, signifies both but stands for their curvature. Thus "snub" connotes curvatures and "snubness" connotes noses. In general, the concrete name stands for the subject of the quality and connotes the quality, while the abstract name stands for the quality and connotes its subject (Quest. Meta., VII, 5).

Not every absolute term is in the category of substance; Buridan admitted the existence of real, separable accidents. His most common example is whiteness. Buridan thought that "whiteness" both signifies and supposits for all individual instances of the color, when used in personal supposition. We read in Quest. Meta., IV, 6 that the concept from which the word "whiteness" is taken is simple, without any connotation, and in VII, 5 that "whiteness" and other names of real accidents are "simpliciter absolutum a connotatione."

c. Buridan often used the terms "connotation" and "appellation" in conjunction, as if they were synonyms; they are in fact different, and not only in their relation to sentences. Connotation is a fixed property of terms. Appellations, on the other hand, can be acquired.

The terms of a sentence may either appellate without suppositing, supposit without appellating, or both supposit and appellate. Empty terms are those which (though they appear absolute) have no personal supposition whatsoever (*Tract. de Appell.*; De Rijk, p. 96). In the sentence, "A chimera is watching me," "chimera" has no supposition because it does not stand for any existing thing. Empty terms do signify something, and this precisely is what they appellate. "Chimera" appellates my idea of a chimera.

An absolute noun may be made purely appellative by the addition of a "destructive" qualifier. Buridan's example (*Tract. de Appell.*; De Rijk, *loc. cit.*) is *homo hinnibilis*, neighing man. The supposition of the noun is destroyed by the addition of the incompatible modifier but the significates of the phrase remain as appellations.

An absolute term supposits without appellating when it is used in the nominative case in personal supposition without any modifier which tends to restrict or destroy its supposition. In "man is white," "man" has no appellation whatsoever.

It is possible, finally, for a connotative or an absolute term both to supposit and to appellate. Concrete terms normally supposit and appellate. Absolute terms whose supposition is restricted also appellate. Buridan says of such terms and phrases that they appellate everything they signify except those things for which they stand. Thus "white man" supposits for all white men but it appellates all other men, as well as all instances of whiteness (Tract. de Appell.; De Rijk, loc. cit.). These words of Buridan, together with the examples considered above, suggest that the supposition and the appellation of a term divide up between them the entire signification of the term.

d. What, then, are we to understand by appellation? This property of a term seems to be the bringing to mind of all the significates left out when the term is used in personal supposition as a subject or predicate. The idea seems to be that a term, when it is put into a proposition with other terms, naturally brings along with it all of its significates: the metaphor invoked is a "driving toward" the proposition of elements inextricably linked to the words but irrelevant to our understanding of the things the proposition is directly about.

e. Thus far we have considered only one kind of appellation, which Buridan calls appellatio formae. Despite the name, the objects of formal appellation are concrete things. (Remembering that we are considering sentences whose terms are in personal supposition, we must grant that all the significata of the terms are real individuals, and so too are the supposita and the appellata.) Another kind of appellation, which he calls "appellatio rationis," has a hidden but important role in his explanation of the Aristotelian division of the sciences. This mode of appellation is quite distinct from the others we have considered.

Buridan distinguishes appellatio formae and appellatio rationis in the following text from the Summula de Dialectica, Tract. 4 (De Rijk, p. 93): "There is a great difference, however, between verbs signifying cognitive acts of the soul (for example these verbs 'to recognize,' 'to understand,' 'to supposit,' 'to promise' and others of that sort), and other verbs (such as 'to cut,' 'to burn,' 'to move,' and so on). For terms taken with respect to verbs not signifying such acts of the soul do not appellate anything except the things (res) which they ultimately signify or connote, and they do not appellate the rationes which they signify. But a term taken with respect to verbs signifying acts of the soul, if it follows the verb and is to be construed as its direct object (tamquam terminata transitum eorum), appellates the rationes according to which it signifies what it signifies. If the term precedes such a verb, then it does not appellate these rationes."

We may clarify the appellatio rationis by using one of Buridan's examples, "cognoscis venientem," "you recognize the one approaching." Let us suppose that the one approaching is your father, but he is sufficiently distant to be unrecognizable. The sentence is then false, because "venientem" follows a cognitive verb and must be understood as the terminus of the act of recognition. According to the rule, "venientem" appellates its ratio, that is, the special notion which the term is imposed to signify. "Veniens" signifies a thing as the one approaching. To say "You recognize the one approaching" is to say "You recognize the one approaching qua the one approaching: you are able to discern his features, and you can tell who he is. But this is false, because it is supposed that you are too far away to be able to discern his features.

