Conceptualization and Organization of Knowledge in Farabi’s
Enumeration of the Sciences (Ihsa al-ulum): A Modern Interpretation.

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A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of
Philosophy in Library and Information Science

Dominican University

October 2012
ABSTRACT

The act of classification is fundamental to human experience and central to the acquisition of knowledge. Though written classifications are a mainstay of literate societies everywhere, they vary representationally according to custom and convention. This study invokes a theoretical framework of positivism, pragmatism, and literary warrant to illustrate points of convergence between the *Enumeration of the Sciences*, a seminal classification of Islamic origin by Abu Nasr al-Farabi (c. 872-951), and prototypal Western classifications, chiefly the Dewey Decimal Classification.

Results of this study indicate that the Farabi scheme, while written by a Muslim of international stature, is grounded in Western epistemology. This discovery may prove useful to scholars of Islamic Studies and Library and Information Science, who are engaged in the development of modern classifications that effectively represent Islam.
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CHAPTER ONE
INTRODUCTION

A recurring theme in Islamic scholarship has been the classification and description of the sciences (see Bakar, 1998; Idrees, 2009; Nasr, 2003 for further discussion). This “urge to classify” in Islam seems to be motivated by a concern to “[preserve] the hierarchy of the sciences [and to delineate] the scope and position of each science within the total scheme of knowledge” (Nasr, 2003, p. 59). My first encounter with Islamic classifications suggested to me the possibility of a philosophy or theory underlying each of them. Beyond this possibility, I was interested in discovering what principles of Islamic classification, if any, could intersect with modern, mainstream classifications of the West. My interest was born not just of idle curiosity for I had become aware, through a review of the literature, of a lingering dissatisfaction among Islamic scholars with mainstream classifications. This dissatisfaction stemmed from the perceived lack of coverage and description afforded to Islamic studies by these classifications. Presented with this problem of inadequate coverage, I determined to examine Islamic classifications in more depth so that I might discover points of convergence with modern schemes.

To set the process of discovery in motion, I decided to focus on a seminal work of Islamic classification; one that I believed resembled other Islamic schemes of knowledge and was representative of Islamic traditions generally. I chose the Enumeration of the Sciences, by Abu Nasr al-Farabi, a Muslim philosopher and polymath born in Turkestan (c. 872). My interest in the Enumeration was prompted, in part, by my awareness of Farabi’s influence on “both Christian and Islamic worlds” (Netton, 1992). It has been argued that Aquinas derived some of
his ideas from Farabi through the medium of Avicenna (Ibn Sina) (d. 1037) (Glick, Livesey, Wallis, p. 171). Farabi’s influence on Ibn Rushd and Maimonides is well documented (see Andalusi, 1991; Glick, Livesey, Wallis, 2005; Netton, 1992). Following Gundisalvo’s twelfth century translation of Farabi’s scheme into Latin (entitled *De Scientiis*), many “European universities began to require readings in the new sciences and the “new” Aristotle” (Glick, Livesey, Wallis, Livesey, Wallis, 2005, p. 171). I was curious to know if the *Enumeration*—once an authoritative classification of knowledge—could continue to find currency in the present age.

Farabi “was the first true founder of epistemology [in Islam] who relied on ‘universal reason’ and [logical] demonstration” (Nasr, 1964, p. 31). Unlike several other great Islamic philosophers, notably Avicenna, little is known with certainty of Farabi’s life. His biography is vestigial and much of what has been transmitted to us is shrouded in myth. It is said, for example, that he spoke seventy languages, that he could produce tears of sorrow or gales of laughter at will just by playing a musical instrument. He was said to lead an ascetic lifestyle, which has led many to assume that he was a Sufi mystic. Even the circumstances surrounding his death are unclear. According to some accounts, he died naturally in Damascus in December of 950, at the age of eighty. At least one account, however, holds that he was mugged and killed on the road from Damascus to Ascalon (Netton, 1992). What we do know is that he was born in Turkestan (c. 890) and that he studied Arabic in Baghdad. It has been claimed that most of his books were written there. Though he had a number of disciples, he did not undertake to dictate his life to any of them, nor did he write an autobiography (Bakar, 1998).
Three Theories that Frame my Investigation and Why I Chose Them

I chose to frame my investigation around three theories or doctrines, namely: positivism, pragmatism, and literary warrant. I believe that concepts of reality, whether embodied in texts and documents or not, are theory dependent. Since a central aim of this study, as per its title, is to contextualize the Enumeration in terms of modern classifications, I thought to choose for this purpose three dominant strains of modern classification theory. I wanted theories that were congenial to me and to the way that I read text. These theories reflect post Enlightenment understandings of the sciences and humanities. They are integral to whole fields of study, such as LIS. When I began this study, I did not know to what extent, if any, I would encounter them—as modes of thought—in Farabi’s work. Happily, I was able to discover their presence, manifestly, in the text of the Enumeration. I consider these theories to form a conceptual link between the Enumeration and modern classifications of knowledge. Since each theory differs substantially from the other, I was afforded several perspectives with which to develop my thesis.

Purpose of the Study

The purpose of this study is to show, through translation and analysis, that al-Farabi’s Enumeration of the Sciences is:

- a product of Western epistemology;
- an effective classification of knowledge which captures the spirit of Islamic scholarship in its traditional sense;
- an exemplary cultural document and legitimate model for the development of new Islamic classifications and modes of research;
• an antidote to prevailing dissatisfaction with contemporary coverage of Islamic subject matter.

• convergent with modern classifications; chiefly, the Dewey Decimal Classification (DDC) and the Library of Congress Classification (LCC), and;

• representative of a shared epistemological heritage with these schemes.

In order to examine the *Enumeration* in a modern context, I reference mainstream classifications; namely, the DDC, the most widely used classification system in the world (OCLC, 2004), the Library of Congress Classification (LCC), and Ranganathan’s Colon Classification (CC). All of these schemes have at one time or another shared the goal of classifying the entirety of the world’s knowledge. Farabi composed the *Enumeration* with the same object in mind. As he says in the introduction to the text: “Our goal in writing this book is to enumerate the known sciences and to make known all that which pertains to each…” (Farabi & Gonzalez, 1932, p. 3). Today, the *Enumeration* may be viewed as an artifact specific to medieval Islam and also as a scheme of knowledge that is abstract, generalizable, adaptive to new subject matter, and founded upon enduring principles of classification, largely of Western origin.

**Statement of Problem**

Among numerous Islamic scholars, there exists a belief that “Western classification schemes lack the adequate room for Eastern/Oriental fields of knowledge, languages, and literature” (Idrees & Mahmood, 2009, p. 1) The DDC, for example, provides only one notation out of one thousand for Islam, i.e., 297. This poses a problem of classification for libraries that have built extensive collections on Islam. Another flaw in the DDC with respect to Islamic
Studies concerns main class 400 (Language). Main class 400 provides eight to ten different notations, out of one hundred, for each of the major European languages, German, French, Italian, Spanish/Portuguese, and English. Not a single notation is designated for Arabic, the language of the Quran and, therefore, the authentic language of Islam. To locate information on Arabic, the language, one must go through notation 492 (Afro-Asiatic languages; Semitic languages). This amounts to a severe bias in the DDC against Islamic Studies. The bias is not easily corrected since there exist only 100 subdivisions (all currently occupied) in each main class of the DDC, as per the rules of the decimal system.

The cloisterization and outright omission of subjects from the DDC affect even the focal point of this study. To wit, there is no DDC notation currently assigned to Farabi’s *Ihṣa al-ulum* (Enumeration of the Sciences). Access and retrieval of this landmark book, therefore, are likely to be less than optimal in those DDC libraries wherein it is held. The Library of Congress does a marginally better job of cataloging the *Ihṣa*, assigning it to main class B753. However, the LCC provides only one subject heading for this work—Classification of Sciences. Improved access to the *Enumeration* will require more LC subject headings and, at the very least, a DDC call number.

In response to the shortcomings of standard schemes, some Muslim scholars have proposed expansions to the given notation for Islam, i.e., 297 (see e.g., Sardar, 1979; Mahmud, 1989; Kindilchie, 1974; 1982; Riazuddin, 2002). While many Islamic scholars favor devising a new and comprehensive classification scheme for Islam (Idrees & Mahmood, 2009), others doubt the ability of Muslim information professionals to accomplish this work successfully and
so prefer to lobby for “amendments and expansions in any of the standard classification systems” (p. 4).

To illustrate problems with Islamic classification in a modern context, I have focused primarily on the DDC, giving less attention to the LCC. Time and space do not permit a full examination of the LCC which, in any case, is unnecessary since many of the deficits vis-à-vis Islamic classification are shared by both systems. The LCC does provide a special subclass—KBP—for Islamic law (Sharia, *Fiqh*). This notation heightens access to information concerning the important subject of Sharia. However, Islam as a general subject is grouped with Baha’i Faith and Theosophy in LCC subclass BP. In contrast, Buddhism (BQ) and Christianity (BR), are assigned independent subclasses, separate and distinct from any other subject. This is perhaps a minor point but it does illustrate the diminished standing of Islam within the LCC, in comparison to other religions.

In sum, though the LCC provides more class divisions than the DDC, obscurity and ambiguous groupings remain a problem with this scheme, hindering its ability to effectively represent Islam. Many authors have criticized the coverage of Islam in major classifications, such as the DDC, LCC, and UDC (see Idrees & Mahmood, 2009, p. 5).

**Research Questions**

This study is guided by the following questions:

1. What is the intellectual foundation of the *Enumeration* and how does this foundation reflect positive and pragmatic theory and the concept of literary warrant?

2. How does the *Enumeration* compare with mainstream classifications of knowledge, especially the DDC and LCC?
3. How does an understanding of the *Enumeration* serve the task of developing classifications that effectively represent Islam?
CHAPTER TWO
LITERATURE REVIEW

Introduction

Though classifications of knowledge come in many varieties, a persistent goal of classifiers generally has been to devise schemes that suit the needs of everyone, everywhere (Miksa, 1998). Historically, most classifications have been structured 1) to find commonalities across different domains and 2) to establish general laws and principles that may apply to all classification systems (Svenonius, 2000). These objectives have proven elusive but they remain a mainstay of the field.

This is another way of saying that most classifications have been designed to be universal in scope. Farabi’s *Enumeration* is universal insofar as it was designed to cover the “known sciences” (Alfarabi & Gonzalez, 1932, p. 4). Other examples of universal classification include the DDC, the LCC, the Universal Decimal (UDC), Bliss’ Bibliographic (BC), and the Colon Classification (CC) (Taylor, Miller, Taylor, 2006). Subject or domain specific classifications have also been devised for specific subjects; they present a greater level of detail than is generally available in a universal classification. Examples of domain specific schemes include the National Library of Medicine (NLM) and the British Catalogue of Music Classification (Chan, 1980).

The *Enumeration* in Context

The *Enumeration* was widely influential in medieval Islam (Bakar, 1998) and “became the model for all later [Islamic] authors” (p. 3). Farabi’s mastery of the art of logic won praise
not only from Muslim scholars but also from the preeminent Jewish philosopher of the Middle Ages, Maimonides (d. 1204), who counseled:

Do not busy yourself with books on the art of logic except for what was composed by the wise man Abu Nasr Farabi. For in general, everything that he composed—and particularly his book on the Principles of Beings—is all finer than fine flour. His arguments enable one to understand and comprehend, for he was very great in wisdom (Maimonides, 1977).

Farabi was first among the people of Islam to define the boundaries and limits of each branch of knowledge and to formulate each science in a systematic fashion (Nasr, 1964). Aristotle, who did the same for the Greeks and for posterity, is known as “The First Teacher”. Farabi, whose Enumeration of the Sciences, is the first classification widely known to the Muslims, gained the title of “The Second Teacher” (p. 134).

Farabi was steeped in the Aristotelian logical tradition. He wrote commentaries on the entire Organon, namely the Categories, Hermeneutics, Prior Analytics, Posterior Analytics, Topics, Sophistics, Rhetoric, and Poetics (Bakar, 1998). He wrote treatises on all branches of the Pythagorean Trivium and Quadrivium, on Ptolemy’s Almagest, and on books I and V of Euclid’s Elements (Euclid, 1956). His work on music theory came to be regarded as the most influential of the middle ages, representing “a significant advance on the music theory of the Greeks” (Farmer, 1926, p. 123). Farabi’s vast learning is reflected in the Enumeration; he tends to include those subjects in the scheme with which he is personally well familiar.

The Enumeration reflects the worldview of one of Islam’s earliest philosopher scientists, arising during a time of intense activity in the study of the philosophical sciences, including mathematics and the natural sciences. It bears the influence of many Arabic translations of
important Greek scientific works, sponsored by the Abbasid court, under the caliphs Harun al-Rashid (786-809) and his son al-Mamun (813-33) (O’Leary, 1949).

Outside the Islamic world, Farabi’s classification was translated into Latin by two prolific twelfth century translators, Domingo Gundisalvo and Vincent of Beauvais (Glick, Livesey, Wallis, 2005). Subsequently, “Farabi’s conceptualization of the number and hierarchy of the sciences became widespread in the Latin West” (p. 171).

The Enumeration has been treated by several scholars (see Bakar, 1998; Domingo, 1954; Rabe, 1985; Nasr, 1964), though to a lesser degree than other works by the same author on the subjects of metaphysics, logic, political philosophy, and music. The Enumeration has been compared to classifications of other Muslim thinkers such as al-Kindi, al-Ghazali, Qutb al-Din, and Ibn Khaldun (Bakar, 1998). It has not been compared to the DDC, the LCC, or any other Western scheme, to the best of my knowledge. If the Enumeration is to hold value and currency beyond its status as historical document, it should be possible to examine it for possible affinities or, at the least, instructive contrasts, with modern classifications. Most current studies of the Enumeration deal “…only briefly with either historical aspects of the classification or with the problem of the relationships between certain sciences discussed by Farabi” (Mahdi, 1975, pp. 113-137). The fact that the Enumeration has not garnered more attention in LIS circles in the West may be owing to the absence of a complete translation of the work in English.

Though often viewed at odds with the West, (Idrees & Mahmood, 2009) classical Islamic philosophy shares many of the ideas that inform Western intellectual tradition. The Enumeration reflects some of those ideas, as expressed through its order, arrangement, and selection of subject matter.
Principles of Logic and Hierarchy in Classification

The study of logic is closely associated with knowledge classification. According to Sayers (1915), “classification is a department of logic, and every step in the construction of a classification scheme is referable to that science” (1915, p. 16). Aristotle was the first logician of the West to establish a formal set of principles and variables that could be used to demonstrate the underlying logical form of arguments (Zalta, 2004). Aristotle looked for “relations of dependence” between things (Aristotle, 1959). He validated these relations through the strength of his premises or the soundness of his argument. In his Categories, he attempted to classify all the possible things that a term can refer to. In so doing he established a classification scheme based on logic.

Farabi elevates the art of demonstration (which is at the heart of logic) in the concluding section on Logic in his Enumeration where he writes, “certain knowledge of the truth is not to be had except through demonstration” (Alfarabi & Gonzalez, p. 17). Demonstration, as we know from the Posterior Analytics, is “a deduction that produces knowledge” (Aristotle & Barnes, 1995, p. 48).

Logic and hierarchy are naturally intertwined. A genus is deduced to be subordinate to a species based on shared properties or attributes. Thus begins the development of a hierarchical tree. Western understanding of hierarchical classification is inherited from Aristotle (Ackrill, 1963), who posited that all nature comprised a unified whole. The whole may be divided into “natural” classes, which are in turn divided into subclasses, and so on. The process of division or enumeration continues until we have revealed, through exhaustive observation, all of the essential attributes of an entity or genus (Kwasnik, 1989).
Exhaustivity means that all the classes produced by a characteristic must be included; otherwise the scheme will be incomplete. This idea can be traced to Porphyry (c. 232 - c. 304), who explained Aristotle’s Categories and developed the principle in his “Tree” that “a given set of objects at the highest genus can be divided into mutually exclusive and collectively exhaustive subordinate genera” (Mai, 2004).

In determining which attributes qualify for membership in a given class, we are guided by philosophy. Only through the act of classification can we claim true knowledge of a phenomenon’s essential qualities (Mai, 2004, p. 1). Thus, dialectic is established between classification and knowledge. Classification is precedent to the attainment of knowledge.

Defining categories, however, is a difficult task. Logic is of little use. Logical division only states that “one characteristic of division should be applied at a time” (Buchanan, 1979, p. 53). It does not tell us what the category is. How we define a category is “related to the historical, social, and cultural context in which the classification system is created and used” (see e.g., Bowker & Star, 1999, p. 23). Ultimately, a classification “is intuited, not hacked out characteristic by characteristic” (Broadfield, 1946, p. 5).

The idea that a classification should reflect the true hierarchy of the sciences (as currently known) remains a central tenet of library science. As Richardson (1930) said, “the closer a classification can get to the true order of the sciences and the closer it can keep to it, the better the system will be and the longer it will last” (p. 33). This principle applies to the classification of items in a library as well. Said Sayers (1915), “It must be clearly borne in mind...that the classification of knowledge should be the basis of the classification of books; that the latter obeys in general the same laws, follows the same sequence” (p. 31).
Classifications are like theories and models in that they constitute “symbolic dimensions of experience as opposed to the apprehension of brute fact” (Kaplan, 1963, p. 294). Symbolically, classifications can be extended to cover new experiences. The more abstract a classification is, the more likely that it will be able to explain processes and behaviors in many contexts. In general, classification clusters experience in a meaningful way. It is useful “during the preliminary stages of inquiry as a heuristic tool in discovery, analysis, and theorizing” (Davies, 1989).

Hierarchical classifications are truly systematic; they encompass all facets of a given application or domain; they subordinate subject categories in a logical fashion; they are readily expandable—new categories can be introduced at any level without affecting other categories; existing categories can be subdivided as necessary (Saffady, 2004). In the context of a library, hierarchical schemes provide a place for every document—the more general the topic, the higher the rank; the more specific, the lower the rank. Hierarchies facilitate browsing of related documents which are physically grouped within categories; they permit retrieval of documents at varying levels of specificity.

The most philosophically interesting semantic relationships are those which are hierarchical (Svenonius, 2000). Hierarchies help to refine search vocabulary; they allow users to move concepts “up or down verbal abstraction ladders until the correct expression is found” (p. 162). There is some evidence that our brains are hardwired to perceive hierarchical relationships and that the only way to comprehend a knowledge domain, therefore, is through the structure that they provide (Simon, 1962). Whether or not this is so, hierarchies are powerful navigation
tools with unrivalled ability to “guide users on encyclopedic tours of knowledge domains” (Svenonius, p. 163).

Hierarchies offer a few challenges: they are time consuming and difficult to construct; they tend to require a comprehensive understanding of targeted knowledge domains and, in a library, they provide only one place where a document may be filed. If a topic deals with multiple subjects, it will be filed with the principle subject (Saffady, 2004). This limitation can be overcome by cross-referencing and annotations that refer to the complete record.

In the modern world, we may perceive more than one reality which would require more than one hierarchy. For example, dogs are mammals. Knowledge of this fact permits an understanding of dogs’ physiological make-up. However, dogs are also pets, which put them into the domain of social behavior and pet ownership. In order to truly know dogs in all their multi-faceted reality, we would need multiple hierarchies with connecting cross-links. This would quickly devolve into a tangled and confusing web; hence, impracticable. In sum, no one classification is able to capture all aspects of a particular domain (Kwasnik, 1989). Notwithstanding their imperfections, hierarchies remain the preferred structures for knowledge representation (p. 2).

**Farabi’s Hierarchical View**

The *Enumeration* is strictly hierarchical though flexible enough to admit new knowledge. As new sciences become known, they can be integrated into it. Subsequent philosophers, like Avicenna, Averroes (Ibn Rushd), and Maimonides, used the Farabi template for that purpose—to add new knowledge (Bakar, 1998). Farabi’s legacy has been overshadowed
by Avicenna, who, nonetheless, acknowledged Farabi as his master in all things Aristotelian (MacDonald, Alfarabi & Palencia, 1934).

Though Farabi was not a librarian, he fully subscribed to the hierarchical view of reality (see quote below). The idea of the hierarchy of the sciences is rooted in the nature of things. Together, the sciences constitute a unity (Bakar, 1998). This is perhaps more nearly the case in a society that is closely bound to revelation, as Farabi’s was. In such a society, the ideas of hierarchy and unity are accepted as axiomatic philosophical truths (Gibb, 1950).

In his *Treatise on the Excellence of the Sciences and the Arts*, Farabi outlines his hierarchical view. He writes:

The excellence of the sciences and the arts is only by virtue of one of three things: the nobility of the subject matter, the profundity of the proofs, or the immensity of the benefits in that science or art, whether these benefits are anticipated or are already present” (trans., Bakar, 1998, p.46).

**Classification in Everyday Life**

Kwasnik (1989) defines classification as “a descriptive and explanatory framework for ideas and a structure of the relationships among the ideas” (p. 63). As we classify information, we impose epistemic order upon factual chaos (Sardar, 1991). In a library, the classification scheme is the principle means by which we arrange materials on a shelf so as to facilitate retrieval. In general, the physical arrangement of items in a library is closely related to the intellectual principles used to organize the knowledge contained within those items (Mann, 2005). As such, classification systems have two important bibliographic functions: they help to
locate specific items on a shelf and they provide a means to place items that treat the same or related subjects in the same area (called collocation) (Rubin 2004).

Classifications constitute a material force in our lives (Bowker & Star, 1999). Their impact is inescapable, as Foucault (1971) reminds us. They guide our behavior in countless ways; by defying them, we risk inconvenience or worse. For example, if we ignore our gender and proceed to the nearest restroom we invite potential embarrassment. If we search for a book under the wrong Library of Congress catalog number or stand in the immigration line at a busy foreign airport with the wrong passport we will fail to reach our goals. Wherever we turn, the reality of categories intrudes (Bowker & Star, 1999).

Categories and classifications are often a source of contention. The U.S. Census asks Americans to indicate their racial category. Many Americans oppose this practice while others find it unobjectionable (Bowker & Star, 1999). All classifications are representative of a society’s moral and ethical agenda and each standard and category will valorize some point of view and silence another. This is not inherently a bad thing as choices have always to be made, for better or worse.

Classifications have deep historical roots and one culture’s idealization of truth and order may resemble another even across many generations. It is also true that classifications may differ dramatically according to particular cultural norms. This fact caught the attention of Michel Foucault (1971) in startling fashion when he encountered a Chinese classification (probably fictitious) of animals in an encyclopedia. The Chinese scheme divides animals into the following categories (p. 71):
The foregoing would appear to violate all rational principles of taxonomy known to the Western tradition. Whether this classification is authentic or not, it is striking in its originality. As Foucault (1971) says, “In the wonderment of this taxonomy, the thing we apprehend in one great leap, the thing that, by means of the fable, is demonstrated as the exotic charm of another system of thought is the limitation of our own, the stark impossibility of thinking that” (p. 71). Classifications are a reflection of a society’s ideology. Like controlled vocabularies, they will
change with cultural viewpoints and the creation of new knowledge (Taylor, Miller, Taylor 2006).

Modern Schemes

In constructing the DDC, Dewey (d. 1931) divided the entire universe of knowledge into ten main classes; Farabi, working almost a millennium before, into seven. Several classes, such as Language, Natural Science (called Physics by Farabi), Social Science (called Political Science by Farabi), and Philosophy (called Logic and Metaphysics by Farabi) are shared by both classifiers. Both Dewey and Farabi bore the influence of earlier philosophical movements—in Farabi’s case, the peripatetic school of Aristotle loomed large;

Though consensus as to the epistemological origins of the DDC remains elusive, a persuasive theory, advanced by Wiegand (1998), shows a compelling link between Dewey’s scheme and that of William T. Harris (as crafted for the St. Louis Public School Library c. 1860). Harris had built his scheme on two sources:

(1) the ideas of Sir Francis Bacon, who had argued that the three faculties of the human mind—memory, imagination, and reason—produced three categories of learning—history, poetry, and philosophy—each of which could be further subdivided; and (2) the ideas of G. F. W. Hegel, who inverted Bacon’s order to give a more prominent role to philosophy, and from which the rest of the structure follows. From philosophy (the science containing all sciences), Harris saw a natural structure of knowledge progressing to theology (the science of the absolute), government, philology, nature (including mathematics, physics, chemistry, and the natural sciences), the
useful and the fine arts, and finally, geography, biography, and history (Wiegand, 1998, p. 182).

To see how this plays out in the DDC, observe the following table:

Table 1
Bacon’s scheme of knowledge vs. DDC

<table>
<thead>
<tr>
<th>History</th>
<th>Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poesy</td>
<td>Imagination</td>
</tr>
<tr>
<td>Philosophy</td>
<td>Reason</td>
</tr>
</tbody>
</table>

Invert this and you have:

<table>
<thead>
<tr>
<th>DDC (main classes):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Works of Reason ────► Bacon’s Philosophy 100 Philosophy &amp; psychology</td>
</tr>
<tr>
<td>200 Religion</td>
</tr>
<tr>
<td>300 Social sciences</td>
</tr>
<tr>
<td>400 Language</td>
</tr>
<tr>
<td>Works of Imagination ────► Bacon’s Poesy 500 Science</td>
</tr>
<tr>
<td>Works of Memory ────► Bacon’s History 600 Technology (formerly Useful Arts)</td>
</tr>
<tr>
<td>700 Arts &amp; recreation</td>
</tr>
<tr>
<td>800 Literature</td>
</tr>
<tr>
<td>900 History &amp; geography</td>
</tr>
</tbody>
</table>
From the above, we see an apparent correspondence between certain main classes of the DDC and each of the three faculties of mind, as devised by Hegel. The Hegelian classes of mind, in turn, correspond to Bacon’s classification of knowledge (turned upside down).