Nevertheless, it is true that you recognize your own father. Accordingly, "Venientem cognoscis" is true, according to the rule, for here "venientem" does not appellate the notion of the one approaching. "Venientem," in other words, is taken in this sentence to mean simply your father, who happens to be approaching. In English this second sentence might be rendered "The one approaching is someone whom I recognize."

Marsilius of Inghen remarks (_Treatises on the Properties of Terms_, p. 139) that appellation ought to be called "acceptance" of a term in a proposition, rather than signification. Of Buridan's example of _appellatio rationis_ he says, "although the term _venientem_ [in the sentence _venientem cognosco_] signifies the thing that comes according to the specific notion according to which it is said to be coming, nevertheless, it is accepted by the intellect without the particular notion."

This, it seems to me, is an enlightening interpretation of Buridan's view. A term need not be accepted as signifying everything it is of a nature to signify. Only if it is accepted in its complete signification will the term be said to appellate its ratio. This interpretation leaves open the possibility of a complex term appellating one or more parts of its complete _ratio_ while leaving out the rest. Moreover, if there corresponds to a name both a simple _ratio_ (answering to the real definition) and a complex _ratio_ (answering to a nominal or causal definition), the name might sometimes be accepted for the simple _ratio_ (appellating its quidditative ratio) and sometimes for all or part of its complex _ratio_. This possibility, suggested by the remarks of Buridan's disciple and not inconsistent with his own teachings, opens the way to a deeper understanding of Buridan's explanation of the unity and distinction of sciences.

Let us suppose that the _appellatio rationis_ does not require the explicit use of a verb denoting cognition or some other act of the soul. The mere fact that a proposition belongs to a given science causes its terms to be accepted in a definite way. In a mathematical proposition "ray" is taken to mean a line extending indefinitely in one direction; in optics it is taken to mean a line of sight.

We know from Buridan's discussion of the principles of the division of knowledge that both connotative and absolute terms are made to appellate reasons when they are used in scientific propositions. I do not say appellate _their_ reasons, for such is the case only in metaphysics, which considers things only according to simple quidditative concepts. Metaphysics studies man in so far as he has the definition of man, triangle as triangle, and so on. The other sciences consider things as they are grasped by "rationes magis constrictae," or more restricted concepts. These are connotative concepts, which conceive things not absolutely but only in a certain respect. It seems reasonable to say that the terms used in the special sciences appellate connotative _rationes_.

Appendix II: Questiones Buridani super De Generatione et Corruptione, Prologue; MS Erfurt Amplonius F357*

Notandum quod scientia huius libri est quedam pars scientie naturalis, ideo videndum est quem locum teneat inter partes principales scientie naturalis. Et ponatur questio prima de entibus naturalibus in communem quantum ad passiones communes et principia communia entium naturalium, et ipsa traditur in libro phisicorum. Alie partes tractant de entibus naturalibus sub rationibus magis contractis. Unde secunda pars tractat de entibus mobilibus ad ubi et tractat hoc in motu simplici, etiam iste datur in libro celi et mundi, ubi tractat de corporibus celestibus que moventu circulariter, de gravibus et levibus que moventur motu recto sursum et deorsum. Quia omnes partes principales mundi ordinantur secundum exigenciam motuum localium; simplicium ut quod mobilia motu deorsum situantur in medio mundi et supra illa situantur mobilia motu recto sursum, scilicet levia, et supra illa situantur corpora celestia que moventur circulariter, ideo in libro de celo et mundo determinatur de constitutione totius mundi.

Deinde alie partes scientie naturalis determinant de entibus mobilibus ad formam, ut expositores antiqui solent loqui. Sed occurit hic dubio, quia videtur quod ista non sit bona divisio, scilicet qua ens mobile dividitur in ens mobile ad ubi et in ens mobile ad formam, quia ens mobile ad ubi videtur etiam que formam secundum auctorem sex principiorum, et sic mobilia coincidunt.

* The Questiones Buridani super De Generatione comprise folios 96r-129v of MS Erfurt Amplonius F357. Anneliese Maier discusses this manuscript in An der Grenze von Scholastik und Naturwissenschaft (Edizioni di Storia e Letteratura, Rome, 1952), pp. 118-119.

Solutio quia in illa divisione accipitur forma pro forma substantiali. Illa enim dicuntur movere ad formam scilicet substantialem que sunt generabilia et corruptibilia, et potest dici quod generatio et corruptio sint motus ad formam substantialem intrinsice, alteratio autem de qua hic determinatur est motus ad formam substantialem non intrinsice secundum dispositionem, quia disponit ad eductionem et inductionem forme substantialis. Sed augmentationem et diminutionem concommitatur alteratio. Sed ubi vel motus localis non potest dici quod aut quomodo sit ad formam substantialem nec extrinsice nec intrinsice, quia aliqua sunt mobilia localia que nullo modo sunt generabilia et corruptibilia, sicud corpora celestia. Sic igitur aliqua sunt mobilia ad ubi et alia ad formam substantialem.