The DDC has been criticized for the illogical ordering of its divisions, the cultural and ideological bias inherent in its scheme, and its inadequacy in covering new branches of knowledge, among other things (Sayers, 1915; Wiegand, 1996). In the DDC, a separation of five main classes marks the distance between Social Sciences (300) and History (900); four classes separate Language (400) from Literature (800). Scholars have struggled to explain these separations since they cannot be justified on the grounds of “practical utility or economy”, ever the watchwords of Mr. Dewey (Sayers, 1915, p. 110). Similarly, the divisions of many of the main classes in the DDC have been criticized for cross division, a lack of exclusivity in terms, and illogical ordering (p. 111). To cite a couple of examples from the 100 class (Philosophy & Psychology): the 140 division (Specific philosophical schools) is separated by three divisions from 180 (Ancient, medieval, Oriental philosophy). This would appear to violate the rule of mutual exclusivity between divisions.

Logic (160) is followed directly by Ethics (170) in the DDC even though Logic does not “modulate” into Ethics (p. 111). Modulation, also called transitivity, is a structural requirement of hierarchical classification (Kwasnik, 1989). It holds that “since attributes are inherited, all subclasses are members of not only their immediate superclass but of every superclass above [them]” (p. 3). The DDC is easier to use than most other schemes, including the LCC (the LCC is based on 21 major classes to the Dewey’s 10 and uses a more technical vocabulary).
The LCC was developed at about the same time as the DDC. Like the DDC, it was “based on the perception of knowledge and the relationships between academic disciplines extant from 1890 to 1910 (Chan, 1980)” The organization of the LCC is focused primarily on the needs of the United States Congress, secondarily on the needs of other government departments, agencies, scholars, etc. (p. 4). Both the DDC and the LCC are enumerative in that “they attempt to provide a unique number for all major concepts or topics” (p. 16). The Farabi system is also enumerative, as per its name.

The LCC is larger than the DDC and has a greater range of numbers. The LCC allows numbers to be modified by adding Cutter numbers to identify the main entry. While the DDC has a basic structural principle that runs throughout the classification, the LCC develops each main class independently from all other classes. Thus, while “knowledge of one DDC class may help in navigating others, this same knowledge in LCC will not carry over into other classes” (Taylor, Miller, Taylor, 2006, p. 17). This is known as the concept of mutual exclusivity. Exclusivity means that classes on the same level should be distinct, such that documents placed in one class could not also be placed in another class (Buchanan, 1979). This is achieved by applying “only one characteristic of division...at a time” (p. 53).

Classifications can be broad or close (Taylor, Miller, Taylor, 2006). A broad classification relies on main classes and divisions and maybe a few subdivisions. A close classification uses many subdivisions to generate extremely specific subjects. OCLC publishes an abridged version of the DDC which rarely uses more than five numbers. This would be an example of a broad classification (p. 8). The Enumeration is broad though extensible.
Shera (1973) distinguished between closed systems and dynamic systems. In a closed system, the relationships between various segments of knowledge are more or less permanent. Open systems, on the other hand, “allow for constant change, constant reinterpretation” (as cited in Svenonius, 2000, p. 92). The longevity of a classification system is to some extent determined by its handling of the demands for relativity on the one hand and stability on the other. That Farabi’s *Enumeration* continued to be taught in Europe in Latin translation (*De Scientiis*) until the 16th century (Rescher, 1963) speaks to its authority, longevity, and openness.

**Postmodern Schemes**

So-called postmodern classifications seek to “provide a pragmatic tool [for the description of] specific domains” (Mai, 2004, p. 39). The domain specific approach seeks to “recognize the relativistic nature of classification” (p. 39). Relativist theory holds that “classifications are never innocent but streaked with arbitrariness... [and]...constantly shifting, whether by design or in spite of our efforts to capture them” (Merrell, 1995, p. 92). Perhaps as an adjunct to the relativist approach, Mai (2004) suggests that classification research should be done from a constructivist standpoint where theories arise in tandem with the formation of knowledge about how users interact with particular information domains (p. 41).

In classification, the truth of all items of knowledge must be verified empirically. That is to say, “objects are grouped in classes on the basis of their experimentally observed properties, and erroneous classifications are discovered and rejected when deductions to new examples reveal exceptions to the proposed rule” (Farradane, Henderson, 1977, p. 85). This is a kind of inverse of Aristotle’s definition of deduction, namely that: “...certain things having been
supposed, something different from those supposed [things] results of necessity because of their being so” (Prior Analytics I.2, 24b18-20) (Aristotle & Barnes, 1995). Apply this logic to classification and we have a “thing supposed” (i.e., the premise or main subject heading) and that which “results of necessity” from this thing (i.e., the conclusion or new subordinate subjects). In sum, most classification systems in the West are devised according to Aristotelian logic and all of Aristotle’s logic revolves around one notion: the deduction.

Modern science is based, to a significant degree, on induction (i.e., argument from the particular to the universal). Aristotle has much less to say about this than deduction. However, it is through induction that we must seek the first principles of the sciences.

Advancing into postmodernism, there is a school of scientific thought, following Karl Popper (1902-1994), that denies the possibility of induction altogether. This school holds that facts themselves are loaded with a priori theoretical premises (Popper, 1972). That is to say, hypotheses precede observations. Preconceptions and values precede actual scientific discoveries. Facts are made, the etymology of the word says so, not given. Thus, there is a dialectical relationship between facts and values or theories and observations. If we subscribe to this view, then our beliefs or sets of values will shape our perception of the world. This is true of Farabi as it would be of any classifier. I venture this digression in order to dispel the illusion that empirical facts are independent of ideological content, whether the setting is medieval Islam or Dewey’s 19th century America.

Classifications are like theories and models in that they constitute “symbolic dimensions of experience as opposed to the apprehension of brute fact” (Kaplan, 1963, p. 294). Symbolically, classifications can be extended to cover new experiences. The more
abstract a classification is, the more likely that it will be able to explain processes and behaviors in many contexts. In general, classification clusters experience in a meaningful way. It is useful “during the preliminary stages of inquiry as a heuristic tool in discovery, analysis, and theorizing” (Davies, 1989).

All classifications place the terms in their vocabularies into categories of high generality. These categories, often called facets, are obtained by dividing a subject discipline into homogeneous or semantically cohesive groups (Hutchins, 1975). Facets help to define the syntax of a subject language. They structure groups of terms into manageable sizes and help to delimit knowledge domains (Svenonius, 2001). Insofar as they denote meaning, facets have an ontological function. They predetermine, “in Kantian fashion, what a document can be about” (p. 140).

Facets serve to curtail and restrict language subjectivity and inconsistency in indexing. There is debate as to whether facets may be used to classify terms in different subject disciplines. In other words, are there such things as semantic universals?

**Semantic Universals**

Ranganathan (d. 1972) was one theorist who answered this question in the affirmative. He “constantly sought to find unity in diversity” (Ranganathan, p. 181, 1965). Ranganathan believed that terms differed from subject to subject on a superficial or phenomenal level but that at a seminal level they could be seen as manifestations of a few fundamental categories, such as Personality, Matter, Energy, Space, and Time (PMEST) (p. 182). Ranganathan’s view of semantics was rejected by the English Classification Research Group, which held that category definition was an empirical matter, based on literary warrant,
and therefore discipline specific (Vickery, 1960). Literary warrant refers to the concept that the vocabulary of a subject language must be empirically derived from the literature it is intended to describe (Hulme, 1950).

For all their benefits, facets are difficult to define. Therefore, it is difficult to class terms into them (Hutchins, 1975). The difficulties arise from the fact that language is unruly. Some terms resist being categorized into only one facet; others are ambiguous or abstract. Further, attempting to define facets according to semantic and syntactic criteria “leads to cross—and inconsistent classification” (Svenonius, 2001, p. 141).

**Subject Headings**

Subject heading lists are an important adjunct to classifications. While classifications put subjects into the context of disciplines, subject headings list subjects outside the disciplinary context (Rubin, 2004). As such, they function as “a kind of index to the classification scheme” (p. 229). The most comprehensive subject heading list in the United States is the Library of Congress Subject Headings (LCSH). The LCSH acts as an authoritative source of subject headings for library catalogs and for many indexes. It controls subject terms for information provider and seeker alike. LC subject headings are developed by the Library of Congress to provide subject access to that library’s collections. They are one of the few “general non disciplinary controlled vocabularies in English” (p. 229). They are used as the official headings in MARC records, which means that all libraries that use the MARC record also have the advantage of the LC subject heading. The LC subject classes serve as a sort of common denominator of subject access to many library collections. Together, they “make up a kind of epistemological labyrinth unto themselves” (Battles, 2003, p. 207).
Though recognized as a standard to many, the LC subject headings have drawn criticism from some quarters. Sanford Berman, a librarian in Minnesota’s Hennepin County Library (HCL) since 1973, has created a list of substitute headings for the HCL to correct what he considers the “racist, reactionary, insulting to human dignity, and plain confusing” (Battles, 2003, p. 208) LCSH. For example, where the LC uses the term “amicide”, Berman offers the plainer term, “friendly fire casualties”; for “dysmenorrhea”, he substitutes the more frank “menstrual cramps”. Berman’s cataloging style is an attempt to reach a broader set of readers who may be put off by the “tone of bureaucratic high-handedness” (p. 207) to be found in parts of the LCSH.

Before subjects can be structured into headings, they must be defined. Traditionally, subject definitions draw upon grammatical models (Svenonius, 2004). In grammar, the subject of a proposition refers to the object that is spoken of. This object can be an idea, a concept, or virtually anything in the world. The role of the predicate is to say something about the subject (p. 35). For example, in the proposition, “the sky is blue”, the subject is the sky. The predicate says something about the sky, namely, it is blue. We may collect a number of propositions about the sky and put them into a document. We now have a document that is about the sky and has the sky as its subject. All of the propositions in the document are about the sky. If we expand this practice to many documents—all about the sky—we will develop a body of knowledge about a subject called “sky.” This approach to subject definition emphasizes language and culture and is pragmatic. It recognizes the complexity of subjects and relies on a system of concepts rather than a single descriptor or idea to formulate a definition.
Positivism, Pragmatism, and Literary Warrant – Definitions and Background

Given my reliance on the three theories above to investigate my thesis, I will now discuss their origins and relationship to the science of classification. Positivism is a philosophy of science that emphasizes "facts, pure observations, logical deductions, and formal models, while ignoring issues related to interpretation and meaning as well as goals, purposes, and values" (Hjorland & Pederson, 2002, p. 585). It is a theoretical approach that derives from Enlightenment thinkers such as Henri de Saint Simon (d. 1825) and Auguste Compte (d. 1857) who sought to replace any hint of metaphysics in the history of thought with pure scientific method. The positive view holds that the only authentic knowledge is that which allows positive verification. Objectivity is achieved to the extent that propositions are verifiable. This condition is known as the Principle of Verifiability (Svenonius, 2004). According to this idea, “the totality of knowledge consists of all meaningful propositions” (p. 572). Propositions are meaningful if they can be defined operationally; that is, if their constituent parts can be converted to variables. Compte believed that a subject was positive to the degree that it could be measured exactly. He held that:

…mathematical demonstration, and therefore mathematics, [is] the general gauge by which the position of every science is to be determined. Generalizing thus, Compte found that there were five great groups of phenomena of equal classificatory value but of successively decreasing positivity. To these he gave the names astronomy, physics, chemistry, biology, and sociology (Ward, 1921).

Following are some additional features of positivism that are relevant to the Enumeration, the DDC, and the LCC (adapted from Hacking, 1981):
1. A concern with axiomatization, that is, with demonstrating the logical structure and coherence of statements.

2. The belief that science is markedly cumulative.

3. The belief that science is predominantly transcultural.

4. The belief that science rests on specific results that are dissociated from the personality and social position of the investigator.

5. The belief that science sometimes incorporates new ideas that are discontinuous from old ones.

6. The belief that science involves the unity of science, that there is, underlying the various scientific disciplines, basically one science about one real world (p. 143).

Pragmatism is a doctrine that emphasizes "…the investigation of goals, purposes, interests, and values" (p. 585). It relates to classification in its insistence that “we base our classifications on knowledge about their purposes” (Hjorland & Pederson, 2002, p. 269). The Enumeration was written to define and enumerate the “known sciences” and to indicate the proper course of study for scholars. Those are two of its purposes (see table 11, p. 125 for a further listing). The DDC has its purposes as well (see table 11).

A pragmatic aim is one that strives to link theory with practice. The pragmatic philosophical movement has its origins in the United States of the 1870s. It can be summarized in terms of the “pragmatic maxim”, devised by Charles Sanders Pierce (d. 1914), one of the movement’s founders: “Consider the practical effects of the objects of your conception. Then, your conception of those effects is the whole of your conception of the object” (Pierce, 1878, p. 286).
The pragmatic orientation holds that knowledge elements may be meaningful in any number of different relationships. Thus, “the external relations and the environment [are] all important to the act of classifying” (Shera, 1973, pp. 83-84). Shera devised the term “social epistemology” to describe the products of classificatory behavior in relation to a particular time and place (Shera, 1973). This kind of relativism is a hallmark of the pragmatic approach. Shera believed that each new age required a new classification of knowledge because each age views reality according to different principles.

While classifications are certainly a product of their environment, they are also designed generally with a purpose in mind. What that purpose is depends upon the goals and the worldview of the classifier. A basic premise of pragmatic classification is that we define a scheme according to how we use it. Viewed pragmatically, words have meanings that are more or less variable; some words are more colored by context than others. This is called the contextual theory of meaning. Frege (d. 1925) is reported to have said that words do not have meaning in isolation, but only in the context of a sentence (Dummett, 1973). Some words have multiple meanings that are unrelated to each other. These are called homonyms. The word “Mercury” is such an example, referring as it does to the planet, the metal, the Greek God, and the car. The contextual theory, which presumes multiple meanings for many words in a natural language, takes us a long way from strictly positive understandings of classification. If taken too far, it can result in a surfeit of “microworlds“ of knowledge. Such a condition is a hindrance to semantic interoperability (a necessity for merging different knowledge representations) and to disambiguation, or the resolution of meaning in words that refer to different topics.
Disambiguation is already “a serious and very large problem” affecting the design of retrieval systems (Svenonius, 2004, p. 577). A certain fixity of term definition, then, is recommended in order to avoid precision failures, or info glut, in retrieval. Overall, a balance is to be sought with respect to pragmatic and positive claims on classification design.

The concept of literary warrant in respect of knowledge classification “can be thought of as the authority [that] a classification invokes first to justify and subsequently to verify decisions about what classes/concepts to include in the system…” (Beghtol, 1995). In practice, literary warrant serves to define the domain or parameters of a classification. The DDC was designed to classify all knowledge; later revisions, based on literary warrant, reoriented its coverage to the sum total of the OCLC bibliographic database.

**Positivism, Pragmatism, and Literary Warrant in LIS**

It is not always an easy task to trace the influence of different epistemological theories in LIS. Often, formal doctrines are employed unconsciously and/or without attribution. Nonetheless, a close review of LIS literature reveals a frequent dependence upon positive and pragmatic ideologies as well as literary warrant. Since I invoke these perspectives in my discussion of Farabi’s *Enumeration* as well as other knowledge classifications, it is fitting that I provide an account of their use in the field of LIS.

One strong example of positive philosophy in LIS is the facet-analytical school of classification as exemplified in Ranganathan’s Colon Classification (CC). The CC provides clear definitions and rules and “those thesauri and classifications that are based on this approach often display a high degree of structure and clarity, which is lacking in systems developed by other traditions” (Hjorland, 1997, p. 144).
Elsewhere, the ideas of Paul Otlet (d. 1944) are still to be found in contemporary LIS research. Otlet was the creator of the Universal Decimal Classification (UDC) and is often considered one of the fathers of information science. Like Ranganathan, Otlet sought to link ideas and subjects together through facets. He devised a system of algebraic notation to describe the intersection between different subjects. He was concerned chiefly with “objective knowledge”, which he thought “was both contained and hidden by documents” (Rayward, 1994, p. 247). His view of knowledge has been described as “authoritarian, reductionist, positive, simplistic, and optimistic!” (p. 247). But, his positive approach lingers on into the digital age. Nelson (1987), in describing the development of hypertext, speaks of “a new form of interconnection for computer files—corresponding to the true inter-connection of ideas which can be elaborated and shared into a shared network” (p. 143). Take out the words “computer files” and these words may have issued from a Ranganathan or Otlet.

Positive assumptions are also to be found in much information retrieval (IR) research. In many IR experiments (see Kinkaid, 1998, for an overview), outputs (i.e., responses to inquiries) are judged to be either relevant or non-relevant. That is, outputs are made to fit a binary framework. A problem with this kind of research stems from the fact that “relevant” and “non-relevant” are simply predetermined, fixed, categories. In real life, of course, such entities are subject to interpretation and may be caused by any number of different factors. For example:

- A word may be used in another conceptual meaning than what the searcher intended.
- Reference to a retrieved document may not be understood by the user.
- Implications for practice may seem vague or unrelated to the searcher’s work domain.
The theses or implications of the document may seem politically problematic for the user.

The positive framework, then, in its indifference to causal or environmental factors, can produce results that are incomplete, and does not fully advance knowledge within the core field of LIS.

Pragmatic strategies are also common to LIS research. Often, they are denoted by an emphasis on language and physical action as chief determinants of knowledge. As Sundin (2003) suggests, “Knowledge is seen as something enacted through linguistic and physical actions whose significance and relevance are judged by the consequences of such actions rather than by a subjective or objective reality” (p. 24). This statement recalls the admonition of Pierce to be ever mindful of the “practical effects” of one’s conceptions.

Rorty (1982) describes the pragmatic assumption in terms of a belief that “the world is not something that is found, but something made by humankind” (p. 165f). No state of affairs can remain eternally stable but is always subject to change through the agency of human action. Humans tend to interact with their environment using the tools that the environment affords; for many pragmatists, Rorty included, language is the most useful tool available and the one that is most “distinctively human” (Rorty, 1999, p. 24).

An example of pragmatism in LIS can be found in Patrick Wilson’s concept of cognitive authority which permeates all of his research on information seeking and learning. For Wilson (1983), the “cognitive authorities” are “institutions, people, or texts whose knowledge we believe in and rely on” (p. 166ff). In Wilson’s view, whenever we retrieve books or articles, we evaluate them not just on the basis of their content but "also, and perhaps primarily, by other
signifiers, for example; author, reputation, publisher, reviews, and personal recommendations from people whose judgment we trust” (p. 166ff). In other words, we search for consensus in regards to knowledge claims. Insofar as we do this, we compromise our independence as information seekers and users. We limit our knowledge to what is sanctioned by the “cognitive authorities.” Our deference to these authorities may not be altogether conscious but it is real nonetheless. This is an example of environmental factors shaping learning. It is also illustrative of the way that artifacts of information are assigned value in a social, cultural, and historical context.

Wilson’s contention that people tend to regard knowledge in terms prescribed by other “cognitive authorities” has been criticized as relativist (see Budd, 2001, p. 224f). While this criticism may be valid, the classifications of both Farabi and Dewey attest to the power of independent minds to create new form and content even in the midst of imposing intellectual arbiters.

Hjorland (1997) is an LIS researcher who espouses a model that is similar to Wilson’s in its emphasis on the creation of meaning, or meanings, at the collective level and within a particular knowledge domain. In true pragmatic fashion, Hjorland understands “knowledge as a tool shaped in order to increase man’s adjustment to his physical, biological, and cultural environment, [seeing] knowledge as historically and culturally developed products organized in collective human organizations such as scientific disciplines” (p. 3). Hjorland’s group centered perspective has been criticized for being too narrowly targeted and for “neglecting pure or autonomous inquiry” (p. 79). Another criticism, applying to Wilson as well, centers on the
reluctance of these authors to question or discuss the legitimacy of the “cognitive authorities.” Hence, the charge of relativism or an “anything goes” mindset.

Another instance of pragmatics in LIS research concerns information retrieval (IR). According to this view, the systems and tools that we use to retrieve the information act to mediate and shape our perspectives. For example, a web-based tutorial on information seeking “not only creates a learning opportunity [but also] mediates a particular theoretical perspective on learning that is built into the construction of the tutorial and its contents, whether this is explicit or not” (Saljo, 1996, p. 84). This is another way of saying that the medium determines the message.

The concept of literary warrant occupies a central place in classification research, which is a subset of LIS studies. The utility of a knowledge classification is based, in large part, on the warrant that informs it. Generally speaking, two types of warrant are spoken of in classification research; namely, syntactic and semantic. These can be subsumed under the general heading, literary warrant, a term coined by Hulme (1923), and still the most familiar designation.

Most classification research, according to Coates (1978), has focused on the syntactics of classification systems, probably in deference to Ranganathan and others, who emphasized “the syntactic work of systematizing the principles of concept division and of standardizing citation orders” (p. 38). During the 1950s and 1960s, the Classification Research Group (CRG) turned to Ranganathan’s work for guidance in developing special schemes that incorporated facets and other syntactic devices for notating “alternative collocations of classes and subclasses and for the provision of special phenomena classes” (p. 39).
Other syntactic studies have been done by Cockshutt (1976), who diagrammed the influence that classification systems have had on each other and the evolution of facet analysis from its rudimentary beginnings, through its incorporation in the UDC, DDC, CC, and LCC (Bury, 1980). In all of this research, the classification systems are examined in terms of syntactic criteria that, taken together, constitute a warrant.

Besides syntactic considerations, classification systems can be understood in terms of their underlying semantic rationale. It is the semantic warrant of a system that “provides the principle authorization for supposing that some class or concept or notational device will be helpful and meaningful to classifiers and ultimately to the users of documents” (Beghtol, 1995, p. 111). In any warrant, there is a close correlation between meaning and function that must be justified philosophically. The meaning may derive from language. Since Wittgenstein, many have advanced the idea that language has no a priori meaning, but attains meaning through use (see Dummett, 1973, Frohmann, 1983). Frohmann criticized the subject indexing platform (called PRECIS for Preserved Context Index System) of the British National Bibliography (BNB) for its a priori semantic theory, which, he believed, rendered it intuitive rather than rational (Frohmann, 1983). According to Frohmann and others, a classification will convey meaningful subject relationships to its users if it is based upon “elements of precedent and usage” within the discourse community. In other words, the literary warrant of a classification should derive from the knowledge community and the “language” should be that of the users. I hasten to add that this context—bound view of warrant is very pragmatic, emphasizing as it does, language, environment, and use. On the other hand, the a priori approach that Frohmann criticizes is positive in its predetermined formulations, irrespective of an evolving context.
The greater question involving warrant, and one that the classifier must ask, is: What do the subjects mean and how do they relate to one another? The quick answer is that the subjects mean what the items in the collection—be they books or some other format—say that they mean. According to Hulme (1950), we should only define subject headings in terms of “the literature in book form [which] has been shown to exist, and the test of the validity of a heading is the degree of accuracy with which it describes the area of subject matter common to the class. Definition, therefore, may be described as the plotting of areas pre-existing in the literature” (p. 175). In other words, a cardinal feature of literary warrant is that a library’s classification should mirror its shelf list. There should be a subject heading or facet in the classification to account for every item in the library’s collection.

**Bibliometric Analysis**

As part of my literature review, I have conducted a bibliometric analysis of published scholarship on Farabi, the DDC, and the subject of classification, in various combinations. The point of this inquiry is to determine how many documents have been published in reference to my topic.

Bibliometrics can be understood as an extension of literary warrant. Hulme (1923) expected that quantitative values could be assigned to bibliographic units once the bibliography of a subject had been definitely compiled (p. 46-47). He called this quantification, “statistical bibliography”, which later became the “bibliometrics” of modern vernacular. Bibliometrics, then, has always sought to illuminate the history of a subject by “counting documents.” The counting of documents has taken on new refinements in the form of statistical formulae which, it
is hoped, offer insight into the impact of a scholar’s published work on a field of study, or the impact of scholarship about a scholar upon a field.

Bibliometrics is a strong approach with which to analyze an information domain because “it shows many detailed and real connections between individual documents [which] represent the authors’ explicit acknowledgement of dependency between, for example, papers, researchers, fields, approaches and geographical regions” (Hjorland & Pederson, 2002).

I measure the volume of published material over the past twenty years on the topic of Islamic classification of knowledge. I formulate different queries on this topic by adding variables such as:

- “Universal” (as in universal schemes or classifications);
- “Domain” (as in domain specific classifications);
- “Farabi” (in reference to the eponymous author);
- “Dewey” (in reference to the classifier and scheme of the same name), and
- “Dewey”; “Farabi” (in reference to both figures).

I also formulate a query on “Enumeration of the Sciences” and “Farabi”. The results are as follows:
<table>
<thead>
<tr>
<th>Query</th>
<th>Papers</th>
<th>Citations</th>
<th>h-index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal; Islamic classification</td>
<td>38</td>
<td>262</td>
<td>6.89</td>
</tr>
<tr>
<td>Islamic classification</td>
<td>69</td>
<td>359</td>
<td>10</td>
</tr>
<tr>
<td>Domain; Islamic classification</td>
<td>19</td>
<td>206</td>
<td>10.84</td>
</tr>
<tr>
<td>Farabi; Islamic classification</td>
<td>13</td>
<td>44</td>
<td>4</td>
</tr>
<tr>
<td>Dewey; Islamic classification</td>
<td>11</td>
<td>2</td>
<td>0.18</td>
</tr>
<tr>
<td>Dewey; Farabi; Islamic classification</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Figures 1-3 Numbers of papers published, citations, h-index.
# Citations

- Universal; Islamic classification: 30%
- Domain; Islamic classification: 24%
- Dewey; Islamic classification: 0%
- Islamic classification: 5%
- Farabi; Islamic classification: 0%
- Dewey; Farabi; Islamic classification: 30%
h-index

- Universal; Islamic classification: 34%
- Domain; Islamic classification: 31%
- Dewey; Islamic classification: 12%
- Islamic classification: 22%
- Farabi; Islamic classification: 1%
- Dewey; Farabi; Islamic classification: 0%
In the above pie charts, all metrics refer to published material on a subject or a combination of subjects rather than a specific author, as per common usage. The h-index, after Jorge E. Hirsch, a physicist at UCSD, is a metric that attempts to measure both the productivity and the impact of published work. An h-index of 10.84, for example, as occurs with my query, “domain”, “Islamic classification”, means that 10.84 papers on this subject have been cited in other papers at least 10.84 times. Thus, the h-index reflects the number of published papers on a subject that have been cited in other publications. The h-index is valid only for works within the same field since citation conventions differ widely between fields. Only the most highly cited articles contribute to the h-index, which is why this metric is useful for demonstrating impact.

Citation searches can be conducted for any kind of knowledge record. The date of the starting-point record is irrelevant: The work may have been published last year or centuries ago (Mann, 2005). I conducted citation searches using Publish or Perish software (Harzing, 2007). Publish or Perish uses Google Scholar data to calculate its various statistics. As a general rule, good citation metrics are demonstrative of significant impact on a field. However, weak metrics are not necessarily a sign of insignificance. They may be caused by a lack of impact on the field but also by the fact that a field may have relatively fewer scholars, fewer papers, and fewer citations. Therefore, the citation threshold is lower. In reference to this study, the subject of “Islamic classification” may occupy a relatively narrow range of concerns within the greater field of LIS. However, the number of papers published on the topic is not inconsiderable. Moreover, the intensity of opinion is high among those calling for reform of existing classifications. This is a qualitative aspect that is difficult to measure by citing numbers of citations or papers published.
As I expected, “Islamic classification” as a single query garners the highest numbers of published papers. Interestingly, “domain” and “Islamic classification in combination yield the highest h-index. I realize that the word “domain” may have multiple meanings, as may the word “universal.” Rarely do words that denote a subject have a single precise meaning.

Other findings: more papers have been published and many more citations generated using “Farabi” & “Islamic Classification” in the query, as opposed to “Dewey” & “Islamic Classification”. Nonetheless, it is significant that eleven papers have been published which treat, in part, the subject of the DDC in the context of Islamic classification. As mentioned earlier, I find no evidence that the *Enumeration* and the DDC, or any other Western scheme, have been treated in conjunction with one another.
CHAPTER THREE
THEORETICAL AND METHODOLOGICAL FRAMEWORK

Introduction

In order to define the *Enumeration*’s intellectual foundation, I undertook to examine how Farabi selected subjects for inclusion in his scheme and how he established the hierarchical position of each one. To assist me with this inquiry, I used:

a) Positive theory;

b) Pragmatic theory;

 c) Literary warrant;

By using these methodological tools, I was able to identify the epistemological heritage of the *Enumeration* and the joint claim on this heritage by the most prominent classifications of today, namely, the DDC and the LCC.

The invocation of post Enlightenment theories, such as those above, in the context of a medieval writer such as Farabi, may strike the reader as anachronous or inapt. To dispel confusion, it may help to think of these theories in simple terms. Positivism, for example, may be understood as corresponding to strongly empirical theory, based on logic; pragmatism, to practical application and effect; literary warrant, to a cultural or intellectual legacy or foundation. Understood thus, these doctrines may come to seem sensible and uncontroversial, even in the context of medieval philosophy. Though I might have defined my theoretical framework using a more modest terminology, I believe that those theories which I do invoke—positivism, pragmatism, and literary warrant—allow for a fruitful and scientific investigation of my topic.
In addition to positive and/or pragmatic orientations, most classifications are devised to be universal in scope or domain specific. It is not always easy, however, to determine where one domain might begin or end; nor, on the other hand, whether what purports to be universal is, in fact, so. Ranganathan, author of the CC, was clearly a Universalist. In his view, “the specific subject of a book is inherent within it, waiting to be uncovered through careful application of logical, rational canons and principles” (Feinberg, 2007, p. 2). Ranganathan analogized his classification to a meccano set, assuming thereby that all knowledge could be built out of a standard set of concepts and relations among them (Ranganathan, 1965, p. 20). The DDC, as any glance at its ten main classes will reveal, is universal in scope. This does not mean, of course, that the DDC is without bias. The Universalist tag does not absolve a classification of bias; merely, it designates the intent of the author as extending beyond the boundaries of a specific domain.

Universal and domain classifications often take a positive or pragmatic slant. Universal schemes, by definition, are broad based and generalizable; they adhere to formalized processes and strictly controlled vocabularies. They classify by predefined disciplines, not individual topics. To find subjects, one must enter through the context of the associated discipline. Sometimes, topics are relevant to multiple disciplines. They are discoverable, as in the case of the DDC, through a relative index. In most cases, universal schemes are positive more than pragmatic if for no other reason than that they are more rigid and less inclusive of subject matter appertaining to a particular discourse group. Domain schemes are pragmatic because of their greater expressiveness and fidelity to the concerns of a group or knowledge community.
CHAPTER FOUR
PRESENTATION OF DATA

A critical edition of the *Enumeration* in English translation has not been published though excerpts of the text (in English) do appear in various books and articles (see Bakar, 1998; Butterworth, 2001; Randel, 1976). Manuscripts in the original Arabic were believed to be lost in the West until the 1920s when several appeared in succession in Lebanon, Cairo, and Iraq (Sarton, 1933). I have used a critical edition of the text by Gonzalez (1932) which consists of a Spanish translation (of the Cairene version) and two old Latin translations of the tractate, one of which was made by Gerard of Cremona (d. 1187). All translations into English of the *Enumeration* (Alfarabi & Gonzalez, 1932) are mine unless otherwise indicated.

I compare the *Enumeration* to the Dewey Decimal Classification (DDC), 22nd edition (Dewey, 2011), with occasional references to the (LCC) and the (CC). It is important to remember that bibliographical classification is not quite the same as knowledge classification, although the former should always hold the latter “as an ideal to which it must approximate as much as possible” (Sayers, 1915, p. 31).

The *Enumeration* is a true hierarchy of knowledge. Though it might form the epistemological basis of a library classification, it was not designed specifically for libraries. The DDC is also a knowledge hierarchy but its primary goals are simplicity and utility in the arrangement of library materials. Indeed, Dewey thought it wholly impracticable to have a library classification represent the best philosophical statement of the interrelations of human knowledge (Sayers, 1915, p. 32). He may have underestimated the possibility of reconciling
theory and utility in this regard. Farabi consistently addresses the concepts of theory and practice in his classification.

**Introduction to the Enumeration**

“The classification, the like of which had never before been composed and the scheme of which had never been adopted by any other author, is an indispensable guide to students in the sciences” (Andalusi & Kumar, 1991).

In the following section, I analyze the *Enumeration* in terms of its content, its structural and hierarchical relationship to modern schemes, chiefly the DDC and LCC; and its alignment with positive and pragmatic design. By examining the scheme in this manner, I seek to demonstrate the grounding of Farabi’s classification in Western epistemology.

Farabi’s *Enumeration* classifies the various branches of the “known sciences” of the time. It is divided into five chapters:

1) The science of language;

2) The science of logic;

3) The science of mathematics (propaedeutic, meaning of an introductory nature);

4) Physics (natural science) and divine science (metaphysics), and;

5) Political science, the science of jurisprudence, and the science of theology.

In a brief introduction to the text, Farabi describes five principle uses of the book:

1) To learn about a particular science, where to begin the study of it, and how to determine its benefit or utility;

2) To compare one science to another and rate it according to excellence, utility, precision, etc;
3) To test the claim of an ignorant person by asking him to enumerate the parts of a science and to describe its content;

4) To test someone who knows something of a science in order to find out how much he knows, and

5) To attain a quick education, learning the outline of every science so as to appear to be a person of learning (Alfarabi & Gonzalez, 1932, p. 4). Farabi describes number five as the concern of a pedant.

The five uses of the *Enumeration* can be viewed as important to the construction of classification schemes generally, with the exception of number five, which is non-essential. The *Enumeration* features detailed subdivisions of the sciences—nothing on the order of an LCC or DDC, but extensive for its time. The level of detail in the classification suggests that Farabi considered the pursuit of specialization to be a legitimate activity though not at the expense of a unified and hierarchical approach to learning (Bakar, 1998).

Farabi excludes a number of the practical arts from his classification, a fact that has been noted and criticized as constituting a defect in his scheme (see Bakar, 1998). Farabi did not disdain the practical (we may call them non-syllogistic) arts per se; indeed, he wrote treatises on several of them, e.g., dream interpretation, alchemy, and astrology. He did, however, consider these sciences to be of a symbolic nature; he was concerned that they “be studied [only] by those who possess the necessary intellectual and spiritual qualifications” (Farabi, trans., Bakar, 1998, p. 76). He counseled that the student of alchemy, for example, should have already mastered at least logic, mathematics, and mineralogy, three subjects that do appear in the *Enumeration*. 
Another important branch of knowledge, related to natural philosophy, and conspicuously absent from the *Enumeration* is medicine. From his writings, Farabi seems to have been interested in this subject only from a theoretical standpoint.

In light of the foregoing, the *Enumeration* comes across as a foundational work; not comprehensive, but inclusive of essential topics, to which others may be added as desired.

Some of the more prominent sciences of the scheme are part of pre-Islamic philosophical tradition; others would be less familiar to medieval Muslims. While Farabi elevated the logical tradition (see Rescher, 1963; Farabi & Dunlop, 1999), he was careful to defend it from grammarians on the one hand and religious authorities on the other, both of whom viewed it as a foreign (Greek) import and unnecessary adjunct to Islamic revelation. Through various analogies, Farabi shows that the sciences of language and logic constitute two related but independent disciplines, both indispensable to the apprehension of the higher intelligibles (i.e., the divine intellect, about which more later). The close relationship between logic and linguistic science is reflected in the Arabic language itself. The word for logic in Arabic, *mantiq*, is etymologically related to the word for speech, *nutq*.

Though al-Kindi, writing a generation earlier, preceded Farabi in his adoption of Aristotelian logic; Farabi surpassed him by noticing “what al-Kindi and others neglected such as the art of analysis and the proper modes of conveying instruction” (Andalusi & Kumar, 1991, p. 70-71). Farabi was in every sense a teacher, not just in his mastery of subject matter, but in the way that he set the boundaries and limits of each branch of knowledge within Islamic civilization (Nasr, 1964).
**On the science of language**

In the following tables, I draw comparisons between the seven parts of language, according to Farabi’s classification, and class divisions of the LCC and DDC. In the LCC, most of Farabi’s sections on language correspond to various notations under subclass P. In the DDC, his discussion of language would be discoverable under main class 400.

*Table 3*

*Classification of Language; LCC vs. Enumeration*

<table>
<thead>
<tr>
<th>Enumeration</th>
<th>LCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Simple expressions</td>
<td>P118-118.75 Language acquisition</td>
</tr>
<tr>
<td>2. Composite expressions</td>
<td>P121-149 Science of language</td>
</tr>
<tr>
<td>3. The rules governing simple expressions</td>
<td>(Linguistics)</td>
</tr>
<tr>
<td>4. The rules governing composite expressions</td>
<td>P321-324.5 Etymology</td>
</tr>
<tr>
<td>5. Correct writing</td>
<td>P325-325.5 Semantics</td>
</tr>
<tr>
<td>6. The rules governing correct reading</td>
<td>P326-326.5 Lexicology</td>
</tr>
<tr>
<td>7. The rules of poetry</td>
<td>P327-327.5 Lexicography</td>
</tr>
<tr>
<td></td>
<td>PE1112 Grammar</td>
</tr>
<tr>
<td></td>
<td>PN83 Reading</td>
</tr>
<tr>
<td></td>
<td>PN1059 Poetics</td>
</tr>
</tbody>
</table>
Table 4  
Classification of language: Enumeration vs. DDC

<table>
<thead>
<tr>
<th>Enumeration</th>
<th>DDC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On the Science of Language</strong></td>
<td>400 Language</td>
</tr>
<tr>
<td>&quot;The science of language, in any town, is divided into seven major parts: the science of simple words, compound words; prayers; the rules that govern simple words; the rules that govern compound words; the rules of correct writing; of correct reading; of verse metrification.&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;...the letters of the alphabet, the organ of the voice by which each is issued...and the words [that are] difficult to pronounce, and what should be done to enable their pronunciation...&quot;</td>
<td>414 Phonology &amp; phonetics</td>
</tr>
<tr>
<td>&quot;...all meaningful words, in any language, are of two types: simple and composite. Simple words are such as ‘white’, ‘black’, ‘man’, ‘animal’; composite words [what we would call sentences] are such as ‘Man is an animal’, ‘Amru is white’.</td>
<td>415 Grammar</td>
</tr>
<tr>
<td>&quot;Certain linguistic properties are common to all languages —for example, all single words fall into three categories— noun, verb, and particle; verbs are classified as either regular or irregular. Other properties are exclusive to a particular idiom.</td>
<td>892 Afro-Asiatic literatures; Semitic literatures</td>
</tr>
</tbody>
</table>
| "...The science of compound words is the knowledge of the phrases that are found to have been composed by any people—which phrases have been invented by the orators and poets... “ | 410 Philology  
815 Semantics  
808 Poetics.  
Versification  
892 Oral tradition |
Most of Farabi’s classification of language corresponds to subheadings under DDC notations 400 and 800. Notice that Farabi speaks of the science of language “in any town.” He means to address linguistic matters universally, unless he specifies otherwise. The DDC classifies linguistic matters under the headings of each particular language to which they apply. Much of Farabi’s discussion on Arabic would be discoverable in the DDC under (892) Afro-Asiatic literatures; Semitic literatures.

According to Farabi, the science of language is composed of two parts: 1. the memory of significant words in any community and the knowledge of their meaning and, 2. the knowledge of the rules that govern the use of these words. So-called rules are universal or general propositions that pertain to the many things that constitute an art. Rules are used to understand what an art consists of so that nothing may be admitted which does not pertain to the art and nothing excluded which is properly a part of the art; or, to safeguard against error or, finally, to facilitate the study of the art and to preserve it in memory. As Farabi says:

Individual things, of which there are many, attain to the level of an art only insofar as their rules are preserved in the soul of the individual according to a known order, such as may occur in the case of writing, medicine, agriculture, commerce, and the other arts, whether or not these are practical or speculative (theoretical).

The ancients defined as rules any instruments used for the purpose of acquiring precise measurements, especially where the senses are liable to err, such as the plumb-bob or plummet, the ruler, the compass, and the scale (Alfarabi & Gonzalez, 1932, p. 8). Farabi divides language into seven great parts: the science of simple words (what we would call lexicology); of composite words (sentences); of the rules governing simple words; of
the rules governing composite words; of the rules governing correct writing; of correct reading, and of poetry. The seventh branch, dealing with poetry, enumerates the meters which are used in poetic verse; the different kinds of rhymes used in each meter, and the kinds of expressions that are appropriate for poetic verse. Elsewhere, in his *Paraphrase of the Categories of Aristotle*, Farabi compares Arabic and Greek terms for syllables and metrical feet as *maqati* and *arjul*, respectively (Farabi & Dunlop, 1999).

**On the Utility of Logic**

The art of logic is an instrument (*alat*) by which, when it is employed in the several parts of philosophy, certain knowledge is obtained of all which the several theoretical and practical arts include, and there is no way to certainty of the truth in anything of which is sought save the art of logic” (Farabi & Dunlop, 1999, p. 234)

Of all the chapters in the book, it is chapter two—On the Utility of Logic—that is the longest and arguably the most important, insofar as it supplies the methodological framework for all of the other sciences (see appendix C for a complete translation of this chapter in English). Farabi is known as “the first specialist in logical studies among the Arabic speaking people” (Rescher, 1963, p. 12). His conception of logic is derived expressly from Aristotle but is framed in an “appropriate and exact Arabic terminology which henceforth became a heritage of nearly all branches of Islamic learning (Nasr, 2003, p. 14)” As he says in his *Introduction to Logic*:

We shall see to it that the canons which we shall lay down here are exactly those which Aristotle contributed to the art of logic. (However), we shall strive to express these
matters, as much as possible by means of words familiar to people who use the Arabic language (Farabi & Dunlop, 1999).

Medieval logic, of which Farabi was a pioneer, deals with the syllogistic arts or those whose parts are integrated and perfected (Farabi & Dunlop, 1999). The non-syllogistic arts are those which “have as their action and end the doing of some particular work, such as medicine, agriculture, carpentry, building, and the other arts which are designed to produce some work and some actions” (pp. 231-2). In making this pronouncement, Farabi outlines a difference between practical and theoretical concerns.

The eight parts of logic, as defined by Farabi, have their corresponding subject headings and notations in subclass B of the LCC and subdivision 160 of the DDC, respectively. While the subject of logic looms very large in the overall scheme of the Enumeration, it occupies significant but less expansive segments of both the DDC and LCC.

Deduction, (162) in the DDC, has to do with the process of reasoning from one or more general statements regarding what is known to reach a logically certain conclusion. This corresponds with Farabi's section two under Logic, which deals with simple statements and the conclusions that follow from them. The "simple intelligibles" as Farabi calls them, are simple descriptions that express the connection between one particular subject and its corresponding predicate (Alfarabi & Gonzalez, 1932, p. 15). The “intelligibles” correspond to Induction (161) in the DDC because they are derived by working from the particular to the general. They are the building blocks from which knowledge is constructed and then classified into genera and species. DDC subdivision 165, Fallacies & Sources of Error, corresponds to Farabi's sections five and six, on dialectical proof and sophistic argument.
Farabi begins chapter two by saying “we will speak in sum of what logic is”, but he does not provide a concise definition; rather, he states in enumerative fashion, what logic does and how it serves us. He says that logic provides the rules by which we may attain right understanding, avoid error and sophism in rational matters. Logic affords us the ability to assess the truth of all rational judgments, including those in which our own understanding is flawed, because even as rational beings, we are prone to error.

This notion prefigures Descartes’ idea that perceptions may not always correspond with reality due to imperfections in the sensory apparatus. But any falsity in perception may be corrected by the intellect. Similarly, Farabi believes that the use of logic can correct any misperception. Like Descartes, or more nearly Plato, Farabi asserts that certain truths are “engraved on the soul” as though we had been born “with certain knowledge of them”. For example, that “the whole is greater than the part” or “the number three is always odd”.

We formulate judgments through reflection and reason—referred to as syllogistic method by Farabi and by the ancients. If we are to avoid error in our reasoning we must abide by the “canons of logic.” Farabi goes on to compare logic with grammar:

The art of logic is analogous to the art of grammar, since between the art of logic and the understanding of ideas there exists the same relation as between grammar and language and words. All of the laws that grammar imparts to language are analogous to those imparted by logic to ideas. Logic also relates to ideas in the same way as does the art of prosody to verse metrification.

What is more, logic provides the means to assess the value of ideas, especially when our naked understanding does not yield us an accurate picture. Farabi compares
logic to the instruments of weights and measures — these are required when the capacity
of the senses is insufficient to render precise and accurate readings (Alfarabi & Gonzalez,
1932, p. 14).

Such then is the aim of logic, an aim that by its very definition reveals its “great
necessity”. In Farabi’s view, the function of logic is referable not only to the ideas that we
ourselves possess but also to the ideas of others, whose truth we wish to determine. Once we
have acquired the logical faculty, our investigations (research) will be aided immeasurably. As
he says,

…we will not permit ourselves to proceed blindly down some path, disregarding any law,
adopting spontaneously whatever methods should occur to us—though they may deceive
us into believing that which is not true. Rather, we will want to know beforehand what
path we wish to follow, what things (phenomena) we wish to study, where we should
begin our search, and how we should apply our energies discretely to each item that we
wish to examine, such that we arrive, beyond a shadow of a doubt, at the thing which we
have proposed to discover (Alfarabi & Gonzalez, 1932, p. 15).

This approach to research, which Farabi advocates explicitly and emphatically, calls to
mind qualitative methods such as grounded theory, which prescribe frequent reassessments of
data (e.g., theoretical memoing) leading, in turn, to new inferences or to the generation of new
theories (see Glaser & Strauss, 1967). It is also inductive in character, although Farabi does not
call it that, insofar as it recommends a close engagement with the subject as the investigation
unfolds.
When we attempt to demonstrate the truth of our opinions to others, we will want to employ those methods and procedures that we have used to persuade ourselves and should someone venture to contradict the arguments that support our thesis, we will provide evidence to sustain our assertions.

Likewise, when others wish to demonstrate the truth of an opinion, we will have the means by which to assess the value of their claims, which if demonstratively true, we will see clearly by what reasoning…

Conversely, if we ignore logic, our situation in all of the above cases will be inverted; worse yet, it will be gravely inferior and shameful.

It is evident, furthermore, that logic is necessary for all those who do not wish to limit themselves to mere opinion in the formation of their judgments and beliefs.

…although, for those who are perfectly content with mere opinion in their judgments, logic is unnecessary (Alfarabi & Gonzalez, 1932, p. 17).

Farabi seems to disclose his support for free will here. Though he asserts that snap judgments (“mere opinion”) are flimsy (because they are not based on demonstration), he accepts that they are good enough for some people. He recognizes that some will choose not to avail themselves of the resources of logic. He writes:

There are those who pretend that the assiduous exercise of polemics or mathematics, such as geometry and arithmetic, will amply substitute for a study of the rules of logic, supplying the individual with the necessary faculty to critique any assertion, argument or opinion. Those who hold this belief resemble those who think that by reciting and memorizing verses and rhetorical passages one can assimilate the rules of grammar and
correct speech and avoid every defect of language while acquiring the faculty to critique the morphology of any word. The answer to those who would substitute the study of grammar is the same as for those who would substitute the study of logic (Alfarabi & Gonzalez, 1932, p. 18).

Farabi does not say what this answer is but we can guess from the tenor of his earlier arguments that he recommends direct study of the rules, especially as regards critical subjects like logic and grammar.

Farabi goes on to tell us that some believe the study of logic to be superfluous and unnecessary because it is quite possible to find individuals, so blessed with natural talent that they always uncover the truth, though wholly ignorant of a single law of logic. Again by way of analogy, Farabi equates those who hold this view to those who suppose that grammar is superfluous since one can also find individuals who never commit a grammatical error, though wholly ignorant of the laws of grammar.

The Purpose of Logic

Farabi tells us that the aim of logic is to derive rules that govern the semantic relationships between ideas or intelligibles and actual words. This aligns with one of the principle goals of logic since the Categories which is to instruct us how to formulate definitions (Black, 1990).

We cannot assess the truth of a judgment by means of the spirit alone; we must reflect upon and analyze closely the argument at hand using the tools of logic…

Logic and grammar both supply rules for the use of words. They are distinguished by the fact that grammar prescribes rules only for a particular community
of people whereas logic affords the rules of language that are common to all people. That is, logic is universal where grammar is provincial (Farabi & Gonzalez, 1932, p. 21).

Farabi was reputed to know 70 languages. While this is undoubtedly a myth, he most certainly knew Turkish, Syriac, Arabic, and quite probably, Greek. In his Book of Letters, he engages in comparative linguistics (Bakar, 1998).

Logic derives, in effect, from logos, a term which held three meanings for the ancients:

1) the logos [word] externalized by the voice, by which means the tongue expresses that which the mind holds secret; 2) the word that is engraved in the soul, that is, the idea or intelligible that we know instinctively and that is signified through speech; 3) the spiritual faculty imbued by God in the individual, which we alone possess, in contrast to all the other animals. With this faculty, we acquire the intelligibles or ideas, the knowledge of science, the intuitive capacity, and the ability to perceive beauty and right moral action. This faculty is present in all men. It is present in children as well though in a more exiguous, unrealized form, like a child’s foot while learning to walk, or a low flame before full combustion, as when setting alight the trunk of a palm tree. It exists also in the mentally infirm and the drunkard, though only as the faculty of sight exists in the eye that squints, or the eye that is shut in one asleep, or in the person who suffers a black-out or whose eye is blinded by a cloud or some other analogous thing (Alfarabi & Gonzalez, 1932, p. 23).

In the foregoing, Farabi asserts that all human beings are endowed with the logical faculty, though not always in equal measure. Age, experience, health, and mental capacity determine, in part, to what degree one is blessed with the logical sense.
Logic consists of different types of syllogism and elocution (speech) that can be used to demonstrate any opinion or to formulate any question. In sum, the number of parts can be reduced to five, namely: apodictic, polemic, sophistic, rhetorical, and poetic. The first three parts correspond to Farabi’s “simple intelligibles” (Aristotle’s *Categories*), “composite ideas” (Aristotle’s *On Interpretation*), and “rules of the syllogism” (Aristotle’s *Prior Analytics*).

The function of apodictic speech is to produce certain knowledge in the resolution of a question.

Polemical speech is used in two cases: 1) when one argues on the basis of accepted premises [commonly held opinions], for the purpose of persuading an adversary of the truth of a thesis, or to defend a thesis from attack.

Sophistical arguments are used to purposely induce error in understanding, to confuse and distract, so that one begins to believe to be true that which is not and to hold as an eminent sage one who, in reality, is not, and to ignore as a true philosopher and sage one who truly is.