Alio modo respondetur quod sive ubi sit forma sive non, tamen non est forma inherens ipsi motori mobili ad ubi inexistens, sicut quia ubi non videtur differe a loco et locus non est intrinsicus sed extrinsicus locato. Ideo dicitur quod duplex est motus, unus ad formam sic intrinsice sive inherenter, alius est motus ad ubi per quem motum ad ubi nulla res acquiritur de novo que ante non esset. Sed per alios motus aliqua res acquiritur per motum, et ad ubi inter ille motus per quem nulla res acquiritur de novo sed per motum ad formam intelligitur ille motus per quem aliqua res acquiritur de novo.

Sed etiam tertia solutio esset bona si suppositum quod motus non esset res distincta a mobili et loco circumscripta verum.

Quarta pars scientie naturalis tractat de quibusdam passionibus consequencibus id est generabilia et corruptibilia secundum quod alterata sunt secundum primas qualitates scilicet secundum caliditatem et frigiditatem et humiditatem et sicciditatem et hoc traditur in librum metheorum, unde liber presens et ille differunt scilicet quod iste liber de generatione et corruptione tractat de generabilibus et corruptabilibus et de elementiis ut generabilia et corruptibilia augmentabilia et alterabilia adinvicem. Sed librum metheorum tractat ultra de quibusdam passionibus consequencibus elementa secundum quod iam alterata sunt secundum primas qualitates scilicet caliditatem, frigiditatem, humiditatem et sicciditatem sicud vero vaporis omnibus etiam exhalationibus et contrariis.

Tunc post illas quattuor partes restat determinare de entibus naturalibus in perpetuali. Sed corpora celestia nullas habent mutationes vel motus nisi motus locales simplices de quibus determinatur in libro celi et mundi et ideo ultra illud quod ibi determinatur de corporibus celestibus non restat alia determinatio in speciali. Verum est tamen quod preter proprietates que possunt concludi de corporibus celestibus per suos motus locales circulares circulares [sic; an illegible word follows] querunt eis proprietates et nature que possunt concludi per actiones eorum illa inferiora, sicud experimur quod aliqui planete sunt calidi, aliqui frigidi, aliqui sicci, aliqui humidi. De istis pertinet ad astronomiam consyderare.

Sic etiam quattuor elementa non habent motus vel mutationes nisi motus locales simplices de quibus determinatur in libro celi et mundi et illos motus de quibus determinatum est in libro de generatione et corruptione, scilicet generationes, augmentationes, diminutiones, alterationes et non de istis 4 elementis non restat specialiter determinare.

Sic etiam de numero mixtarum, quedam sunt mixta perfecta sicud lapides et ligna metalla et animata et cetera solida. Alia sunt mixta imperfecta sicud vapores, exhalationes et consimila, de quibus in primo 2^{o} et 3^{o} metheorum determinatur, ideo nulla restat consyderatio de illis. Ideo sequitur quod post illos quattuor libros non restat nisi determinari de mixtis perfectis in speciali.

Tunc illa pars scientie naturalis esset de mixtis inanimatis que vocantur mineralia ut lapides metalla et cetera de quibus in speciali [non] habemus ab Aristotele quia non fecit vel quia non est translatus. Sed Albertus de hoc fecit librum et Avicenna. Alie partes scientie naturalis sunt de animatis et est sexta pars de anima in communem et de primis partibus eius et de potentiis eius in generali que traditur in libro De anima.

Alia pars scientie naturalis determinat de operationibus et passionibus communibus corpori et anime sensitive et hoc in libro de sensu et sensato, de sompno et vigilia, de memoria et reminiscentia, et de passionibus communibus corpori et anime vegetitive vel intellective determinatur in libris de longitudine et brevitate vite, de juventute et senectute, de morte et vita. Sed idem operationibus communibus corpori et potentie secundum locum motive determinatur in libro de motu animalium et in libro de gressu animalium. Alii libri parvorum naturalium sunt de bene [?] esse ad completum predictorum librorum determinatorum.

Octava pars scientie naturalis tractat de animalibus in speciali descendendo ad quodlibet genus.*

Nona pars tractat de qualibet planta in speciali descendendo ad quamlibet speciem.*

Istis pertractatis nihil plus restat in scientia naturali. . .

* I do not know why Buridan says that the science of animals descends to the lowest genera, but that the science of plants descends to the lowest species. Did he think that the species of plants are knowable, but not the species of animals? I doubt it. Nothing remains beyond these sciences, he says; but God certainly possesses the science of all the lowest species. I do not think the difference in the descriptions of the last two sciences is significant.

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