The purpose of rhetoric is to persuade a person of some opinion, to incline a person to trust in the truth of what one says and to obtain assent, of greater or lesser intensity… Further, in spite of the various degrees of intensity of persuasion, no form of rhetorical speech is capable of producing assent of so high a probability that it approximates certainty. Rhetoric differs from polemic in this regard (Farabi & Gonzalez, 1932, p. 26).
I do not know why rhetoric should be incapable of producing so high a degree of assent as polemic. Nor does Farabi provide an explanation. Perhaps polemical speech is more persuasive because it may include a measure of intimidation.

Poetic speech is used to excite in people the inclination, by artfully playing upon their emotions, to do a particular thing or act in a certain way. It is only poetic speech which is beautiful, ornate, full of emphasis and redundancy, and polished with the splendor and brilliancy that characterize the resources of logic (p. 27).

Here Farabi imbues poetic speech with attributes that we would associate with an oral culture. “Emphasis”, “redundancy”, “splendor”, and “brilliancy”, are, in the oral society, characteristics of speech that are designed to linger in the collective consciousness (Ong, 1982). I am not sure how such descriptors “characterize the resources of logic.”

Though neither the Rhetoric nor the Poetics form parts of the original Organon, Aristotle accepted both as possible modes of reasoning or discourse. Aristotle speaks of the rhetorical art as being “a branch of dialectic and similar to it” (Aristotle & Barnes, 1995, p. 2156). Both rhetoric and dialectic are considered arts of persuasion and both are concerned not just with specific genera or subjects, but with the principles of things that are common to all people. Rhetoric differs from dialectic in that it employs not only syllogism but also makes use of the character of the speaker and the emotions of the audience in its efforts to persuade. I would liken it to poetics in this regard. Aristotle describes the art of poetry as “an imitative mode of expressing things that is rooted in human nature” (p. 2158).

By including the Rhetoric and the Poetics in his chapter on logic, Farabi makes clear his view that both constitute essential parts of the greater Aristotelian logical system. He may also
be of the opinion that both subjects are suitable to Muslim culture. Mahdi (1975) points out that the arts of rhetoric and poetry may not belong to the category of logic but, if this is so, they are no less parts of it than sophistry, dialectic, or demonstration. While I agree with the questioning of sophistry, I fail to follow Mahdi’s challenging of demonstration and dialectic; both of these, after all, are dependent upon syllogism, which is at the heart of logic.

It is not clear, at any rate, to what extent any of these arts is “practical” or “theoretical.” That is an independent question. In any case, scholars have questioned the traditional arrangement of the Organon since the Age of Scholasticism; they have yet to provide definitive answers to some of the puzzles therein.

Farabi names five demonstrative arts or types which are used to prove the thesis of any argument. They can be termed: certain, probable, falacious, persuasive, and imaginative. Each one of these arts contains properties that are exclusive to it and properties that are shared by the others.

There are, in sum, eight parts of logic, each of which is contained in a special book [these are the books of the Aristotelian Organon].

Book #1 (Categories) contains the rules regarding single ideas and the words that express them.

Book #2 (On Interpretation) contains the rules regarding simple phrases treating of only two isolated ideas or the two words that express them.

Book #3 (Prior Analytics) contains the rules by which to evaluate the five demonstrative arts.
Book #4 (Posterior Analytics) contains the rules by which to evaluate apodictic (demonstrative) and other statements used to frame philosophical questions so that the most complete, excellent, and perfect answers are obtained. This book is titled in Arabic, Kitab al-burhan (Book of Demonstration) (Alfarabi & Gonzalez, 1932, p. 31).

According to Farabi, it is the fourth part of logic (corresponding to Aristotle’s *Posterior Analytics*) that is the most important since it explains “demonstration”, that is, how to obtain “the most complete, excellent, and perfect answers” to philosophical questions. The three parts which precede it—*Categories, On Interpretation*, and *Prior Analytics*—are in sequential order of learning or instruction and contain elements that are common to all of the other five parts. They prepare the way for study of the main subject, namely, the “demonstrative syllogism and the special rules by which the demonstrative or philosophic art is constituted (Bakar, 1998, p. 129). The medieval translator of Farabi, Gundisalvo Domingo (fl. 1140), explained why the first three parts should precede the study of demonstration:

The sure cognition of truth is not obtained except through demonstration. Therefore, it was necessary that a book be composed in which would be taught how and out of what things demonstration is made... (Domingo, 1954, p. 43).

Gundisalvo goes on to say that the *Categories* (first book) was written to teach how many kinds of terms there are and what is the significance of each of them; *On Interpretation* (second book) was written to teach the number of terms and which terms go to make up a proposition, and *Prior Analytics* (third book) was written to teach the number and kind of propositions and how syllogisms should be constructed according to mode and figure (Grant, 1974).
The four parts which follow—*Topics, Sophistics, Rhetoric, and Poetics*—are auxiliaries to the “demonstrative art” and serve as tools of comparison and contrast with the syllogistic arts generally. In Farabi’s words:

It is important that the various parts are well defined and discernible from each other so that the learner does not fall into dialectical argument, for example, without realizing it, nor make use of rhetorical devices, which only lead to persuasion, while seeking absolute truth; nor follow sophistical argument, suspecting it to be true when, in reality, it is not; nor become a follower of poetry and thus formulate judgments based on mere imaginary representations.

In all of these cases, one will persist in walking what one believes to be the path to truth, without actually doing so. In the same way, one who is not able to distinguish between food and medicine and poisons, by means of the signal characteristics which pertain to each, will not know which is which, and will take the poison, believing it to be food, and thus perish miserably (Alfarabi & Gonzalez, 1932, p. 29).

The last four parts of logic are needed to: “…impart to the practitioner of each art all of the means that constitute the correct use of that art…” (p. 30).

Farabi is careful to delineate and clearly define each logical part so that confusion or unintended overlaps can be avoided. This is an example of his tendency to compartmentalize subjects according to set rules and procedures. In the following table, I identify positive and pragmatic strains in Farabi’s classification of logic.
Positive Strains in Farabi’s Logic

Farabi describes the art of logic as an instrument by which “certain knowledge is obtained… and there is no way to certainty of the truth in anything of which is sought save the art of logic” (Farabi & Dunlop, 1999, p. 234). This is a definitive statement and a formalist one too. Rarely does Farabi make such peremptory claims on behalf of any faculty or discipline. Farabi introduces all of his eight parts of logic with the words “Rules of…” We can, therefore, characterize his view of logic as a positive or formalist enterprise.

Farabi strengthens the formalist framework for logic by equating it to grammar. Grammar, of course, is the formal structure that underpins language. While grammatical laws vary according to custom, logic is described by Farabi as a universal tool which will always lead to truth, regardless of national or linguistic affiliation.

Pragmatic Strains in Farabi’s Logic

Farabi believes all human beings to be endowed with the logical faculty, though to differing degrees. Thus, the practical effects of logic will vary by individual. Not will everyone use the logical tool to equal advantage.

Though all eight parts of logic are bound to specific rules, some of the rules are more scientifically “demonstrable” than others. The most “certain” of the parts is the apodictic; the least certain is probably the poetic. The purpose of the poetic is to “stir the imaginative sense” while “artfully playing upon the emotions.” Quite likely, language and culture will play a greater role in poetic propositions. The same could be said for polemics, sophism, and rhetoric.

There appears to be a hierarchy of the logical parts, from most to least “demonstrable”, in the following order: 1. Apodictic; 2. Polemical; 3. Sophistic; 4. Rhetorical; 5. Poetical. Another
hierarchy occurs when Farabi names the five demonstrative arts: Certain; Probable; Fallacious; Persuasive; Imaginative. These also proceed from most to least “syllogistic” or certain.

**The Mathematical Sciences**

The science of number is the ‘root’ of the sciences, the foundation of wisdom, the source of knowledge, and the pillar of meaning. Mathematics in the Islamic perspective is regarded as the gateway leading from the sensible to the intelligible world, the ladder between the world of change and the heaven of the archetypes (Nasr, 2003, p. 146).

From the above quotation, we appreciate the high regard with which the Muslim world once held the subject of mathematics. In the *Enumeration*, Farabi classifies the mathematical sciences in chapter three, just after logic.

In the table below, I compare Farabi’s classification of mathematics to DDC notations 510-520. The hierarchy of subheadings under Mathematics (510) in the DDC is similar to that of the *Enumeration*. Arithmetic (513) and Geometry (516) follow the same order in both schemes. The DDC places Algebra before Arithmetic. Though Farabi mentions algebra, he omits it as a subject from his scheme. Even had he chosen to include it, it is highly unlikely that he would have placed it prior to arithmetic. That would have violated his sense of proper sequential learning, namely a progression from elementary to advanced. The DDC, though hierarchical, is less sequential with respect to learning than the *Enumeration*.

Very interesting is the correspondence between theoretical and practical math. Numerical analysis seeks approximate but accurate solutions to hard problems such as weather prediction (Hosking, 1996). It leads to practical applications. Thus, the two schemes share, at least in this instance, a movement from theoretical to practical.
In the proper sequence of learning, Farabi considered mathematics to follow logic. Within the subject of mathematics, arithmetic comes first, being an important stage in the hierarchy of the theoretical sciences. Says Farabi: ‘Whosoever desires to learn the theoretical art begins with numbers, then ascends to magnitudes (measures), then to the other things to which numbers and magnitudes essentially belong, like perspectives (optics)’. (Farabi, 1932, p. 90) Thus, we see knowledge of mathematics as prerequisite to the study of optics, astronomy and the natural sciences. Mathematics comes first because numbers and magnitudes do not allow for any confusion. They exemplify precision and clarity and train the student in that intellectual path. Geometry comes after arithmetic because it depends upon demonstrations, “giving us certain knowledge and banishing all uncertainty” (p. 92). Farabi considered geometry to be superior to many of the other sciences, a prevalent view of his time (Bakar, 1998). Because of their rigor, geometrical proofs were generally admired as perfect. Indeed, one of the three cardinal criteria that Farabi uses to judge the excellence of a science or art is the

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<td><strong>Enumeration</strong></td>
<td><strong>DDC</strong></td>
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<tr>
<td>The Mathematical Sciences (sections 1—2)</td>
<td>510 Mathematics</td>
</tr>
<tr>
<td>1. Arithmetic, comprised of:</td>
<td>511 General principles</td>
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<tr>
<td>a. the theoretical science of numbers</td>
<td>513 Arithmetic</td>
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<tr>
<td>b. the practical science of numbers</td>
<td>514 Topology</td>
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<tr>
<td>2. Geometry, comprised of:</td>
<td>515 Analysis</td>
</tr>
<tr>
<td>a. theoretical geometry</td>
<td>516 Geometry</td>
</tr>
<tr>
<td>b. practical geometry</td>
<td>518 Numerical analysis</td>
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<td></td>
<td>519 Applied mathematics</td>
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“profundity of the proof” (p. 46).

Farabi divides mathematics into seven parts: “numbers (arithmetic), geometry, the science of perspectives, scientific astronomy (contrasted with astrology), music, dynamics and the science of machines” (Farabi & Gonzalez, 1932, p. 91).

In Farabi’s view, the domain of mathematics extends beyond the Latin Quadrivium (arithmetic, geometry, astronomy, and music) to include optics, weights, and tool-making (known today as engineering or more precisely, mechanical engineering). In modern science, these last three parts belong to physics.

Farabi divides three of the parts—arithmetic, geometry, and music—into practical and theoretical categories (see quotation below). Possibly, he declines to divide astronomy in this way since it deals with mathematical forms in relation to celestial bodies and is, therefore, not a practical science. Likewise, he does not ascribe a practical side to the science of optics. He does this perhaps because of the very close affinity of optics with pure geometry. I do not know if Farabi was familiar with the outstanding achievements of Muslim and Christian ophthalmologists practicing in his lifetime. Even a generation earlier, the Iraqi scholar Al Masawaih (d. 857), working at the Fatimid court under Al-Hakim, was performing cataract removals with a hollow needle through suction (Lindberg, 1967).

Farabi considers the science of weights and the science of ingenious devices (tools) to be based entirely upon applied mathematics and, therefore, practical. Following is my translation of Farabi’s section on arithmetic. Notice the author’s explicit arrangement of the subject into theoretical and practical classes:
The science of arithmetic divides into practical and theoretical classes. Practical arithmetic deals with numbers insofar as they are concerned with physical bodies or similar things whose quantity it is necessary to obtain. Examples are men, horses, dinars, and other numerable things. These are the numbers that people use in commercial transactions at the souk [outdoor market] and in the cities.

Theoretical arithmetic is used only for numbers in the abstract sense, apart from any physical bodies or numerable things, and only to speculate upon abstract notions. Theoretical arithmetic is considered a science [practical arithmetic, presumably, is not].

Theoretical arithmetic deals with abstract numerical relations such as, odd vs. even, factor vs. divisor, equal vs. unequal ratio, etc. It is also concerned with sums, products, quotients, exponents such as the square and the cube, perfect and imperfect numbers, and numbers that describe shapes of three dimensions such as rectangles, etc.; in sum, all of the operations that result from numbers (Alfarabi & Gonzalez, 1932, p. 39).

Farabi frequently describes subjects in terms of their practical and theoretical qualities. So often does he do this that it may be considered a signature practice. It so happens that his practical and theoretical divisions align with my positive and pragmatic readings of his text. For example, when he describes arithmetic in marketplace terms, counting “men, horses, and dinars”, he is invoking a practical application of the subject, which I qualify as pragmatic. When he cites the arithmetic of “abstract numerical relations such as, odd vs. even, factor vs. divisor, equal vs. unequal ratio”, he is alluding to universal, governing laws, which is most certainly the purview of positivism.
On the Science of Geometry

Farabi defines geometry thus:

The science of geometry is also divided into practical and theoretical classes. Practical geometry is concerned with lines and surfaces as they relate to materials; for example, wood for the carpenter, iron for the ironworker, wall brick for the mason; land for the farmer; in sum, any and all lines, surfaces, squares, triangles, and circumferences insofar as they relate to physical materials.

Theoretical geometry studies only lines, surfaces, and bodies in abstract form. Lines are considered in the most general way possible unlinked to any particular body... In general, all geometric shapes are to be studied apart from any tangible material. They should be considered in the abstract and not in conjunction with any material such as wood, brick, or iron; rather, in accordance with the forms that are common to all of these. It is the theoretical class that... determines which bodies are proportional and which are not; which are commensurable or incommensurable, rational or irrational... (Alfarabi & Gonzalez, 1932, p. 41).

It is worth noting that both geometry and arithmetic have principles and that other things derive from these principles. Principles are defined things; what derive from the principles are undefined things. In the book attributed to Euclid the Pythagorean (the Elements), we find the principles of geometry and arithmetic. The study of this material can be done according to two methods: analytic or synthetic. The ancients employed both methods, except for Euclid, who used only the synthetic.
Farabi’s mention of analytic and synthetic method is significant. Historically, analytic truths are those which seem to be knowable by knowing the meanings of the constituent words alone (Beaney, 2007). For example, the statement, “Cardiologists are doctors”, would appear to be incontrovertible on its face and thus analytic. Synthetic statements, on the other hand are true by virtue of their words’ meanings and by the relation of those meanings to the world. For example, the statement, “Cardiologists are ill-tempered”, is a synthetic proposition. It is not self-evident. It requires knowing the meaning of the words and something about their relation to the world. The analytic-synthetic dichotomy, then, is a conceptual distinction used primarily in philosophy to distinguish propositions into two types.

However, philosophers have used the distinction in different ways; some have argued even that there is no distinction. Since Farabi mentions Euclid by name, he most likely understands the analytic-synthetic distinction in the Euclidean sense.

Euclid understood analysis to be regressive, involving a working back from the thing that is sought. The thing that is sought is taken as a given. It is a first principle. For example, in Pythagoras’ theorem—where the square on the hypotenuse of a right-angled triangle is equal to the sum of the squares on the other two sides—we take as ‘given’ a right-angled triangle with the three squares drawn on its sides. We work back from this basic premise to investigate or analyze the relationships between other relevant areas. Basic analysis, then, involves regression to first causes, principles, or theorems. This ‘regressive conception’ has dominated views of analysis until well into the early modern era (Beaney, 2007).
In synthesis, on the other hand, we suppose that what was last discovered through analysis is already done. We now proceed to arrange things in their natural order as consequents, linking one with another until we arrive at the construction of the thing sought.

**On the Science of Aspects (Optics)**

“Optics inquires into the same things as does geometry, namely figures, magnitudes, order, positions, equality, inequality, and other things but only insofar as they are in lines, surfaces, and solids in abstraction. The study of geometry is thus more general than that of optics” (Alfarabi & Gonzalez, pp. 79-80, 1932).

The geometrical approach to the study of optics is a hallmark of the Hellenistic world (Eastwood, 2007). After Euclid’s Optics, the geometrical treatment of light (rays) was confirmed by Ptolemy and others. Farabi places optics alongside the disciplines of geometry, arithmetic, astronomy, and music in his classification. He considers all of these to be mathematical and demonstrative sciences. In an interesting departure from Aristotle, Farabi completely divorces geometrical optics from physics. Aristotle had subordinated all of the contents of his Meteorology, for example, including a theory of the rainbow, to physics (Simplicius & McKirahan, 2001).

Farabi’s geometrical treatment of light (rays) found many adherents in the Middle Ages in part because of its metaphysical significance. The Neoplatonists of the time tended to see an ultimate reality in everything as falling under the heading of geometry (Eastwood, 2007). Naturally, they were enthusiastic about an optical/illumination theory based on “geometricals” (Merlan, 1960). The idea of true knowledge as dependent on divine light had been around since at least St. Augustine; by adding technical understanding to the workings of
light, medieval Muslims like al-Kindi, Farabi, and al-Haytham added a veneer of scientific credibility to this belief.

It is important to determine to what degree the science of optics follows the science of geometry since most of what pertains to geometry—figure, position, order, etc.—is reversed or inverted when seen from various angles or distances. Likewise, those things that are in reality square appear from a certain distance as circular; those that are joined appear separated; those that are placed on the same plane appear to be on different levels, some lower, some higher; those that are in front appear to be in back, and other such things (Alfarabi & Gonzalez, 1932, p. 43).

Farabi’s descriptions here bring to mind the Book of Optics by Iraqi scientist al-Haytham (965-1039), born 15 years after Farabi’s death. In his book, al-Haytham catalogs a number of optical illusions such as how the moon, when low in the sky appears larger than it does when higher in the sky and how, when one is in a boat floating down a river, the trees appear to be moving or how a shadow cast by the sun appears to remain still, when in fact it is slowly moving as the day passes; or, the apparently small size of celestial bodies (Khaleefa, 1999). All of these illusions may incite sensory skepticism, causing one to doubt the certainty of things, even to distrust sensory beliefs altogether. Al-Haytham’s systematic examination of these illusory experiences gave rise to a tradition of skepticism among medieval scholars such as Roger Bacon (d.1294) and Nicholas d’Autrecourt (d. 1369).

There is no evidence that Farabi was a skeptic per se; nonetheless, his mention of optical illusions in the Enumeration proved fertile material for medieval thinkers concerned with various skeptical challenges, including sensory illusion, dream skepticism, skepticism about induction
and causal skepticism (Tachau, 1988). Epistemological standards for sensory knowledge came under scrutiny. Was God possibly deceptive? Given the existence of sensory deception, was knowledge ever to be trusted with mathematical certainty?

Descartes and others of the early modern era would examine these questions in more depth. Descartes found a model for proper reasoning in mathematics, especially geometry, based on four basic rules, like a geometric proof. Rule number four, described here in Descartes’ own words resembles Farabi’s *Enumeration* in its scope and purpose, that being:

…to make throughout such complete *Enumerations* and such general surveys that I might be sure of leaving nothing out. These long chains of perfectly simple and easy reasonings by means of which geometers are accustomed to carry out their most difficult demonstrations had led me to fancy that everything that can fall under human knowledge forms a similar sequence; and that so long as we avoid accepting as true what is not so, and always preserve the right order of deduction of one thing from another, there can be nothing too remote to be reached in the end, or too well hidden to be discovered (Descartes, 1912)

Farabi sought truth in propositions through logic; Descartes sought to determine which beliefs he could be certain were true. Starting from four indubitable basic beliefs, he attempted to derive further knowledge.

Returning to the discussion of optics, Farabi asserts that this science explains why things appear at sight differently from how they really are. Optics examines the causes of illusion through apodictic demonstration. It instructs us in the ways that the visual faculty may err and
the means by which we can correct such error through the use of ingenious devices (i.e., lenses).

As Farabi says in his own words:

   This art [here Farabi refers to optics as an art whereas earlier he calls it a science] permits one to measure the distance of faraway magnitudes, of those things that are beyond our reach, their distance from us and their distance from each other… Whatever we look at and whatever we see, we do so by means of a ray that crosses the atmosphere, running through every transparent body, improving our sight and connecting us, ultimately, to the seen object (Alfarabi & Gonzalez, 1932, p. 46).

Farabi is describing optical theory as devised by the Greeks and systematically analyzed later by Ibn al-Haytham. Such theory insists that vision occurs because of rays entering the eye (Lindberg, 1967).

Farabi considers four different types of rays: rectilinear, reflected, converse (reversible), and fractured. Rectilinear are those that proceed from the eye in a direct line until they pass from sight and break off. Reflected are those that proceed from sight along their path until they encounter a mirror which causes them to diverge from their path in a straight line, reflecting obliquely on one of two sides of the mirror. Afterwards, they return towards the viewer from the side in which the mirror caused them to diverge. Converse rays are those which return from the mirror along the same path that they initially set out upon, until they meet the eye of the viewer.

For this reason, one who looks at a mirror sees himself reflected therein. Fractured rays are those that return from the mirror, passing obliquely in front of the viewer on one of two sides and falling upon another object, either behind, to the right or left, or on top of, the viewer. The viewer is able to see what is behind or beside him. The media that come between the viewer and
the seen object are, in sum, transparent bodies: air, water, blue material [sky?], artificial composites of crystal, or things of this nature. The mirrors that reflect rays and prevent them from following their path may be artificial composites of polished iron, opaque polished wood, water, or some other similar material.

Optical illusions, which Farabi enumerates briefly, are difficult to measure in precise terms. They represent a skeptical challenge to mathematically based knowledge. Moreover, it is unclear whether they should be considered as belonging to syllogistic science. They may vary in intensity and degree depending on the mental or emotional state of the viewer. In sum, they are a product of the individual mind. They are variable and, in some ways, non-quantifiable. They do not lend themselves to any obvious practical application but neither do they constitute any universal law.

**On the Science of Astronomy**

In the following table, I compare Farabi’s classification of astronomy with the DDC. Though the understanding of cosmology has changed dramatically from Farabi’s time to the present, moving from a geocentric to heliocentric model, certain hierarchical principles remain the same. Celestial Mechanics (521) in the DDC equates somewhat to "Science of the Heavens" in the *Enumeration*. Similarly, “Specific celestial bodies & phenomena” (523), “Earth” (525), and “Mathematical geography” (526) in the DDC align with subheadings "i" and "ii" in the *Enumeration*. Subheading "iii", “The earth's climatic zones”, equates with “Meteorology” (551) in the DDC.
Apparently, Farabi was the first Muslim to believe in Ptolemy’s “Planetary Hypothesis”, according to which the universe consisted of nine spheres, namely: 1) the First Heaven, which is starless, 2) The sphere of the fixed stars, 3) Saturn, 4) Jupiter, 5) Mars, 6) Sun, 7) Venus, 8) Mercury, 9) Moon (Adamson & Taylor, 2005). Ptolemy was the first to introduce the idea of a starless heaven above the sphere of the fixed stars (Goldstein, 1997). Ptolemaic theory was followed by all Muslim philosophers until Ibn Rushd rejected it in the 12th century.

Farabi distinguishes between two types of astronomy — the astrological and the mathematical. Astrology is concerned with the signs of the stars that predict the future, explain what is happening now and what has happened in the past. Farabi considers astrology to be an interpretive or occult science. He compares it to dream interpretation, augury by shout and acclamation, the flight of birds, and other similar faculties. He is critical of the practice but not

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<td>Classification of astronomy: Enumeration vs. DDC</td>
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<tr>
<td><strong>Enumeration</strong></td>
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<td><strong>On the science of astronomy</strong></td>
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<td>4. Science of the heavens, divided into:</td>
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<tr>
<td>i. Figures, masses, and relative positions of the heavenly bodies</td>
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<td>ii. Motions of the heavenly bodies and their conjunctions</td>
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<tr>
<td>iii. The earth’s climatic zones</td>
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dismissive; his treatise *On the True and the Untrue in Judicial Astrology* suggests that he found at least some value in the subject. Astrology was very popular in his time which may be why he mentions it in his classification. He is careful to distinguish between mathematical astronomy, which is an exact and certain science and astrology, which is not. As he says:

> Mathematical astronomy deals with celestial and earthly bodies in three forms: 1) their figures and positions with respect to each other; their order in the world as defined by magnitude (mass); the magnitude of their extensions and the relation of these to each other; the fixity of the earth in its place (Alfarabi & Gonzalez, 1932, p. 48).

This idea of the earth as fixed in place is of course a centerpiece of Ptolemaic theory. Muslim astronomers began to seriously question Ptolemaic spherical models in the generation following Farabi (see e.g., Ibn al-Haytham’s Doubts on Ptolemy) (Voss, 1985) but they continued to work within the geocentric paradigm, thereby foreclosing any possibility of preceding the Copernican revolution.

Farabi describes the second form of astronomy as:

> … concerned with how cosmic bodies move; accepting that all movements are circular but seeking to know which types of circular movements are common to all planets and to all stars; what special movements are peculiar to each star; the quantity of these movements and their direction; how to distinguish with certainty the location of each star according to the parts of the zodiac, in whatever class of movement… (Alfarabi & Gonzalez, 1932, p. 48).

The zodiac in Farabi’s time was understood, as it is today, to be the belt or band of constellations through which the sun, moon, and planets move in their journey across the sky. It
is based upon Ptolemy’s Tetrabiblions (2nd century AD), which itself is a continuation of Hellenistic and ultimately Babylonian traditions. Obviously, Farabi cannot have been aware of several “cosmic bodies” that have been discovered in the modern era, notably; Uranus, Neptune, Pluto, and Ceres. Necessarily, then, his understanding of astronomy was incomplete.

Farabi goes on to describe other planetary movements, such as:

…the solar and lunar eclipses and all of the things that happen to the cosmic bodies by virtue of their position in relation to earth. All of these properties are to be demonstrated along with their quantity, form, time of occurrence, and duration. This includes the rising and setting of the sun (p. 48).

**Positive and Pragmatic Strains in Farabi’s Astronomy**

Farabi’s inclusion of “judicial astrology” is suggestive of practical application. Astrology and other of the occult sciences were used to predict the future, explain the present, and the past. Whether Farabi actually held these “sciences” to be legitimate is subject to debate. However, he does afford them a place in the classification.

Under “Astronomy”, Farabi places the “third form [which] deals with the earth insofar as it is inhabited or not inhabited, the quantity of the part that is populated, the major divisions and climates of the parts. It counts the areas that share the same climate at one time and the site of each population and its relation to the world” (Alfarabi & Gonzalez, 1932, p. 47). This describes a number of subjects for which new scientific laws were emerging, namely; meteorology, geography, and demography.

Farabi’s “Astronomy” is largely an adoption of the Ptolemaic spherical model. In its observance of the regular motions of planets, based on geometrical laws, it represents an
incipient attempt at a positive framework, though it is founded on flawed premises, such as geocentricity.

**On Science of Music**

Farabi designates five parts of “theoretical” music. These correspond to different subdivisions of music (e.g., rhythm, harmony, arrangement) in the DDC.

The goal of “practical” music, according to Farabi, is the discovery of sounds that are perceptible in both natural (human voice) and artificial (e.g., flute & lute) instruments. These categories also correspond to sections of the DDC. Hierarchically, Farabi places the science of music just before the science of weights. Both are considered mathematical sciences. In the DDC, the subject of music is placed in the class of (700) “the arts; fine & decorative arts”. Interestingly, Farabi ascribes a qualitative value to certain melodies; when “set in poetical statements”, they become “perfect”.

Farabi’s brief treatise on music in the *Enumeration* captured the interest of medievalists working with Latin translations in the 12th and 13th centuries (Randel, 1976). The appeal of his work rested primarily on his division of this subject into theoretical and practical sides. Of course, Farabi employed this dichotomous approach with many, if not all, of the subjects that he treated. Latin writers in a variety of fields seem to have admired and sought to adopt his insistence on the conformity of theory and practice (p. 13).

Much of Farabi’s personal experience with music, not to mention the actual music itself (of Persian and Arabic origin), was alien to medieval Europeans. What they chose to borrow from Farabi, through the mediation of their colleagues at work in the natural sciences, was a methodological structure into which they could fit their own musical experiences (Randel, 1976).

The present chapter on music is really a brief outline of Farabi’s magisterial *Grand Book on Music* (Kitab al-musiqi al-kabir). The *Grand Book* is available in French and Italian, though
not English, translation. It is an important adjunct to the *Enumeration* insofar as it clarifies and defines in great detail several technical terms and descriptions found in that brief treatise. The *Grand Book* was not available to medieval Latins who, consequently, struggled with some of Farabi’s meaning and vocabulary in the somewhat terse *Enumeration*. In any case, as mentioned earlier, the Latins seem to have been interested chiefly in Farabi’s scientific approach to music rather than his substantive discussion of the topic itself.

According to H.G. Farmer, Farabi’s definitions of music were known as far away as England by the end of the twelfth century through Daniel of Morlay, a pupil of Gerard of Cremona (d. 1187). His definitions continued to be quoted by musicologists until the sixteenth century (Farmer, 1926). In the East, Farabi’s treatise was the indispensable reference on music for Muslim writers from Ibn Sina in the eleventh century to Tantawi in the twentieth century (p. 56). More than just an able theoretician, Farabi was also an excellent composer and performer. His compositions continue to be performed by various Sufi orders such as the Mawlawi of Anatolia (Nasr, 2003). The following is my translation of the chapter:

The science of music, in sum, seeks to know the different classes of sounds, of what they are composed, how they are used to make a composition, and through which stages or variations they need to pass in order to arrive at a perfect and complete state of being. The science of music is of two types: the practical and the theoretical.

The goal of practical music is to find the various sounds that are perceptible in the known instruments, whether these be natural or artificial. The natural instruments are the throat, the uvula (the pendant fleshy lobe in the middle of the posterior border of the soft palate) and its attendant parts, and the nose. Artificial instruments are such as the flute,
the lute, and others. The practical musician only performs melodies and sounds by way of these instruments.

Theoretical music is concerned with the science of sounds, how sounds are made, not in connection with any particular material, but in an absolute sense, apart from any instrument; sounds are considered as they are heard in a general way and also in terms of which instruments are capable of producing them and which are not.

Theoretical music is divided into five large parts. The first of these is the discourse on the principles and the propositions, the nature of which is used to derive what is in this science; the way in which these principles are applied; how this art [again Farabi refers to as an art what he had earlier termed a science] is discovered; from which things and from how many things it is joined; and how an investigation into this art should be conducted.

The second part is the discourse on the rudiments of this art; and the discourse on the derivation of the notes; and the knowledge of how great their number is and how many species of them there are; and the explanation of the proportions between one and another, and the demonstrations for all of that; and the discourse about the species, their composition, and the arrangements of them by which they become concordant, for one chooses from them what one wants and composes melodies from them.

The third part is the adaptation of the rudiments, propositions, and demonstrations to the different classes of artificial instruments; and the production of all of the notes in these instruments according to the calculations and arrangements that are explained in the rudiments.
The fourth part is the discourse on the species of natural rhythms which are the measures of the notes.

The fifth part is on the composition of melodies in general and on the composition of the perfect melodies, which are those that are set in poetical statements composed according to arrangement and regularity and in the manner of their art. By virtue of being set in poetical statements, these melodies become more profound and effective in the attainment of the purpose for which they are composed (Alfarabi & Gonzalez, 1932, p. 50).

We require the help of the *Grand Book* in understanding fully Farabi’s remarks. He explains in that book, for example, that melodies “in general” are of two kinds. The first kind merely pleases the senses, whereas those of the second kind are for the purpose of affecting the soul. The latter are the “perfect” melodies (Farabi, Neubauer, Koprulu, 1998). The key point about the perfect melodies is that they are designed to arouse in the listener a certain state or to induce a certain action (much as poetry is supposed to do). Only with the aid of texts can melodies attain this purpose (Randel, 1976).

Also in the *Grand Book*, Farabi describes the importance of musical rudiments, echoing his support for “rules” in the chapter on logic. He tells us that there are three conditions necessary for the theorist of any art: to know the rudiments, to be able to discover what is attendant on them, and to be able to recognize and correct the errors of others (Farabi, Neubauer, Koprulu, 1998).

**Positive and Pragmatic Strains in Farabi’s Music**
Farabi’s theoretical music “is concerned with the science of sounds, how sounds are made, not in connection with any particular material, but in an absolute sense, apart from any instrument…” (Alfarabi & Gonzalez, 1932, p. 50). This describes a pure science, one which could encompass the broader science of acoustics. When Farabi writes of the “…derivation of the notes…the knowledge of how great their number…and how many species there are…and the proportions [intervals] between [them]…and the demonstration for all that” (p. 50), he is establishing a body of rules for music, suggestive of a positive framework.

On the pragmatic side, Farabi states that: “…the goal of practical music is to find the various sounds that are perceptible in the known instruments…” (Alfarabi & Gonzalez, 1932, p. 50). In his Grand Book of Music, he explains the two types of melodies: the first kind is used to “please the senses” [like divertimenti, chamber music, and popular music?]; the second kind is used to “affect the soul” (p. 50). He does not say how the soul differs from the senses. At any rate, in both instances, the aim of music is to “induce a certain state or action”; i.e., the aim is practical.

The Science of Weights

Farabi considers the following two sections—the science of weights and the science of ingenious devices (tools)—to fall under the heading of applied mathematics. All of Farabi’s applied “mathematical sciences” correspond to divisions and sections of the DDC. The difference: the engineering sciences fall under the main class of Technology (600) in the DDC, as opposed to Natural Sciences & Mathematics (500). In earlier editions of the DDC, the 600 class was called “Useful Arts.” Also, the craft of making musical instruments is a part of the 780 class (Music) and Archery, a part of 790 (Recreation & Performing Arts) in the DDC. In the
following table, I compare Farabi’s classification of weights and ingenious devices with the DDC.

Table 7
Classification of weights and ingenious devices: Enumeration vs. DDC

<table>
<thead>
<tr>
<th>Enumeration</th>
<th>DDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 3</td>
<td></td>
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<tr>
<td>Sections 6 &amp; 7</td>
<td></td>
</tr>
<tr>
<td>Science of weights (section 6)</td>
<td>620.1 Statics</td>
</tr>
<tr>
<td>Science of tool making (section 7)</td>
<td>620 Engineering &amp; allied operations</td>
</tr>
<tr>
<td>“Use of arms” (weaponry)</td>
<td>623 Military &amp; nautical engineering</td>
</tr>
<tr>
<td>“civil engineering”</td>
<td>624 Civil engineering</td>
</tr>
<tr>
<td>“The sciences of geometrical devices are many: among them the art of:”</td>
<td>690 Buildings</td>
</tr>
<tr>
<td>“masonry”</td>
<td>691 Building materials</td>
</tr>
<tr>
<td>“carpentry”</td>
<td>694 Wood construction &amp; carpentry</td>
</tr>
<tr>
<td>“measurement”</td>
<td>522 Techniques, equipment &amp; materials</td>
</tr>
<tr>
<td>“musical instruments”</td>
<td>784 Instruments &amp; instrumental ensembles</td>
</tr>
</tbody>
</table>

The science of weights consists of two parts: the weights that are themselves measured or that are used to measure other things, and these are fundamental matters concerning
scales; and, the principles of instruments by which heavy bodies are lifted and on which they are moved from place to place, and these are the fundamental matters of instruments used to lift heavy things and to transport them from one place to another (Alfarabi & Gonzalez, 1932, p. 50).

The Science of Ingenious Devices

This science today would be called engineering. Farabi describes it as devising …ways to make all the things happen whose ‘modes of existence’ were stated and demonstrated in the theoretical sciences, including the principles of the civil practical arts employed in bodies, figures, positions, arrangements and measurement as in the arts of building construction, carpentry, and others. This science treats of lines, surfaces, bodies, numbers, and other things in the abstract…Engineering sciences are those that provide the means of knowledge through instruction and method, removing obstacles and facilitating invention and practical application.

The chief science of engineers is arithmetic followed by what is known to us as algebra and mocabala and that which resembles these (Alfarabi & Gonzalez, 1932, p. 51).

This is the first and only time that Farabi mentions algebra in the Enumeration. Whereas he devotes a whole section of chapter three to geometry, he has nothing to say about algebra, an equally important branch of mathematics. The omission of algebra is all the more startling given that its “father”, Muhammad ibn Musa al-Khwarizmi (780-850), died just twenty years before Farabi was born. The invention of algebra marked a momentous shift in the development of mathematics. As J. J. O’Conner and E. F. Robertson write in the MacTutor History of Mathematics archive:
Perhaps one of the most significant advances made by Arabic mathematics began at this time with the work of al-Khwarizmi, namely the beginnings of algebra. It is important to understand just how significant this new idea was. It was a revolutionary move away from the Greek concept of mathematics which was essentially geometry. Algebra was a unifying theory which allowed rational numbers, irrational numbers, geometrical magnitudes, etc., to all be treated as "algebraic objects". It gave mathematics a whole new development path so much broader in concept to that which had existed before, and provided a vehicle for future development of the subject. Another important aspect of the introduction of algebraic ideas was that it allowed mathematics to be applied to itself in a way which had not happened before (O’Connor & Robertson, n.d., p. 84).

It seems unlikely that Farabi would not have been aware of al-Kwarizmi’s work and its importance. Both scientists lived and worked in Baghdad; al-Kwarizmi at the court of al-Mamun; Farabi under the tutorship of Yuhanna during the caliphate of al-Moqtader (908-32).

Besides his signal contributions to the mathematical sciences, al-Kwarizmi also revised Ptolemy’s Geography, correcting the great astronomer’s gross overestimate for the length of the Mediterranean Sea, among other things (Kennedy, 1996). It remains a mystery why Farabi ignores this and other important Muslim contributions to the sciences which might have altered the arrangement and scope of his classification, had he chosen to include them. Returning to the discussion of tool making or ingenious devices, Farabi says:

This science also holds much in common with geometry and with the principles that Euclid gives in regards to rational and irrational numbers in the tenth book of his Elements and of that which is not [italics mine] cited in this book. Rational and irrational
numbers (surds) correspond to different magnitudes. By discovering what kind of number relates to a given magnitude we will acquire a more precise reading of that magnitude (Alfarabi & Gonzalez, 1932, p. 52).

Here, Farabi is indicating a practical application of irrational numbers. Irrational numbers are the subject of the tenth book of Euclid’s Elements and are simply those real numbers that cannot be expressed as a ratio a/b where a and b are integers. Informally, this means that irrational numbers cannot be expressed as simple fractions. Probably the best known irrational number is pi (3.14). As a practical matter, calculating the length of a circle is done according to the formula: \( L=2\pi R \).

The sciences of geometrical devices are many; among them the art of masonry, the measurement of distinct bodies, the art of astronomical and musical instruments, and many other practical arts such as archery and the use of arms; and the use of optical devices (lenses) that so as to comprehend the reality of things that are far away (Alfarabi & Gonzalez, 1932, p. 52).

Here, Farabi mentions a practical use of optical lenses, something that he might have done in the section on optics, had he chosen to discuss practical applications there.

Also, the art and placement of mirrors so that they reflect or refract images or divert rays of the sun onto other bodies. From here we proceed to the art of combustible mirrors [presumably Farabi is referring here to the use of mirrors to kindle combustible matter at a distance] and to the lifting of extraordinary weights.
These and other similar things constitute the science of engineering and of the civil and practical arts and are used in respect of physical bodies, figures, positions, order and measurement in the context of masonry, carpentry, etc.

Such are the mathematical sciences and their kind (Alfarabi & Gonzalez, 1932, p. 52).

With this statement, Farabi concludes chapter three of the classification. Of all the mathematical sciences that he treats, Farabi considers only theoretical arithmetic and theoretical geometry to be truly "pure" in the sense that they deal with numbers and magnitudes independent of material objects. The other sciences in chapter three—optics, astronomy, music, weights, mechanics—can be seen to progress from mostly theoretical to progressively more practical.

**The Science of Physics**

Farabi defines natural science as that discipline which “inquires into natural bodies and the accidents inherent in them” (Farabi & Gonzalez, 1932, p. 90). The causes of this science are based upon Aristotle’s four causes though Farabi couches them in Arabic terms. They are: 1) that from which (corresponding to Aristotle’s material and efficient causes; *allati amha* in Arabic); 2) that by which (corresponding to the formal cause; *allati biha* in Arabic); 3) that for which (corresponding to the final cause; *allati laha* in Arabic) (p. 91). Farabi divides the chapter on natural science into eight parts, each part corresponding to a book of Aristotle, in the manner of his earlier chapter on logic. Farabi begins by distinguishing between artificial and natural bodies:

Examples of artificial bodies are glass, swords, beds, cloth; in short, everything that exists by virtue of the art and will of man. Natural bodies are those that exist not by
virtue of the art and will of man, such as the sky, the earth, and that which is between these, and plants and animals. Most of the principles of artificial bodies and of their accidents are better known than the principles of natural bodies and their accidents. Most of the principles of artificial bodies can be known through sense perception, either directly, as in the case of a garment, or indirectly, as in the case of the healing power of medicine (Alfarabi & Gonzalez, 1932, p. 59).

I am not sure how the healing power of medicine is any less direct than the tangible sensation of handling a garment. Perhaps it is a matter of degree of visual perception. The garment is seen and observed at all times; the healing power of medicine, on the other hand, occurs inside the body, away from sight. Farabi continues:

The accidents that exist in artificial bodies are, for example, the brightness of cloth, the gleam of the sabre, the transparency of glass, and the frame of the bed. Artificial bodies exist according to the purpose for which they were made; for example, cloth is made for clothing to wear, the sabre to injure the enemy, the bed to guard one against the wetness of the earth and for other things, and glass so as to be able to see what is inside, unlike other vessels that are not transparent. The accidents of the artificial bodies have their purposes as well. For example, a bright cloth is beautiful, a resplendent sabre will frighten the enemy, a finely carved bed is handsome, and a glass jar will allow one to see what is inside. Artificial bodies also exist for artists and builders. For example, the bed exists for the carpenter, the sabre for the polisher. Artificial bodies depend upon two things for their existence. [These two things would correspond to “form” and “matter.”] For example, the sword exists because it is sharp and because it is made of
iron; the sword’s sharpness gives it its shape and purpose [to cut]; the iron gives the sword its substance and sustains its form and figure. Likewise, fabric has two parts to its existence: the thread and the stitch of the weave in the loom; the stitch constitutes the form and figure and the thread holds the form together. Likewise, the bed exists according to two things: the frame and the wood. The frame constitutes the form and the wood makes up the matter that sustains the frame. The same applies to all the rest of the artificial bodies. The essence and perfection of each thing are a result of the union of form and matter. Each thing works, is made, or is used, in function of that for which it was formed, when its form adheres to its matter. For example, the sword is only perfected when its edge has been duly sharpened; the fabric is only useful when the stitching together of the thread has been completed, and so on for all of the other artificial bodies.

Natural bodies only exist in terms of intention and purpose. That is their essential quality. The same is true for all of the accidents of the natural bodies; and each natural body and its accidents have an agent or creator from whom they receive their existence (Alfarabi & Gonzalez, 1932, p. 59).

Notice that Farabi is theologically neutral as to who the creator or agent is. He does not call it God, as Aristotle does in the Metaphysics. Aristotle refers to the agent upon whom all movement and growth depend as the Prime Mover. The Prime Mover is that which moves other things but is itself unmoved. Farabi continues:

The being and accidents of any natural body whatsoever depend on two things: 1) that thing resident in the body which serves the same purpose as the sharpness of the sword,
i.e., the “form” of that natural body; and 2) that thing resident in the body which is like the iron of the sword, that is, the “matter” of the natural body, the substratum. It is like the carrier of the form of the artificial bodies except that the form and the matter of the sword, the bed, the clothing, and the remaining artificial bodies are verified by the sight and the senses.

The forms of qualities and the matters of natural bodies are not tangible. We are certain of their existence only by syllogism and apodictic demonstration. The same is true of the many artificial bodies which lack a tangible form: For example, wine, which is a substance that is made artificially for the purpose of inebriation, is not perceptible to the senses; we become aware of its existence by virtue of its action. The inebriating quality of wine is its form just as the sharp pointedness of the sword is its form. The same is true of medicines which have been devised according to the art of medicine, such as antidotes and their like; these only have an effect on the human body by virtue of their composition; and they are not perceptible by the senses except as they produce a physical effect. All medicine is such as it is for two reasons: the mix, from which it is composed, and the virtue (means) by which it effects its cure. The mix is the material (matter) and the virtue is the form; and if the curative power of the medicine is removed, it is as if the sharp-pointedness were removed from the sword or the weave removed from the fabric. These things would cease to be what they were. In this way we should understand the form and matter of natural bodies. We perceive them not from the outside but through their effects; their effects become their matter and form and verify their existence. Other examples would be the eyeball and its capacity to see or the hand and its capacity to
grasp, or any other member of the human body; for the visual potential cannot be verified by any tangible side effect; it can only be apprehended intellectually (Alfarabi & Gonzalez, 1932, p. 60).

In this previous discussion, Farabi describes and accepts the Aristotelian doctrine of the four causes: material, formal, efficient, and final. The material cause describes the material out of which something is composed. For example, the material cause of a table is wood. It is not about action. The formal cause is the idea that one has before making or causing a human made (artificial) object to exist. This could be the idea or plan in the mind of the artisan or carpenter or engineer. The efficient cause is the “primary source.” It is what sets a thing in motion. For example, of two dominoes of equal weighting, the first is knocked over causing the second also to fall over. This is the efficient cause. The final cause is the purpose or telos or that for the sake of which a thing exists or is done. Modern notions of final cause can include psychological or affective states such as volition, need, rational, irrational or ethical motivation (Falcon, 2005).

Farabi defines several instances of a final cause such as the curative power of medicine or the inebriating capacity of wine. He is concerned to show that the purpose of a thing is its reason for being. Farabi also accepts the Aristotelian principles of potentiality and actuality. Potentiality refers to any possibility that a thing can be said to have (such as the capacity of the eye to see); actuality is a change or activity that represents a fulfillment of a possibility that has become real in the fullest sense (Aristotle, Ross, et al., 1947). As Aristotle wrote, “matter exists potentially, because it may attain to the form; but when it exists actually, it is then in the form (Aristotle & Sachs, 1999, p. 45). Farabi concludes his section on physics with
a discussion of the eight parts of this science, each of which refers to a work or pseudo work of Aristotle.

The physical science is divided into eight major parts: 1) the first treats of that which is common to all natural bodies—simple bodies as well as those compounded of elements. All of this part is included in the book entitled Physics by Aristotle.

2) This part is concerned with whether simple bodies exist, and if so, what kinds of bodies they are… It then examines the elements of the compound bodies, whether they exist in the simple bodies whose existence has been demonstrated, or are distinct bodies derived from them; whether they exist in the simple bodies but are not derived from them, or whether they constitute all or only a part of the simple bodies. It then examines what the simple bodies fit into, what things are elements and principles of the composite bodies, and what are not.

It is the study of the sky and its parts (treated in the second book of Aristotle’s On the Heavens). It studies then the properties of the parts that are not elements [of the composite bodies?] and of the principles and accidents inherent in these. This is the material of the second, third, and fourth book of On the Heavens (Alfarabi & Gonzalez, 1932, p. 62).

On the Heavens (De Caelo et Mundo) is Aristotle’s signal work on cosmology; it includes his astronomical theory and his ideas on how the earth works. Aristotle believed that the heavenly bodies are the most perfect realities (or “substances”) whose motions are ruled by principles different from those in the terrestrial sphere. The terrestrial bodies are composed of one or more of all of the four classical elements—earth, water, fire, air—and are perishable; the
heavenly bodies, in contrast, are made of imperishable ether and so are not subject to
degeneration or corruption.

As we have seen and will continue to see, Farabi accepts and imparts this Aristotelian
view without alteration. Of course, much of Aristotle’s cosmology was based on a faulty
premise and was therefore wrong. Like most philosophers of his time, he tried to understand the
world by reasoning logically and carefully from first principles. His first principle, vis-a-vis the
universe, was that the heavens were perfect and unchanging whereas Earth was imperfect and
changeable. Once this first principle was accepted as true, whatever could be derived from it had
also to be true. Such a line of reasoning, based on flawed premises, would lead to a host of
incorrect assertions that are outside the scope of this study. Suffice it to say, had Aristotle relied
more on the scientific method (for all intents and purposes not yet invented), with its insistence
on evidence and hypothesis, and/or had the use of more sophisticated instruments of celestial
observation been available to him, he might have arrived at a more accurate cosmology. We
return now to the remaining six parts of Farabi’s Physics.

3) This part is concerned with the generation of natural bodies and their
corruption (i.e., their passing away), as well as with the things peculiar to them.

4) The fourth part treats of the principles of the accidents of elements and the
peculiar effects of those elements considered individually in exclusion of those bodies
which are compounded of them.

5) The fifth part deals with the study of bodies compounded of elements, as
follows: Some of these bodies are of similar parts, some of dissimilar. Those of similar
parts are of two classes. There are some whose parts are composed of dissimilar parts,
like meat and bone. Others have no part but serve as a basis for a natural body of
dissimilar parts, for example, salt, gold, and silver.

6) This part is contained in the Book on Minerals. It treats of bodies which are
not composed of dissimilar parts. These are mineral bodies, stones, and the various
species of minerals and stones.

7) The seventh part is contained in The Book of Plants. It is concerned with those
things that the species of plants share and those things that are peculiar to each species.

8) The eighth part is contained in the Book of Animals and in the Book of the
Soul (both of Aristotle). It studies that which the different species of animals share and
that which is peculiar to each species.

Such then is a summary of what is studied in the science of physics, and these are
its parts and all that refers to the parts (Alfarabi & Gonzalez, 1932, p. 63).

We are aided in understanding Farabi’s outline of the natural sciences in the *Enumeration*
by referring to another of his books, *The Philosophy of Plato and Aristotle*, where he states that,
according to the hierarchic reality of the cosmos, plants and animals, including the human body,
are more complex and cannot be adequately described merely in terms of their natural or
physical properties alone. Plants and animals are endowed with higher (what he calls animate or
psychical) faculties. That is, they have a soul. The plant soul accounts for its capacity to grow,
reproduce, and obtain nutrition. The animal soul has still greater and more numerous faculties
than the plant (Farabi, Mahdi, Butterworth, 2001).

Farabi’s natural science classification, were it updated, would include many of the
sciences that fall under the broad disciplines of mineralogy, botany, and zoology. Of the
sciences related to mineralogy, he includes chemistry and geology but excludes alchemy and metallurgy. Likewise, he excludes agriculture, which is the most important science related to botany, and medicine, which is one of the most important sciences related to zoology. What all of these omitted sciences have in common is that they are largely practical in nature. As he has shown repeatedly, Farabi seems to value theoretical knowledge over practical, perhaps believing that knowledge of the former will permit apprehension of the latter.

**The Science of Metaphysics**

Farabi divides metaphysics into three parts: 1) Part one, ontology, or that which deals with “beings and their attributes insofar as they are beings” (Alfarabi & Gonzalez, 1932, p. 99). 2) Part two, which establishes the legitimacy of the subject matter of each particular theoretical science by using demonstrative proof (p. 99). For example, the proof that the point, the unit, lines, and surfaces are all part of mathematics and not some other subject. 3) Part three, which deals with “beings that are neither bodies nor in bodies” (p. 99). It demonstrates that incorporeal bodies exist, are many, and can be ranked hierarchically. The hierarchy culminates in God.

Part three also demonstrates that the universe is a unity and is hierarchically ordered. Farabi writes:

…the sciences, according to their multitude, rise up from the most imperfect to the most perfect, and the most perfect arrive at an ultimate limit of perfection, beyond which it is not possible to find anything that is more perfect … wherein is located the first being, before whom nothing else can have existed and besides whom nothing can have derived its cause. This is the first being, the absolute, the one and only … the uniter of all other
beings that are outside of him, the first truth, that gives truth to all other beings that have truth; and that demonstrates how this is done, and in whose being it is not possible that there be any plurality, nor for any cause nor reason; that demonstrates that He, in his actions, has no injustice, nor defect, nor doubt, nor bad conduct, nor bad proceeding … And, repudiates, at last, all erroneous opinions about God (May his praises be multiplied!); and destroys those errors with demonstrations that achieve such certitude that men can harbor no doubt, nor preoccupation, nor suspicion, nor possibility of separating themselves from Him for any reason (Alfarabi & Gonzalez, 1932, p. 64).

It is evident from the foregoing that Farabi considers metaphysics to be the most demonstrative and perfect of sciences. In all three parts of his metaphysics, Farabi follows Aristotle. Part one, “being qua being” is concerned with ontology in a general sense. As Aristotle put it, all of the other particular sciences “cut off a part of being and [investigated] the attributes of [that] part”. This is interesting because it describes the practice of specialization and studying things in isolation, both hallmarks of modern science. Classical Islam, in general, rejects specialization for a more unified approach to scientific inquiry (see Nasr, 2003, p. 22).

Part one of Farabi’s metaphysics also includes Aristotle’s “second substances.” These refer to the universal categories like existence, quiddity, unity, necessity, contingency, substance, and accident (Aristotle & Barnes, 1995). The “second substances” bring to mind Ranganathan’s Colon Classification which is based on semantic universals, namely, personality, matter, energy, space, and time (PMEST).

**Science of Society**
Farabi divides the science of society; let us call it political science, into two parts. Part one deals with the different kinds of human action, conduct, and ways of life. It is concerned with the concept of happiness, really the central theme of this chapter. It describes what true happiness is versus merely what men think that it is but are mistaken. True happiness is attainable only through right and virtuous actions. The pursuit of such things as wealth, honor, and sensual pleasure, as the only ends in this life, does not lead to true happiness, though it presumes to do so. In his only allusion to an afterlife in this section, Farabi explains that true happiness cannot possibly be of this life, but of another life after this. He says nothing more about this afterlife. According to Mahdi (1975), Farabi may be referring to the religious view of paradise or beatific vision or perhaps the philosophic view that man should not confine himself to the pursuit of vulgar goods—those things which are called good by the multitude—but, rather, seek a higher end, such as virtue or knowledge, and thereby lead “another” higher life in “this” life (p. 132). Farabi believed that a virtuous polity composed of ethically minded citizens could arise if the political leadership conducted its affairs in a reasonable (i.e., logical) manner. Virtuous behavior in the community, as in the individual, is viewed as founded upon rationality. “Ignorant” authority, on the other hand, may be effective for a time but, ultimately, will not lead to true happiness.

Political science distinguishes the virtuous citizens from those who are not; it makes known the governing functions by which the virtuous ways of life and actions are established and ordered among the citizens of the cities, and

...enumerates the activities by which to preserve what has been ordered and established among them. It then enumerates the various kinds of royal crafts which are not virtuous—how many
they are, what each one of them is, and what functions each one of them performs (Alfarabi & Gonzalez, 1932, p. 68).

The royal crafts to which Farabi refers here are just politics by another name. He acknowledges that all of this discussion is found in the book of Politics by Aristotle, the Republic by Plato, and other books by Plato and other authors. He remarks that all of the non-virtuous actions, habits, and customs of politics are like blight or plague on the virtuous actions.

He goes on to discuss the two different classes of authority or rulership. The first class concerns good authority, which makes virtuous behavior possible, and which leads to happiness. The cities that conform to this authority are good; ignorant authority, on the other hand, makes possible a kind of behavior that appears to lead to happiness but really does not. This second type of authority (the ignorant) comes in many varieties depending on the goal of the rulership (government). If the goal is mere riches, the authority is avaricious; if the goal is honor and recognition only, the authority is vain, etc.

Real authority or power is composed of two strengths: 1) the strengths founded in universal laws, and 2) the strengths that man acquires through experience in civil society. Farabi likens this twofold nature of authority to the physician who attains perfect competence either by 1) learning the general laws of medicine by reading books (theoretical knowledge), or 2) performing medical treatments over a long period of time on patients and observing the results. By virtue of this experience, the physician learns to administer medicine and treatment in the proper dose, according to the case.

In the same way, the ruler learns to calibrate his actions according to each accident, condition, city, or time. Farabi’s recounting of the rules of virtuous government here recalls his
earlier counsel (never stated explicitly but hinted at) to learn the rules of grammar in order to speak correctly or to learn the different parts of logic in order to formulate arguments correctly, according to the audience and the occasion.

Political science indicates all of the things that comprise good government. Some of these things are based on theory, some on practice. Theory and practice combined are a powerful force from which a body of laws can be devised that preserves and maintains a virtuous city or polity; and the virtuous city will endure only so long as the rulers are consistent in the application of the law throughout their ministries and from generation to generation.

The science shows, further, what traits and characteristics to look for in the sons of the rulers, so that they may be worthy of being elected king; and, how to educate them so that they become complete leaders who command real authority. Likewise, it is important not to nominate leaders whose authority is of the ignorant type. Those of the ignorant type do not need “either theoretical or practical philosophy”; they can run their cities on the basis of their wits alone, what Mahdi (1975) calls the experiential faculty and what the ancients (i.e., Aristotle) call “prudence” (p. 135). Farabi does not pass judgment on these ignorant types other than to say that they should not be elected to rule. They would appear to fall into the category of a certain kind of prince—amoral but gifted. Again, the description here recalls the “intuitive” grammarian or logician of chapters one and two—always able to uncover the truth or to utter a correct statement even without knowing “the rules.”

It would appear that the construction of the virtuous city, established and preserved by an enlightened body of rulers, and the education of that body, are the chief ends of political science. Farabi does not say whether political science is wholly practical or theoretical. It
appears to be a combination, or rather a culmination, of both. After all, the attainment of the virtuous city entails, in some respects, a mastery of all of the sciences enumerated so far. As Mahdi (1975) suggests, “it is political science or philosophy which includes, transcends, and rules all the ‘theoretical and practical sciences’” (p. 137). In this regard, we can see a progression or upward movement in the *Enumeration* from the sciences of language to the sciences of logic, to the science of mathematics, and on to natural science and political science. All of these are building blocks for that which follows. Though the metaphysics is the science of supreme intellect, it attains an even higher status when manifested in the collective of the virtuous city.

In terms of subject range, Farabi’s political science can be said to encompass anthropology, sociology, philosophy of law, practical psychology, ethics, and public administration. As such, it is the most comprehensive branch of the humanities (Bakar, 1998).

*Fiqh (Jurisprudence)*

The final two sections of the *Enumeration* are decidedly about religion; Mahdi (1975) claims that they are Islamic. For once, there is no obvious Greek model or source to which we need refer. Unlike many of the arts and sciences mentioned so far, the arts of jurisprudence and theology exist and are practiced in certain nations at certain times. They are based on divine law (*shar’ia*) and religions of a particular nation. There are of course many different lawgivers, religions, juridical disciplines, and theologies. Farabi is neutral on the value of each, declining to praise or condemn any as good or bad. Nor do *fiqh* and *kalam* investigate the truth or falsehood of the opinions given in any religion about God, his attributes, and the universe. This would have been the business of the third part of Farabi’s metaphysics, discussed earlier.
Farabi defines the art of jurisprudence as:

…that by which man can make a determination in respect of anything that is not heroically included by the lawgiver in his definition of the law; by means of other things which were explicitly determined and defined by the lawgiver.

A jurist should strive to infer correctly the intention of the lawgiver who legislated for the nation to which he gave that religion.

In any religion, there are dogmas [opinions] and operations [actions]. Dogmas are, for example, the affirmations established in respect of God (glorified be his name!) or his attributes, or in regard to the world and similar things. The operations are, for example, the acts with which one honors God and those other things by which one obtains the compliance of the cities. For this reason, the science of law has two parts: That which treats of dogmas; and the other which treats of operations (Alfarabi & Gonzalez, 1932, p. 72).

One can interpret the two parts of law—opinion and action—as corresponding to theory and practice though Farabi does not refer to them in this way. Farabi has no more to say about jurisprudence, to which he devotes just two paragraphs. His definition of the subject, however, is not unlike modern definitions of *fiqh*—described as being a methodology by which Islamic law is derived from primary (namely, the Quran and hadith) and secondary sources (i.e., the rulings of Islamic jurists) (Souaiaia, 2005).

*Kalam* (Dialectical Theology)

Finally, we arrive at the end of the classification with a description of *kalam* or dialectical theology. *Kalam* is a kind of religious rhetoric which arose out of the need to systematically
defend the tenets of religion against attacks from, for example, the proponents of other religions (Bakar, 1998, p, 146). It is akin as a discipline to apologetics. Farabi describes it as the art by which to defend (using reason) the dogmas and acts mentioned under jurisprudence and to condemn all of that which is opposed to these. Kalam is also divided into two parts; like jurisprudence, the one part dealing with dogmas, the other part with operations, as indicated by the founder of the religion. The alfaqui [doctor of Muslim law or priest] accepts the dogmas and operations prescribed by the founder of the religion without question and takes them as principles upon which to deduce things of the religion. The mutakallimun [theologian] defends the principles established by the alfaqui, without deriving from them anything that is new. And if it should be the case that one person fulfills the function of both alfaqui and mutakallim, then this person will defend (the principles) as theologian and deduce from them (practical rules) as alfaqui.

Concerning the methods and ideas with which it is suitable to defend the religions, some mutakallimun maintain that the dogmas and precepts of religion cannot be subjected to criticism by means of ideas, opinions, and human reason because they are of a superior grade to these, being of a divine cause and therefore containing divine mysteries which are simply beyond the capacity of human reason, being weak, to comprehend. Farabi goes on to say that:

In effect, those things, established by the religions, that offend our reason and our principles, are not in reality worthy of being denied nor are they absurd; but, rather, they are true according to theological understanding. This is so because man, though he reaches the limit of human perfection is, with respect to one blessed with theological understanding, like a child and fledgling youth in relation to a perfect boy; and, as such, like many boys and men who lack
expertise, denies many things that, in reality, should not be denied, that are not impossible, though he believes that they are (Alfarabi & Gonzalez, 1932, p. 75).

This analogy recalls an earlier one in the chapter on logic where Farabi describes the logical faculty of a child as extant but still fledgling and inexpert. He concludes:

This, then, is the situation of those who arrive at the limit of human perfection in relation to theological understanding. The same occurs when man, prior to becoming educated, denies many things and detests them, and imagines that they are absurd; and when he is educated in the sciences and receives instruction through experience, he leaves behind such opinions, and the things that appeared to him as absurd are transformed and are seen as necessary; and now, having defined these things, he wonders at the contrary of what he had at first wondered (Alfarabi & Gonzalez, 1932, p. 76).

From the foregoing, we see Farabi outlining two paths to divine understanding or divine intellect. One path proceeds through prophecy and revelation; the other through education in the sciences and practical experience.

According to Farabi, theologians are of the opinion that it is important to demonstrate the truth of religions. There are two ways that a prophet can do this:

Either through the performance of miracles or on the basis of testimonies of credible persons who have come before and whose words, guaranteeing the prophet’s truthfulness and character as a representative of God are trustworthy; or by both ways together. When we have certified, by these methods, the truthfulness of the prophet, then there can be no doubt as to the truth of what he has said, nor recourse to reason, reflection, opinion, or rationale. These, then, are the
ways in which the theologians believe that religions are to be defended (Alfarabi & Gonzalez, 1932, p. 77).

Notice how Farabi ascribes these ways of defending religion to the theologians. He declines to say whether he shares their views or not.

Different mutakallimun will defend religions in different ways. Some will fixate on all of the dogmas which the founder of the religion has imposed, using the same words to express the dogma that the founder used; next, they will examine the tenets of the religion on the basis of what they observe, on consensus opinion, and according to the dictates of reason; and, if they discover any self-contradicting aspect of the doctrine, they will interpret it metaphorically, so that it comes into harmony with the religion. As Farabi says:

If the tenets of the religion generally admitted by consensus opinion and by sense evidence contradict one another, then the theologians will look to see which view has more probative value in favor of the dogma, and so accept it and discard the other and condemn it. If it is not possible to interpret the text of the religion in such a way as to harmonize any contradictions that may arise, then the theologians will say simply that the dogma is true, for the one who expressed it cannot have spoken an untruth nor been wrong. This, then, is how the theologians defend the religions (Alfarabi & Gonzalez, 1932, p. 77).

Another group of theologians believes that it is possible to defend the parts of religious dogma that are supposed to be reprehensible by examining in depth all of the other religions and by gathering from them the reprehensible parts, such that; if a sectarian from one of these other religions tries to refute some dogma that is found in the religions of the theologians, they will turn and present to him the condemnable parts of his own religion, and thus send him away.
Farabi asserts repeatedly that these are the methods of the theologians. We are left to wonder whether he approves of their methods or not. He seems to be impartial. Finally:

Others, considering their religion to be true and having no doubt as to its truth, are of the opinion that they must defend it against the others by praising it as the best and suppressing those things in it which are reprehensible, and rejecting its enemies by any means that may come to mind. They… employ mendacity and sophism to reject and defeat [their enemies]… (Alfarabi & Gonzalez, 1932, p. 78).

This final paragraph here recalls the practice of *taqiyya*, which means literally, caution, in Arabic but is used to dissimulate or to conceal one’s faith when under duress. The practice actually originates in the Quran (3:28), which holds blameless those who disguise their beliefs when in danger. Of course, the Quran permits dissimulation as a means to safeguard one’s personal safety in the presence of unbelievers. Farabi seems to be describing the use of dissimulation for the purpose of manipulating non-believers. In either case, the use of mendacity is considered legitimate.

**Positive and Pragmatic Strains in Farabi’s *Fiqh* and *Kalam***

The *alfaqui* (doctor of Muslim law) accepts the dogmas prescribed by the founder of the religion without question and “uses [these] as principles upon which to defend things of the religion” (Farabi & Gonzalez, 1932, pp. 72-73). He demonstrate the truth of religions “on the basis of testimonies of credible persons who have come before and whose words, guaranteeing the prophetic truthfulness and character as a representative of God, are trustworthy” (p. 72).
These words describe reasoned argument and discourse and reliance on logical argument advanced by persons of high moral character and ethical standards. The whole subject of fiqh or Islamic jurisprudence is described in terms of laws, but these are not scientific laws; they derive from prophecy, are theological or metaphysical and have no basis in positivism. Farabi continues: “When we have certified by these methods, the truthfulness of the prophet, then there can be no doubt as to the truth of what has been said, nor recourse to reason, reflection, opinion, or rationale” (Farabi & Gonzalez, 1932, pp. 72-73). These words echo earlier definitions of rhetoric and polemics from chapter two, on logic. Farabi continues:

… [The] knowledge of the religions teaches man something whose comprehension is beyond our understanding. If it were not thus, [we] would need neither prophecy nor revelation nor would either of these exert any sort of effect upon [us]. There are those who will defend the religion by any means necessary. They will use lies, sophism, and calumny or disdain because, in their judgment, those who oppose their religion are either their enemy, in which case it is permissible to employ mendacity and sophism to reject and defeat them… (Farabi & Gonzalez, 1932, p. 73).

The use of “mendacity”, “sophism”, “calumny”, in short, any stratagem that can be of service in defending the religion; all of these are admissible and can be construed as pragmatic.

CHAPTER SIX

SUMMARY OF THE ENUMERATION
Judged in its entirety, the *Enumeration* appears strongly hierarchical and based upon age-old notions of sequential learning. With some exceptions, the classification proceeds from a consideration of the elemental to the complex; hence the beginning chapter on the science of language. Presumably, without a proper understanding of language, the seeker of knowledge will fail to grasp the faculty of logic and the syllogism and from there the mathematical and applied sciences. Metaphysics and political science, of greater complexity still, are further along the educational continuum.

Each science in the *Enumeration* is broken down into constituent parts which are hierarchically ordered. In chapter one, for example, “On the Science of Language”, syntax precedes grammar which precedes pronunciation, speech, and, finally, poetry. Poetry, coming at the end, can be understood to be the most abstract and inspired form of language.

Chapter two, on logic, begins with the rules governing simple ideas and expressions, corresponding to Aristotle’s Categories. The Categories enumerate all the possible kinds of things that can be the subject or predicate of a proposition. As such, they constitute the backbone of logical, indeed of philosophical, thought.

From simple concepts, ideas, and expressions, Farabi proceeds to the rules governing the syllogistic arts. Presumably, knowledge of basic ideas or categories is prerequisite to understanding the syllogism.

Chapter three, on mathematics, begins with simple arithmetic, proceeds to geometry, and is followed by optics and the science of the heavens. Optics in the Middle Ages was considered a form of geometry. Interestingly, the study of optical devices appears as a subdivision under Engineering, at the end of the chapter. Optics, in general, is a theoretical concern; when related
to devices, it becomes practical. As mentioned earlier, algebra is named but not discussed in the chapter on mathematics; a most peculiar omission given the cardinal significance of this subject and the powerful Islamic pedigree surrounding its invention.

A pronounced rationalism runs through the *Enumeration* as exemplified by the author’s exclusion of certain so-called esoteric sciences—e.g., alchemy, dream interpretation, agriculture and, most intriguingly, medicine—from his classification. This is curious given that these “sciences” were notable for their popularity and for having attracted the participation of many of the great minds of Islam. Al-Kindi (801-873), for example, known as “the philosopher of the Arabs”, was, among other things, a great physician. Indeed, Islamic medicine is one of the best known facets of Islamic civilization and a branch of the sciences in which Muslims excelled (Nasr, 2003). The wise man or *hakim*, traditionally a central figure in the Islamic transmission of the sciences, was usually also a physician.

Farabi’s exclusion of medicine from his scheme may have to do with an underlying, if unstated, skepticism towards the subject. Not everyone in the Islamic world had complete faith in the medical art. Many, especially among the Arabs, were distrustful of the power of the physician to cure the illnesses of the body (Nasr, 2003). Furthermore, the medical arts were largely imports from foreign sources. Islamic medicine had come into being as a result of the integration of the Hippocratic and Galenic traditions of Greek medicine with the theories and practices of the Persians and Indians (p. 188). It is also true that Islamic medicine was closely allied with alchemy, another of the “esoteric” sciences. Interestingly, alchemy sought concrete causes for individual phenomena rather than the general causes sought by Peripatetic “natural philosophy” (Waite, 1926).
Farabi was very much of the Peripatetic school. By rethinking Greek philosophy in terms of Islamic doctrines, or vice-versa, it might be more accurate to say, he established the basis for Peripatetic philosophy in Islam. The main tendency of the Peripatetics was a reliance on the discursive faculty and the syllogistic method (Nasr, 2003). This tendency conforms with Farabi’s rationalist approach to classification.

A recurring theme in the *Enumeration* is the organization of the sciences into practical and theoretical dimensions. Often the split is stated explicitly in the heading of the chapter; other times in the opening paragraphs; and, sometimes it is referred to obliquely by way of analogous terms. Farabi’s reduction of the sciences into theoretical and practical domains derives from Aristotle’s view that “all science (dianoia) is either practical, poetical, or theoretical” (Aristotle & Ross, 2000). For Aristotle, the practical sciences included ethics and politics; the theoretical sciences included physics and mathematics; and the poetical sciences meant the study of poetry and the other fine arts.

Farabi does not allude to a “poetical science” but his dividing of subjects along practical and theoretical lines occurs more frequently than with Aristotle. For example, he explicitly divides arithmetic, geometry, and music into theoretical and practical sides. His science of weights and of engineering can be termed entirely practical. His metaphysics is completely theoretical and his political science combines theory and practice.

Theoretically, the *Enumeration* can be viewed in terms of its status as exemplar of good science. The same is true of the DDC and of other classifications of historical import. According to Kuhn (1962), a mature science experiences phases of normal science and revolutions. In a normal science, key theories, instruments, values, and metaphysical
assumptions are relatively fixed. In a revolutionary phase, the science undergoes revision, in order to permit the solution of anomalous problems that have disturbed the established order.

By introducing Greek science into Islam, under the guise and outline of the *Enumeration*, Farabi altered the established order of knowledge classification, insofar as such an order existed at the time. Foreign knowledge was in some ways indispensable to the growth and development of the Islamic polity. Rapid military conquest had fostered a concomitant need for scientific and cultural advancement. By writing the *Enumeration* in such a way as to achieve consensus among Islamic grammarians, religious authorities and, subsequently, Latin scholastics, Farabi succeeded in changing the paradigm of knowledge classification.

By inaugurating a new tradition in classification, then, Farabi achieved for his scheme the status of scientific exemplar in its time. The *Enumeration* embodies an approach to classification that is at once Islamic and fundamentally Western. By adopting some of the principles that underlie this universal, if at times archaic, classification, scholars of both Islamic and Western affinities can work in closer alignment with a broader scientific community that neither discourages nor overstates specialization.

**Consideration of Findings in Comparison to Theory**

In framing a theory for this study, I invoke the doctrines of positivism, pragmatism, and literary warrant. Positivism emphasizes facts, logical deductions, and formal models; pragmatism encompasses goals, purposes, interests, and values. Literary warrant means that the vocabulary of a subject language—or the content of a classification—must be empirically derived from the literature it is intended to describe. The *Enumeration* aligns with all three of these theories, as do the DDC and the LCC. By comparing tabular data, I have tried to show
where content from the *Enumeration* matches that of the predominant classifications of today; the DDC and LCC.

**Positive Findings in the *Enumeration***

In the *Enumeration*, Farabi explains how the syllogistic method or logical deduction is the surest path to true knowledge. Though he does not describe parts of propositions as “variables”, he does invest in them a kind of scientific function that is akin to what variables do. To the extent that he does this, he is advancing a positive method. Farabi classifies and hierarchizes many subjects in his scheme according to how “syllogistic” they are. Here, I equate the word “syllogism”, which denotes an exact form of reasoning, to positivism.

Farabi defines subjects and assigns “classificatory value” to them in terms of their resemblance to the highest form of reasoning, namely the syllogism. This is a positive approach to classification that is, at once, Aristotelian, Western, and, since undertaken by a Muslim of established credentials, also Islamic.

**Pragmatic Findings**

The pragmatic view concerns “goals, purposes, interests, and values” (Hjorland & Pederson, 2002, p. 585). The *Enumeration* appears to fit this description. Farabi declares his goals and purposes in the introduction to the text, saying: “In this book, I propose to give a survey of the known sciences one by one and to try to know the contents in general of each one of them, then to know the divisions where this applies and what comes under each division” (Farabi & Gonzalez, 1932, p. 5).
The *Enumeration* was written to define and enumerate the “known sciences” and to indicate the proper course of study for scholars. Those are two of its purposes (see table #11, p. 125 for a further listing). The DDC has its purposes as well (see table #11).

In assigning value to knowledge, Farabi was mindful not to offend the grammarians or religious authorities of the time, both of whom were liable to condemn his eager adoption of Greek science and philosophy. Through his dispassionate yet persuasive exposition of the Greek *oeuvre*, Farabi managed to broaden the scope of Islamic epistemology, while rising to the level of, even surpassing, other “cognitive authorities” hitherto more imposing than himself. Dewey, in his promulgation of the DDC, accepted implicitly, and incorporated into his work, the cultural and intellectual *zeitgeist*, but still managed to produce an original and effective classification.

The purpose of this classification then can be described as providing a survey of existing human knowledge and arranging it in such a way as to establish a framework for epistemological growth. Farabi seems to be interested in actualizing the entire Greek corpus (as known to him) within the Islamic worldview. He does not so much incorporate Islamic subjects into his typically Aristotelian scheme as add them in the form of appendixes. We see this in the case of the final two sciences of the book—jurisprudence (*fiqh*) and dialectical theology (*kalam*). These are left dangling at the end. It is true that they follow political science, to which they bear some affinity. Nonetheless, the modulation from one to the other is not altogether natural.

Furthermore, we are left with the impression sometimes that Farabi does not possess sufficient confidence in those sciences to which Muslims were major contributors, such as algebra, medicine, geography, agriculture, astronomy, and ophthalmology, as to highlight them.
in his classification. He mentions the Muslim contributions cursorily or omits them entirely. For such an eclectic thinker as Farabi was, this oversight seems likely to have been intentional.

Farabi displays a marked tendency towards generalization, abstraction, and compartmentalization in his classification. Clearly, his intent was to classify and define knowledge in a general way. Perhaps he felt that this would yield the best guide for knowledge seekers in the pursuit of their goals. His generalized objective is understandable given the need to establish a starting point for learning. However, his neglect to cite particular Islamic sciences is not helpful to the development of future classifications. In particular, he ignores the Islamic commitment to serving religious truth within the context of the newly acquired sciences. For example, he distinguishes between political science and the science of jurisprudence. He cites jurisprudence as a science which serves the purposes of religious (Islamic) law, but he quotes political science in a context that is alien to that purpose. He conceives of political science as concerned with the rulings of the human mind outside the teachings of Islamic law (al Najjar, 1964). In Islamic culture, there is no distinction between civil knowledge and jurisprudence, unless one thinks that governmental and administrative affairs are not the business of Islamic law. This separation of civil and religious is an example of Farabi’s compartmentalization and is contrary to the reality of Islam as a comprehensive way of life.

**Literary Warrant in the Enumeration**

A parenthetical note: the subject of this dissertation, Farabi’s *Enumeration*, appears in the OCLC database, but without a DDC class number. This would appear to violate the literary warrant of the DDC, namely, to include in the classification all items which appear in the DDC collection.
Farabi’s *Enumeration* was designed to include the “known sciences.” In other words, the “known sciences” are the literary warrant of Farabi’s scheme. Essentially, the “authority” that Farabi invokes in deciding what the “known sciences” are derives from his knowledge and interpretation of Greek science and logic. The DDC, LCC, and *Enumeration* are all founded on Western, ultimately Greek, sources of knowledge. This is not to say that any of these schemes is limited to Mediterranean epistemology; merely, that the principles that inform their original design are, to a large degree, Western in origin.

The literary warrant of Farabi’s *Enumeration* was in large measure the Greek corpus of science and philosophy, transliterated for an Islamic community. The warrant of the *Enumeration* differs from that of the DDC or LCC in that it was not invoked with a particular library collection in mind. Rather, it was meant to serve as a knowledge template for a broad based, even universal, community. The Farabi warrant was powerful in that it was based on some of the most legitimate knowledge claims available at the time; it was also, in part, exclusionary in its indifference to non-Greek, namely, Islamic, knowledge claims. Another semantic component of Farabi’s classification is its qualitative ranking system, whereby subjects are admitted to the scheme on the basis of their nobility (approximation to mathematical purity), methodological rigor, and practical utility (see table # 12, p. 127) for further explanation of ranking criteria).

Farabi’s *Enumeration*, then, is replete with concepts that converge with Western classifications. Far from being a source of discouragement for Islamic scholars, these connections, if acknowledged, can serve as a tonic for Islamic scholars generally, opening new avenues for research and restoring old ones.
Farabi discloses his ideology or set of objectives in the introduction to his text. He claims that the *Enumeration* will teach what a particular science is about, where to begin study of a science, how to determine the benefit or utility of a science, alone and in comparison with other sciences, and how to test the knowledge of another person in relation to a science. Apparently, Farabi’s proposed scope far exceeds that of most modern classifications. The DDC, for example, was designed primarily to improve economy (simplicity) and utility in the search for bibliographic material, while giving a fair representation of the world’s knowledge. Its goals were pragmatic though its scope was universal. Farabi actually attempts to define in some depth the epistemology of his age, something no modern classifier(s) would have ventured to do.

In addition to enumerating the “known sciences”, Farabi defines all of the disciplines in concise narrative form. As such, the *Enumeration* becomes a primer and introductory text book of sorts, in addition to being an outline and Islamic syllabus of the sciences. Much of the *Enumeration*’s content is drawn from Greek sources, especially Aristotle, whose ideas on logic, physics, metaphysics, politics, and cosmology are reproduced with some alteration.

Farabi transmutes the Aristotelian *Organon*, Euclidean geometry, Ptolemaic astronomy, and Platonic political philosophy into a short Arabic compendium. Had he done nothing else, this would have registered as a significant achievement. But he goes further, adding sections on language, grammar, music, and of course jurisprudence (*fiqh*) and theological rhetoric (*kalam*). His exposition of these subjects is less “Greek”, though I would hesitate to call it thoroughly Islamic. Perhaps it is a harbinger of a more mature Islamic thought yet to come. After all, Farabi was only the most prominent of a “second generation” of Islamic philosopher
scientists, the first generation being represented by al-Kindi. The development of Islamic divine philosophy and science was still emerging from its nascent stage.

Perhaps the chief objective of Farabi, as an author and thinker, extending beyond the *Enumeration*, and encompassing the sum total of his work, was to outline a theory of happiness. He devoted a treatise to this subject called *Attainment of Happiness* and his most famous work—*The Virtuous City*—is a culmination of his thought on happiness within the collective or community. Chapter five of the *Enumeration*, on political science, can be read as an outline of *The Virtuous City*. Drawing from Aristotle, Farabi asserts a strong correlation between ethics and the theory of knowledge. Ethics or virtuous behavior is posited as closely related to happiness. Therefore, we can read Farabi as holding the view that speculative philosophy (knowledge) and practical philosophy (virtuous behavior and mastery of the practical sciences) are the two prerequisites of man’s happiness in this life (Fakhry, 1965).

It is beyond the scope of this study to pursue the origins of Farabi’s conception of happiness. It is enough to cite it as an integral part of his ideology, a theory that is founded upon the various practical, theoretical, religious, and rational strains that constitute the *Enumeration of the Sciences*. Farabi explains his view of happiness in his book, *The Political Regime*:

Happiness is the good without qualification. Everything useful for the achievement of happiness or by which it is attained, is good too; not for its own sake, however, but because it is useful with respect to happiness; and everything that obstructs the way to happiness in any fashion is unqualified evil (Farabi & Najjar, 1964, p. 45).

Farabi’s ideology is also based upon his hierarchical conception of the sciences, mentioned earlier in the literature review. He defines the excellence of a science or art by virtue
of three possible criteria: the nobility of the subject matter, the profundity of the proofs, or the immensity of the benefits (see table 12, p. 127). He cites the religious sciences and the crafts as excelling because of their immense benefits. Interestingly, he places the religious sciences alongside craftsmanship on the basis of practical value. Those sciences that excel because of the profundity of their proofs are like geometry. As noted earlier, the rigor of geometrical proofs was generally admired as perfect. The more that a science approximated this kind of rigor, therefore, e.g., optics, the higher its position in the hierarchy.

Those subjects which excel because of their nobility are like the celestial bodies, generally considered perfect in an ontological sense. Farabi systematically describes the hierarchy of beings in terms of intelligence, soul, and effusion or emanation from God. His ontological theory draws from Plotinian cosmology, Aristotle, Ptolemy, and other sources (Bakar, 1998). It is not based upon an evolutionary chain and may be considered premodern.

Convergence of the Enumeration with the DDC

In the following four tables, I classify numerous attributes of the Enumeration and the DDC according to four different criteria, namely:

1) Ideology;
2) Processes;
3) Problems to be solved;
4) Body of knowledge

These criteria are borrowed from Svenonius (2001), who considers them requisite to the construction of effective classifications. I would classify criteria one and two—Ideology and
Processes—as positive categories insofar as they concern governing rules. Criteria three and four are more pragmatic in orientation.
Table 9  
Processes

<table>
<thead>
<tr>
<th>Processes:</th>
<th>Enumeration</th>
<th>DDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Such as those provided by linguistic concepts or entity-attribute-relationship models.</td>
<td>• hierarchical;</td>
<td>• decimal division;</td>
</tr>
<tr>
<td></td>
<td>• enumerative;</td>
<td>• hierarchical;</td>
</tr>
<tr>
<td></td>
<td>• literary warrant;</td>
<td>• enumerative;</td>
</tr>
<tr>
<td></td>
<td>• classification by discipline;</td>
<td>• literary warrant;</td>
</tr>
<tr>
<td></td>
<td>• broad;</td>
<td>• classification by discipline;</td>
</tr>
<tr>
<td></td>
<td>• non-numeric</td>
<td>• synthetic;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• mnemonic;</td>
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<tr>
<td></td>
<td></td>
<td>• “close” (i.e., uses many sections to generate specific subjects);</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• abridged DDC is “broad”; rarely uses more than five numbers;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The concept of relative location;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• relative index</td>
</tr>
</tbody>
</table>
Table 10
Body of Knowledge

<table>
<thead>
<tr>
<th>Body of knowledge:</th>
<th>Enumeration</th>
<th>DDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gained through research, particularly as expressed through broad generalizations about the design and use of the system, and</td>
<td>• Designed according to canons which are exactly those which Aristotle contributed to the science of logic.</td>
<td>• Heavy emphasis on knowledge created and disseminated in Europe and North America, 19th century Christian and Western biases (have made some attempts to remove).</td>
</tr>
<tr>
<td></td>
<td>• Based on Peripatetic natural philosophy, which favors rationalism, the discursive faculty, and the syllogistic art.</td>
<td>• Conceptually, based on knowledge classification of Francis Bacon (in inverted order) (see p. 24 for further explanation).</td>
</tr>
</tbody>
</table>
### Table 12: Farabi’s Three Criteria

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Method</th>
<th>Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>If the knowledge is to be organized intelligently and the system is to advance.</td>
<td>Forged a union of logic and language by positing syllogism as the form to which all rational argumentation could be reduced.</td>
<td>Solves the problem of fixed location by introducing the principle of relative location.</td>
</tr>
<tr>
<td>The celestial bodies are considered by Farabi to be the most perfect entities and, therefore, the most “noble”.</td>
<td>A subject that excels others because of the “profundity” of its proofs is like geometry. In general, Farabi conceived of three kinds of proof, each admitting of a degree of certainty: Syllogism, Induction</td>
<td>As for the science or art which excels others because of the immensity of its benefits, it is like the religious science (shari’ah) and the crafts needed in every age by every nation.</td>
</tr>
<tr>
<td>Farabi speaks of a “hierarchy of being in terms of intelligences and souls and their effusion or emanation from God” (Bakar, 1964).</td>
<td>Universalized logic as tool of reason.</td>
<td>Interestingly, Farabi considers religious science to be excellent on account of the problem of finding exact location of a topic.</td>
</tr>
</tbody>
</table>
In another scheme, he gives the following hierarchy, in order of perfection:

- God who is the cause of the existence of all other beings;
- The angels which are completely immaterial beings; the celestial bodies; the terrestrial bodies (Farabi & Druart, 1981).

- Rhetorical
- Demonstrative syllogisms are composed of premises that are true, primary, and necessary (Farabi & Dunlop, 1999).
- Induction refers to the examination of a subject to determine whether a predicate or judgment made about that subject applies universally, or not (Rescher, 1963).
- Rhetorical proof is not, strictly speaking, syllogistic because it omits a premise. (Farabi & Dunlop, 1999, p. 231).

In table 12, above, I explain how Farabi determines hierarchical rankings of subjects within a classification. In deciding which sciences to include in his classification, Farabi follows three major criteria, which may be described as follows:

1. Ontological standing;
2. Methodological rigor;

These three criteria constitute Farabi’s literary warrant insofar as they represent “the authority [that] a classification invokes first to justify and subsequently to verify decisions about what classes/concepts to include in the system…” (Beghtol, 1995).
Problems of Contemporary Islamic Classification

As mentioned earlier in my Problem Statement, many Islamic scholars are of the belief that “Western classification schemes lack the adequate room for Eastern/Oriental fields of knowledge, languages, and literature” (Idrees & Mahmood, 2009, p. 1). Islamic scholars chafe at the narrow notation (i.e., 297) afforded Islam in the DDC versus the almost 70 notations (220-289) specified for Christianity. Efforts to correct the shortcomings of the DDC vis-a-vis Islam are of three types: 1) Expansion of the 297 notation (see Shafi, 1962; Ibrahim, 1982; Riazuddin, 2002; Khan, 2004 for examples). Attempts to incorporate some of these expansions into the DDC proper have, so far, been unsuccessful; 2) Amendment of the original organization of the DDC’s class of religion (substituting Islamic notations for those originally allocated to Christianity) (see Sabzwari, 2007); 3) Development of a new, comprehensive classification scheme for Islam (see Rehman et al., 2003).

Each of these approaches offers solutions and exacerbates certain problems. Expansions leave the basic DDC intact while elongating a specific notation. This adds relevant and more evolved search terminology to the classification but it does not liberate Islamic studies from the 297 shell nor does it level the playing field with the other 70 “Christian” notations. The amendment approach, which replaces the Christian notations under the DDC’s class of religion with Islamic subjects, certainly levels the playing field, creating in the process a new sort of bias. This might be acceptable for collections of predominantly Islamic material. The third approach, the creation of a wholly independent Islamic classification, represents the most radical but, in some ways, the most appropriate solution. It is also the solution favored by most Islamic scholars, according to recent surveys (see Idrees & Mahmood, 2007).
Creating an independent, domain specific, classification would be a daunting task from an organizational standpoint and would signify a departure from the goal of universalizing Islamic studies via mainstream classifications. However, it would not be without precedent. There are many domain specific classifications which serve the needs of both specialized and lay clientele. The National Library of Medicine Classification (NLM) (which resembles the LCC), the British Catalogue of Music Classification, and the Computing Classification System (CCS) are notable examples. The strength of domain oriented classifications lies in their fidelity to a particular scientific or discourse community. They are highly subjective and self-contained. Of course, they may be used alongside, or even inserted into, more universal classifications. Nonetheless, their purpose is to describe in precise detail a specific subject area. Their goal is not a classification that will best suit everyone everywhere (Miksa, 1998). Their concern for underlying commonalities across disciplines is nil.

One very important distinction between early Islamic classifications and those under development today has to do with scope. A review of the literature of proposed expansions shows a consistent concern for single notations, like the 297 in the DDC, or the KBP (Islamic Law) in the LCC. This stands in contrast to early Muslim schemes, like Farabi’s, which sought to survey and enumerate the “known” sciences. Islamic scholars today are concerned with a much smaller segment of knowledge; namely, that which pertains to Islamic religious tradition. A proposed expansion (see below) by Eraqi (1985) illustrates the subjects of interest to Islamic scholars.

*Table 13*

*Expansions to Dewey Class 297*

<table>
<thead>
<tr>
<th>Notation</th>
<th>Class description</th>
</tr>
</thead>
</table>


Absent is any preoccupation with mathematics, in a theoretical or applied sense; or with language, music, physics, or political science. All of the sciences that once so captivated the Muslim mind have been separated from the more pressing matters of the faith tradition. Of course, this does not presuppose a diminution in the number of Muslim scientists working in any number of fields. Merely, that the goal of constructing a generalized classification of knowledge from an Islamic perspective is no longer pursued. In other words, the purview of Islam has shrunk in accordance with a reduced role in world affairs.

**Future Directions**

The question arises as to what reforms Islamic classification should undertake going forward. Should Islamic studies be confined to the subjects listed in the table above? Or, should a more ambitious classification be attempted? A more ambitious scheme would seek to reintegrate all of the sciences under an Islamic rubric. This would approximate a kind of updating of Farabi’s *Enumeration*; it should be said, parenthetically, that what Farabi ended up
accomplishing was more of a grafting and adoption of foreign sciences on to a mostly clean slate, rather than a true integration.

It is also appropriate to ask whether an explicit and systematically worked out Islamic epistemology still exists and, if so, how does it differ in orientation from Western epistemology? Scientific knowledge, comprising natural and physical sciences, has been sought and developed by Muslim scientists and mathematicians since the end of the seventh century. Nonetheless, since the advent of modern science, Islamic scholars have been confronted with “the question of the validity of the knowledge derived from sources external to Islam and the methodological adequacy of the four traditional sources of jurisprudence: the Quran, the dicta attributed to the Prophet (hadith), the consensus of theologians (ijima), and juristic reasoning by analogy (qiyas)” (Talattof, Moaddel, 1999, p. 1).

Some intellectuals have sought to align Islamic sources of knowledge with prevailing standards of scientific rationality and modern social theory (Talattof, Moaddel, 1999). There continues to be debate and disagreement between scholars as to how best to interpret modern scientific thought within the context of Islamic historical and religious perspectives. In a similar vein, classifiers of Islamic studies differ in their reform efforts, with some preferring expansion to existing schemes and others amendment or development of an independent, domain specific classification.

From a Muslim perspective, any future link between Islam and Western science must be rooted in the Quran on the one hand, and a global discourse between Western science and religious thought on the other hand (Iqbal, 2002). If a classification is to be developed within the framework of the Islamic worldview, it should have a holistic appeal and be premised “on the
unity of nature, which is an indication of the unity of nature’s Creator. The idea of unity of the creator is the fundamental principle of Islam and overwhelms all other ideas” (Golshani, 2000, p. 609). The Islamic outlook seeks to demonstrate the interrelatedness of all parts of the universe. This objective was pursued by Farabi in the *Enumeration* but only partially achieved due to an emphasis on Greek, at the expense of Islamic, science.

Of course, sound scientific method requires that empirical data be gathered, examined in detail, and interpreted within a specific context. This entails a division of knowledge into various disciplines. The challenge, therefore, is to not forget the whole at the expense of the parts.

In the view of many Islamic scholars, modern science has neglected teleology, thereby engendering the view that the world has no purpose, or that believing in a purpose, other than utilitarian or temporal, is futile. The Quranic view, however, holds that the world has a telos, and that one should not neglect this aspect of existence. Says the Quran: “do they not reflect in their own minds? Not but for just ends, and for a term appointed, did Allah create the heavens and the earth and all between them. Yet there are truly many among men who deny their meeting with their Lord” (Surah Al Ram 30:8).

Future research should continue to explore trends in Islamic classification, especially of the broad type, where less work has been done. Numerous studies regarding proposed expansions to notations have already been published, though their impact has been marginal. Large classification enterprises, like the Library of Congress, employ subject specialists in-house for the purpose of maintaining and updating all of the notations.

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Notation</th>
<th>Class description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>900</td>
<td>World, continents: geography and history</td>
</tr>
<tr>
<td>2.</td>
<td>900</td>
<td>Oceans: geography and history</td>
</tr>
<tr>
<td>3.</td>
<td>800</td>
<td>Literature</td>
</tr>
<tr>
<td>4.</td>
<td>800</td>
<td>Language</td>
</tr>
<tr>
<td>5.</td>
<td>700</td>
<td>The arts</td>
</tr>
<tr>
<td>6.</td>
<td>(700)</td>
<td>The arts</td>
</tr>
<tr>
<td>7.</td>
<td>600</td>
<td>Technology</td>
</tr>
</tbody>
</table>
This is the kind of Islamically oriented but outward looking classification that is likely to excite the imagination of a wider range of scholars outside the narrow bounds of exegetic theology and religious customs and traditions.

**Conclusion**

When I began this study, I was of the view that examination of the *Enumeration* would yield solutions to the problem of marginalization affecting Islamic studies. I have not abandoned that view but I have modified it after a close reading of the text and a more informed consideration of contemporary Islamic classifications. I thought initially that the *Enumeration* would list and describe indigenous Islamic sciences, thus serving as a natural template or model for modern Islamic classifications. What I discovered is that the *Enumeration*, though written in Arabic by a Muslim, is more an exposition of Greek science and philosophy in Islamic guise. It
would appear that Farabi sought to enlarge and improve the Islamic catalog by cleverly importing foreign sources. These sources are largely Western in origin. To be sure, his introduction of *fiqh* and *kalam* in chapter five represents an inchoate attempt to synthesize Islamic and Western thought, especially as regards political and theological philosophy. Nonetheless, his expansion of the Islamic canon is mainly along Western lines. How, then, to address, through his work, the problem of Islamic marginalization in modern classifications? The facile answer would be to encourage Islamic scholars to adopt a more Western outlook. This would constitute a kind of capitulation to the dominant worldview for the sake of expediency. A more nuanced proposition would be to acknowledge and encourage acceptance of Western epistemology as the joint heritage of Islam. From the moment that Farabi and other learned Islamic classifiers undertook to integrate Greek science and philosophy into the Islamic canon, the epistemological traditions of West and East moved closer together.

We do not know what prompted Farabi’s near wholesale adoption of the Greek oeuvre. The works of Aristotle were a thousand years old when Farabi encountered them. Neither Hellenistic nor Alexandrian power was any longer in the ascendant. Islam was the dominant military and cultural power from China to Spain. Farabi may have adopted Greek knowledge in part because he viewed it as intrinsically valuable and useful to the project of establishing an Islamic polity akin to the Virtuous City.

Having translated most of the *Enumeration* into English, it seems clear to me that Farabi left a great deal of his thought unstated. No doubt, this is owing to his conception of the text as a survey, outline, and primer for the student, and not a definitive exposition of his philosophy. To
capture the whole trajectory of his thinking, it would be necessary to read many of the treatises that he wrote concerning the disciplines that are listed, and some that are not, in the

*Enumeration*. His *Great Book of Music, The Political Regime, Philosophy of Plato and Aristotle, Treatise on the Excellence of the Sciences and the Arts, Epistle on the Intellect, Utterances Employed in Logic, Aphorisms of the Statesman, Book of Letters, The Virtuous City*; these and many other works besides would be helpful to anyone seeking a fuller understanding of the *Enumeration*’s intellectual foundation. I have read portions of these texts, as cited by secondary authors. Future research would indicate a better acquaintance with the bulk of Farabi’s extant work and its relationship to Islamic epistemology and classification.

The contributions of this dissertation to LIS scholarship and to the field of knowledge organization can be described as follows:

1) A contemporary exposition and near complete English translation of Farabi’s *Enumeration of the Sciences*, the once celebrated and widely influential Islamic classification of knowledge.

2) A repositioning of Farabi’s *Enumeration* into the discussion of how to improve Islamic classification around the world.

3) A forceful plea, substantiated by evidence and review of the literature, for an expansionist approach to Islamic classification which reclaims many of the sciences that once inspired the Muslim imagination.
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Appendix A

The *Enumeration – Selected Translations* (certified)

The Science of Language

The science of language, in sum, is composed of two classes: 1) the knowing by memory of significant words used in any community; 2) the knowledge of the rules of these words. Rules are called in each art universal or general propositions; that is, they pertain to many of the things that the art consists of, up to and including the totality of the things.

La ciencia del lenguaje, en resumen, es de dos clases: 1ª, el saber de memoria las palabras significativas en un pueblo cualquiera, y el conocimiento de lo que cada una de ellas significa; 2ª, el conocimiento de las reglas de estas palabras. Reglas se llaman en cada arte unas proposiciones universales, esto es, generales, que cada una de ellas abarca muchas cosas de las que este arte comprende, hasta llegar a la totalidad de las cosas…

Las cosas individuales, muchas en número, solamente vienen a ser artes, o a estar comprendidas en ellas, en cuanto que se contienen en reglas conservadas en el alma del hombre, según un orden conocido; como, por ejemplo, la escritura, la medicina, la [6] agricultura, el comercio y las demás artes, ya
sean prácticas, ya especulativas.

Por esta razón los antiguos llamaban reglas a todo instrumento por el que se comprobaba [la verdad] de aquello en lo que es fácil que el sentido haya errado respecto de la cantidad del cuerpo, o de su calidad, &c.; como, por ejemplo, la plomada, el compás, la regla y las balanzas; y llamaban también reglas a los compendios del cálculo y cuadros astronómicos. Los libros compendios que se usan como recordatorios de los libros extensos, son también reglas, puesto que son cosas de pequeño número que abarcan cosas de número más elevado; pero que aprendiéndolas y conservándolas en la memoria, aunque pequeñas en número, hemos aprendido otras de número mayor.

…las palabras significativas, en cualquier lengua, son de dos clases: simples y compuestas. Las simples son, por ejemplo, ‘el blanco, el negro, el hombre, el animal’; compuestas son como si decimos: ‘el hombre es animal, Amru es blanco’. Los nombres y los verbos tienen como propiedades inherentes la masculinidad y la feminidad [el género] [7] y el singular, dual y plural [el número]; el verbo lleva consigo, especialmente, la idea de tiempo: pretérito, presente y futuro.

Individual things, of which there are many, attain to the level of an art only insofar as their rules are preserved in the soul of the individual according to a known order, such as may occur in the case of writing, medicine, agriculture, commerce, and the other arts, whether or not these are practical or speculative (theoretical).

The ancients defined as rules any instruments used for the purpose of acquiring precise measurements, especially where the senses are liable to err, such as the plumb—bob or plummet, the ruler, the compass, and the scale. They also referred to as rules calculation sheets and astronomical tables. Likewise, those summary books (what we would call annotated bibliographies) that describe concisely other more extensive books — these also are rules because they treat in brief things of great extent, so that, by learning and remembering them, though they be of lesser content, we apprehend things of greater content (Alfarabi & Gonzalez, 1953).

…all meaningful words, in any language, are of two types: simple and composite. Simple words are such as ‘white’, ‘black’, ‘man’, ‘animal’; composite words [what we would call sentences] are such as ‘Man is an animal’, ‘Amru is white’. Simple words can be nouns, verbs, and particles. Nouns and verbs are inherently either masculine or feminine (gender) or singular or plural (number); verbs especially carry the idea of time: preterit (simple past), present and future.
La ciencia del lenguaje, en todo pueblo, se divide en siete grandes partes: ciencia de las palabras simples; ciencia de las palabras compuestas [oraciones]; ciencia de las reglas en virtud de las cuales son simples las palabras; regla en virtud de las cuales son compuestas las palabras; reglas de corrección de la escritura; reglas de corrección de la lectura, y reglas de los versos.

Este arte es análogo al arte de la gramática, pues entre el arte de la lógica y el entendimiento y los inteligibles existe la misma relación que entre el arte de la gramática y la lengua y las palabras: todas las leyes que la ciencia de la gramática nos da respecto de las palabras, son análogas a las que la ciencia de la lógica nos da respecto de las ideas. Es también análogo a la ciencia de la prosodia, pues la lógica hace, respecto de las ideas, lo que la prosodia respecto de las medidas del verso…

…no dejaremos en libertad a nuestro espíritu para que en la investigación de la verdad que queremos comprobar proceda negligentemente siguiendo el curso espontáneo de las ideas tal como le vengan, sin sujeción a ley alguna, ni dirigiéndose a la meta a que aspira por cualquier camino que le ocurra de improviso, ni adoptando cualesquiera métodos que puedan engañarnos haciéndonos creer que es verdad lo que no es verdad;

antes al contrario, es preciso que de antemano sepamos qué camino conviene que sigamos, qué cosas debemos conocer [como medios], por dónde debemos comenzar nuestro camino y cómo conviene que apliquemos nuestro espíritu separadamente a cada una de aquellas cosas, hasta que lleguemos sin ningún

Particles cannot be understood alone but must be joined to a verb or a noun or to both together (Alfarabi & Gonzalez, 1953).

The science of language, in any town, is divided into seven great parts: the science of simple words; the science of composite words [sentences]; the science of the rules of simple words; the science of the rules of composite words; the science of correct writing; the science of correct reading; the rules of verse.

**The science of logic**

The art of logic is analogous to the art of grammar, since between the art of logic and the understanding of ideas there exists the same relation as between grammar and language and words. All of the laws that grammar imparts to language are analogous to those imparted by logic to ideas. Logic also relates to ideas in the same way as does the art of prosody to verse metrification.

…we will not permit ourselves to proceed blindly down some path, disregarding any law, adopting spontaneously whatever methods should occur to us — though they may deceive us into believing that which is not true.

Rather, we will want to know beforehand what path we wish to follow, what things (phenomena) we wish to study,
género de dudas a la cosa que nos propusimos averiguar. Es, igualmente, preciso que conozcamos de antemano todas las cosas que nos pueden conducir a error o a equívoco, a fin de precavernos contra ellas en nuestro camino. Sólo entonces podremos estar seguros (respecto de la materia que queríamos investigar) de que hemos tropezado con la verdad y de que no nos hemos equivocado. Y así, cuando nos ocurrieren dudas respecto de una cosa que hayamos averiguado y nos asalte la sospecha de que en su averiguación hemos descuidado algo esencial, inmediatamente podremos someter nuestra averiguación a crítica, y si en ella hubo efectivamente algún error, nos daremos cuenta de él y corregiremos con facilidad el mal paso que hubiéramos dado.

…cuando intentemos demostrar a los demás la verdad de nuestras opiniones, puesto que para evidenciar a los ojos la verdad de una opinión nuestra, habremos de emplear análogos medios y procedimientos a los que hemos empleado para evidenciarnos de ella a nosotros mismos. Y si alguno nos contradijere respecto de alguna afirmación o de algún argumento de los que le hemos presentado en apoyo de aquella opinión nuestra podremos evidenciarle todo eso.

Igualmente, cuando alguien quisiere demostrarnos la verdad de una opinión, tendremos medios de aquilatar el valor de sus afirmaciones y de sus argumentos con los que él supone que su opinión se demuestra, y si en realidad fueren demostrativos, veremos claramente por qué
razón lo son y así admitiremos lo que admitamos a ciencia y conciencia; lo mismo que en el caso contrario, si él trata de engañarnos o se engaña, descubriremos la razón de su falacia o de su error, y así podremos también a ciencia y conciencia condenar como de mala ley lo que rechacemos.

En cambio, si ignoramos la lógica, nuestra situación en todos estos casos será completamente contraria y a la inversa, dije mal: será más grave, mucho peor y más vergonzosa.

Es, pues, evidente que la lógica es necesaria para todo aquel que no quiera limitarse a meras opiniones en la formación de sus juicios y creencias, pues las meras opiniones son aquellos juicios que uno forma sin estar seguro de que luego no los ha de abandonar para admitir otros contrarios a ellos. Ahora, para aquel que prefiera contentarse con meras opiniones en sus juicios, no es necesaria la lógica.

Hay quienes pretenden que un asiduo ejercicio en las discusiones y argumentos polémicos o una práctica continua de las matemáticas, v. gr., de la geometría o de la aritmética, suple perfectamente por el estudio de las reglas de la lógica o equivale a él [20] y desempeña su misma función o proporciona al hombre la facultad necesaria para criticar toda afirmación, argumento y opinión, o basta para dirigirle rectamente hacia la verdad y la certeza, a fin de que no yerre en ninguno de sus conocimientos. Mas el que tal pretende se asemeja a quien supusiera que el ejercicio y la disciplina consistentes en aprender de memoria

Conversely, if we ignore logic, our situation in all of the above cases will be inverted; worse yet, it will be gravely inferior and shameful.

It is evident, furthermore, that logic is necessary for all those who do not wish to limit themselves to mere opinion in the formation of their judgments and beliefs. After all, what we adopt on the basis of mere opinion we are just as likely to abandon later on for a contrary thesis; now, for those who are perfectly content with mere opinion in their judgments, logic is unnecessary (Alfarabi & Gonzalez, 1953).

There are those who pretend that the assiduous exercise of polemics or mathematics, such as geometry and arithmetic, will amply substitute for a study of the rules of logic, supplying the individual with the necessary faculty to critique any assertion, argument or opinion. Those who hold this belief
versos y trozos retóricos y en recitarlos asiduamente suple por el estudio de las reglas de la gramática, y para evitar todo defecto de lenguaje, y proporciona al hombre la facultad de criticar la morfología de toda palabra para decidir si es correcta o defectuosa. La respuesta que debe darse en este caso, respecto de la gramática, es exactamente la misma que conviene dar en aquel otro, respecto de la lógica.

…porque la verdad de un juicio no conseguimos aquilatarla dentro de nuestro espíritu, sino reflexionando, examinando atentamente y fijando en nuestro espíritu ciertas ideas y objetos cuya función es servir de medios para probar la verdad de aquel juicio; e igualmente no podemos demostrar a los demás la verdad de un juicio, sino hablándoles con palabras que les hagan comprender aquellas ideas y objetos cuya función es servir de medios para demostrar la verdad de aquel juicio.

Pero no es posible que demoselremos la verdad de cualquier juicio que se nos ocurra con cualesquiera ideas que a la mente nos vengan, necesitaremos servirnos de ciertas y determinadas ideas, que han de ser de un número taxativo, que deberán reunir condiciones cualitativas fijas y que tendrán que organizarse y componerse entre sí de un modo preciso;

Y por eso necesitamos forzosamente reglas que nos preserven y guarden de todo error respecto de las ideas y de su expresión por las palabras. [22]

Los antiguos daban a cada una de resemble those who think that by reciting and memorizing verses and rhetorical passages one can assimilate the rules of grammar and correct speech and avoid every defect of language while acquiring the faculty to critique the morphology of any word. The answer to those who would substitute the study of grammar is the same as for those who would substitute the study of logic (Alfarabi & Gonzalez, 1953).

We cannot assess the truth of a judgment by means of the spirit alone; we must reflect upon and analyze closely the argument at hand using the tools of logic. Likewise, we cannot demonstrate to others the truth of an argument except by speaking to them in words that make them understand those goals and ideas whose function it is to demonstrate the truth of that argument.

However, in order to assert the truth of any judgment we must avail ourselves of certain, determinate ideas, of specific number, organized in a precise manner.
estas dos cosas, es decir, a las ideas o inteligibles y a las palabras que las expresan, un mismo nombre: razón y verbo; pero a las ideas las denominaban «el verbo o la razón interior, grabada en el alma»; aquello mediante lo que se expresa ese verbo interior, lo denominaban «el verbo o la razón exteriorizada por la voz»; aquello de que el hombre se sirve para comprobar dentro de sí mismo la verdad de un juicio, es el verbo grabado en el alma; aquello que sirve para demostrarla a los demás es el verbo exteriorizado por la voz. El verbo, cuya función consiste en demostrar la verdad de un juicio cualquiera, lo denominaban los antiguos «el silogismo».

Deriva, en efecto, de logos [verbo], término que tenía para los filósofos antiguos tres sentidos: 1º El verbo exteriorizado por la voz, mediante el cual expresa la lengua lo que en la conciencia se guarda oculto. –2º El verbo guardado en el alma, es decir, las idea o inteligibles, significadas por las voces. –3º La facultad anímica puesta por Dios en el hombre, mediante la cual se le distingue, con diferencia última, de todos los demás animales; con ella adquiere el hombre los inteligibles, es decir, las ideas, los [25] conocimientos científicos, las artes; mediante ella se realiza la intuición intelectual; mediante ella se distingue la belleza y fealdad moral de las acciones. Esta facultad se encuentra en todos los hombres, hasta en los niños; pero en éstos es muy exigua, no llega todavía a realizar su función propia, lo mismo que le sucede a la facultad del pie del niño para andar, o como el fuego poco intenso, que no llega a producir la combustión del tronco de palmera. También existe esta facultad en

To this end, we need perforce rules that will guide us and safeguard against any error in respect of ideas and their expression in words.

The ancients assigned two words—reason and verb (logos)—to the intelligibles (ideas) and the words that express them. However, ideas and words are of two types—interior and exterior. Interior ideas are those “engraved on the soul” and are expressed according to an inner voice. Their purpose is to confirm the truth of a judgment to the inner mind—a kind of internal reasoning or reflection. Conversely, we speak outwardly of our ideas when we wish to demonstrate their truth to others. We externalize our ideas through speech.

The faculty of reason, whether employed internally or externalized through speech, is called syllogism by the ancients and is governed by the rules of logic.

Logic derives, in effect, from logos, a term which held three meanings for the ancients: 1) the logos [word] externalized by the voice, by which means the tongue expresses that which the mind holds secret; 2) the word that is engraved in the soul, that is, the idea or intelligible that we know instinctively and that is signified through speech; 3) the spiritual faculty imbued by God in the individual, which we alone possess, in contrast to all the other animals. With this faculty, we acquire the intelligibles or ideas, the knowledge of science, the intuitive capacity, and the ability to perceive beauty and right moral action. This faculty is present in all
los locos y en los ebrios; pero sólo como en el ojo del estrábico reside la facultad de ver. En el hombre, mientras duerme, también, pero está como en el ojo cerrado; en el que sufre un síncope, como en el ojo velado por una nube de vapor o cosa análoga.

Las elocuciones apodícticas son aquellas cuya función consiste en producir un conocimiento cierto acerca de la cuestión cuya resolución se busca; y esto, tanto si el hombre las emplea dentro de su propio espíritu para investigar él mismo dicha cuestión, como si se sirve de ellas para demostrársela a otro, como si otro las usa para demostrársela a él. En todos estos casos la función propia de tales elocuciones es dar por resultado un conocimiento cierto. El conocimiento es cierto, cuando lo conocido no cabe absolutamente que sea de otro modo; cuando no cabe en modo alguno y por ninguna causa que el hombre que lo posee se retracte de él, ni que él mismo conciba como posible tal retractación; cuando no cabe que le ocurran sospechas de error, ni le venga a las mientes sofisma alguno que le obligue a rechazar lo que ya conoce, ni dudas ni conjeturas.

Las elocuciones polémicas se emplean en dos casos: 1°, cuando uno arguye con afirmaciones de común sentir, de esas que todos los hombres admiten, tratando sólo de vencer al adversario sobre una tesis de cuya verdad éste responde, o defender contra él otra tesis con afirmaciones de aquel mismo género. Si el que arguye se propone vencer al defensor, pero con afirmaciones o medios que no sean de común sentir, entonces la función de ambos no pertenece al método men. It is present in children as well though in a more exiguous, unrealized form, like a child’s foot while learning to walk, or a low flame before full combustion, as when setting alight the trunk of a palm tree. It exists also in the mentally infirm and the drunkard, though only as the faculty of sight exists in the eye that squints, or the eye that is shut in one asleep, or in the person who suffers a black—out or whose eye is blinded by a cloud or some other analogous thing (Alfarabi & Gonzalez, 1953).

The function of apodictic speech is to produce certain knowledge in the resolution of a question. This applies whether one seeks to answer a question of a personal nature or to answer a question put forth by others. In all cases, the function of the apodictic is the same—to procure certain knowledge. Knowledge is certain when there is no possibility of it being other than it is, when the person who possesses it will not retract it for any reason nor even conceive of retraction as a possibility. Neither will there occur to any mind suspicion of error nor sophistic argument that would oblige a rejection of what is already known, nor doubts nor conjectures.

Polemical speech is used in two cases: 1) when one argues on the basis of accepted premises [commonly held opinions], for the purpose of persuading an
polémico; 2°, cuando el hombre se sirve de afirmaciones de común sentir como medios para sugerir sospechas vehementes de error en su propio ánimo o en el de otra persona, respecto de una opinión cuya verdad intenta comprobar, llegando hasta imaginar que es cierta, sin que en realidad lo sea.

Las elocuciones sofísticas son aquellas cuya función propia consiste en inducir al entendimiento, extraviarlo y confundirlo, a fin de que llegue a sospechar que es verdad lo que no lo es y recíprocamente; que es un eminente sabio el que no lo es en realidad; y que no es un filósofo verdadero y un sabio el que realmente lo es.

Este nombre, sofística, designa la habilidad técnica que da al hombre la facultad de engañar, de adulterar la verdad, de falsificarla, mediante la palabra, hasta el punto de hacer pensar a los demás una de estas cosas: o que él está en posesión de la ciencia, de la filosofía y de la perfección y que los otros son imperfectos, sin que realmente sea así; o que una tesis cualquiera es falsa siendo verdadera, y recíprocamente.

Las elocuciones retóricas son aquellas cuya función propia consiste en conseguir persuadir al hombre acerca de cualquier opinión, haciendo que su espíritu se incline en la verdad de lo que se le dice y otorgar a ello su asentimiento, con intensidad mayor o menor; porque las adhesiones fundadas en la mera persuasión, si bien son inferiores en intensidad a la opinión muy probable, admiten entre sí varios grados; siendo unas más firmes que otras, según que lo sean las elocuciones que las producen, puesto que, indudablemente, ciertas elocuciones adversary of the truth of a thesis, or to defend a thesis from attack. If one is defending or refuting an argument that is not based on accepted premises, then one is not engaging in polemics. 2) When one uses accepted premises to cast radical doubt on the truth of an assertion in one’s mind or in the mind of others, going so far as to imagine certainty where, in reality, none exists.

Sophistical arguments are used to purposely induce error in understanding, to confuse and distract, so that one begins to believe to be true that which is not and to hold as an eminent sage one who, in reality, is not, and to ignore as a true philosopher and sage one who truly is.

The word sophistical indicates an ability to deceive, to adulterate and falsify the truth by way of words, so far as to make others believe one of these things: that one is in possession of science, of philosophy and of perfection, and that the others are imperfect, though the truth be otherwise; or, that any thesis is false being true, and vice-versa.

The purpose of rhetoric is to persuade a person of some opinion, to incline a person to trust in the truth of what one says and to obtain assent, of greater or lesser intensity, because those opinions which are held on the basis of mere
persuasivas son más eficaces, más elocuentes, más fidedignas que otras; lo mismo ocurre con los testimonios: cuantos más en número, tanto más elocuentes y eficaces son para persuadir y convencer de la verdad de una noticia y para obtener en asentimiento más firme respecto de la verdad de aquello que se dice. Más, a pesar de esta variedad de grados en la intensidad de la persuasión, ninguna de las elocuciones retóricas puede llegar a producir el asenso propio de la opinión muy probable, próxima a la certeza. Y en esto se diferencia, bajo este respecto, la retórica de la polémica.

Las elocuciones poéticas son aquellas que se componen de elementos cuya función propia consiste en provocar en el espíritu la representación imaginativa de un modo de ser o cualidad de la cosa de que se habla, sea esta cualidad excelsa o vil, como, por ejemplo, la belleza, la fealdad, la nobleza, la abyección u otras cualidades semejantes a éstas.

Al escuchar las [30] elocuciones poéticas, nos ocurre, por efecto de esa sugestión imaginativa que en nuestros espíritus provocan, algo análogo a lo que nos pasa cuando miramos un objeto parecido a otro que nos repugna, porque inmediatamente que lo miramos, la imaginación nos lo representa como algo que nos disgusta, y nuestro espíritu se aparta y huye de él, aunque estemos bien ciertos de que el tal objeto no es en realidad tal como nos lo imaginamos.

Así, pues, aunque sepamos que lo que nos sugieren las elocuciones poéticas respecto de un objeto no es tal como ellas nos lo sugieren, sin embargo obramos tal y como obraríamos si estuviésemos seguros

poéticas are those that consist of elements whose function is to stir the imaginative sense towards ways of being or speaking, whether these be of excellent or vile quality, such as, for example, beauty, loyalty, nobility, abjection, or other qualities of this sort.

Upon hearing poetical speech, something occurs in our soul, via the effect on our imaginative faculty, that is analogous to what happens when we see an object that resembles something repellent; no sooner do we see it than our imagination represents it to us as disgusting and we distance ourselves from it immediately, even though we are quite certain that, in
de que es así, porque el hombre muchas veces obra en consecuencia de lo que imagina, más que siguiendo lo que opina o sabe; y muy a menudo resulta que lo que opina o sabe es contrario a lo que imagina.

Las elocuciones poéticas se emplean únicamente cuando se dirige la palabra a un hombre a quien se le desea excitar a que haga una cosa determinada provocando en su espíritu una emoción o sentimiento e inclinándole así con arte a que la realice. Mas esto no puede ser sino en dos hipótesis: o cuando el hombre ese a quien se trata de inducir es un hombre falto de reflexión para dirigirse por ella, y, por tanto, tiene que ser excitado a obrar lo que se le propone por medio de la sugestión imaginativa, la cual hace para él las veces de la reflexión; o cuando se trata ya de un hombre [31] dotado de espíritu reflexivo, pero se quiere conseguir de él que realice algún acto que, si él lo examina reflexivamente, no es seguro que lo haga; y en este caso se le aborda de improviso con frases poéticas a fin de que la sugestión imaginativa preceda a su reflexión y se lance de este modo, por la precipitación, a realizar aquel acto, antes de que la reflexión acerca de sus consecuencias se le hagan retractarse de su propósito y se abstenga en absoluto de realizarlo o se decida a no apresurarse y a dejarlo para más adelante, en vista de la conveniencia de estudiarlo detenidamente. Por esta razón, las elocuciones poéticas son las únicas que se presentan hermoseadas, adornadas, llenas de énfasis y redundancias, pulidas con el esplendor y brillo que proporcionan los recursos de que trata la ciencia de la lógica.

So it goes, then, that even knowing that what is suggested by poetical speech is not in fact real, we behave as though it were because man, in many instances, behaves in consequence of what he imagines, more than in accordance with what he believes or knows; and quite often what he believes or knows is contrary to what he imagines.

Poetic speech is used to excite in people the inclination, by artfully playing upon their emotions, to do a particular thing or act in a certain way. But, this cannot occur except under two hypothetical situations: 1) When the person whom one is trying to influence is lacking in reflective capacity [reason] and therefore must be moved to act by means of the imagination, in this case a substitute for reflection; or, 2) when one means to influence someone whose reflective capacity is strong and who is unlikely to act except upon careful reflection; in this case, one will need to entertain the subject with poetical phrases such that the imagination supersedes reflection and the subject embraces, precipitously, what is being suggested before proper reflection can take hold, reveal the consequences of action, and cause delay or retraction.

It is only poetic speech which is beautiful, ornate, full of emphasis and redundancy, and polished with the splendor and brilliance that characterize the resources of logic (Alfarabi & Gonzalez, 1953).
Las elocuciones demostrativas, lo mismo si se las considera en cuanto grabadas en el alma como en cuanto exteriorizadas por la voz, se componen: en el primer caso, de varias ideas o inteligibles enlazadas y organizadas entre sí para demostrar la verdad de una cosa; y en el segundo caso, de varias palabras enlazadas igualmente y organizadas entre sí, las cuales expresan aquellas ideas y equivalen a ellas, resultando, de esta correspondencia de las palabras a las ideas, que las palabras son como los auxiliares y ayudas de las ideas para producir en quien las oye la demostración de una verdad.

Las elocuciones fónicas que constan de menos elementos se componen de dos solas palabras; y las elocuciones mentales correspondientes a ellas se componen también de dos solas ideas o inteligibles. Estas elocuciones se llaman simples.

Las elocuciones demostrativas constan de elocuciones simples y son, por ello, elocuciones compuestas. De éstas, las que de menos elementos constan son las que se componen de solas dos elocuciones simples. El máximo de elementos que pueden tener es indefinible.

…las partes de la lógica han de ser necesariamente ocho, cada una de las cuales se contiene en un libro especial.

Libro 1º, que contiene los cánones de las ideas aisladas y de las palabras que las expresan.
Libro 2º, que contiene los cánones de las elocuciones simples, las cuales constan de dos solas ideas aisladas o de las dos palabras que las expresan.  

Book #1 (Categories) contains the rules regarding single ideas and the words that express them.

Libro 3º, que contiene los cánones, mediante los cuales se aquilata el valor de las especies de demostración comunes a las cinco artes demostrativas.  

Book #2 (On Interpretation) contains the rules regarding simple phrases treating of only two isolated ideas or the two words that express them.

Libro 4º, que contiene los cánones, mediante los cuales se aquilata el valor de las elocuciones apodícticas y aquellos por los que se rige la sistematización de los problemas de la filosofía para que sus investigaciones tengan el éxito más perfecto, más excelente y más completo.  

Book #3 (Prior Analytics) contains the rules by which to evaluate the five demonstrative arts.

…distinguiéndolos de los cánones de las otras, no podrá estar seguro el hombre, cuando busque la verdad cierta, de no servirse de argumentos dialécticos, sin saber que lo son, y apartarse así de la certeza para dar en meras opiniones probables; o de emplear, sin darse cuenta, pruebas retóricas que sólo le conducirán a la persuasión; o de echar mano, sin pensararlo, de razonamientos sofísticos, los cuales, o le harán sospechar que es verdad real lo que no lo es y que debe darle crédito como a tal, o le dejarán en el estado de la duda negativa; o bien se servirá, sin advertirlo, de elocuciones poéticas, y así formulará sus juicios, apoyándose sobre meras representaciones imaginativas. …en todos y cada uno de estos casos, el hombre se obstinará en creer que camina por el sendero que conduce a la verdad y que ha encontrado lo que busca, sin que realmente

Book #4 (Posterior Analytics) contains the rules by which to evaluate apodictic (demonstrative) and other statements used to frame philosophical questions so that the most complete, excellent, and perfect answers are obtained.

It is important that the various parts are well defined and discernible from each other so that the learner does not fall into dialectical argument, for example, without realizing it, nor make use of rhetorical devices, which only lead to persuasion, while seeking absolute truth; nor follow sophistical argument, suspecting it to be true when, in reality, it is not; nor become a follower of poetry and thus formulate judgments based on mere imaginary representations.
sea así. De la misma manera, el que conoce los alimentos y los medicamentos, si no los sabe distinguir, in actu, de los venenos, mediante sus signos característicos que le permitan formar un juicio cierto, no podrá estar seguro de que no se los propine a sí propio, creyendo que son un alimento o una medicina, sin darse cuenta, y así perezca miserablemente.

Con el nombre de Ciencia de la aritmética se conocen dos clases: 1ª, aritmética práctica; 2ª, aritmética teórica.

La aritmética práctica se ocupa de los números, en cuanto que son números para los cuerpos o las cosas semejantes, cuya medida necesita precisarse. Ejemplo: hombres, caballos, dinars, dirhemes u otras cosas numerables. Estos son los números que usa el pueblo en las transacciones comerciales de los zocos y de las ciudades.

La aritmética teórica solamente se ocupa de los números en abstracto, en cuanto que en la mente están separados de los cuerpos y de todos los objetos numerados. Y no especula sobre ellos sino en cuanto que están abstraídos de todos los cuerpos sensibles que pueden numarar, y de todo respecto que abarca a la totalidad de los números que sirven para numar las cosas sensibles y las insensibles. Esta última clase de aritmética es la que entra en el cuadro de las ciencias.

La aritmética teórica trata de los números haciendo abstracción de todas sus propiedades esenciales simples, que no se...

In all of these cases, one will persist in walking what one believes to be the path to truth, without actually doing so. In the same way, one who is not able to distinguish between food and medicine and poisons, by means of the signal characteristics which pertain to each, will not know which is which, and will take the poison, believing it to be food, and thus perish miserably (Alfarabi & Gonzalez, 1953).

The Mathematical Sciences
The science of arithmetic divides into practical and theoretical classes.

Practical arithmetic deals with numbers insofar as they are concerned with physical bodies or similar things whose quantity it is necessary to obtain. Examples are men, horses, dinars, and other numerable things. These are the numbers that people use in commercial transactions at the souk [outdoor market] and in the cities.

Theoretical arithmetic is used only for numbers in the abstract sense, apart from any physical bodies or numerable things, and only to speculate upon abstract notions. Theoretical arithmetic is considered a science.
relacionan entre sí, como, por ejemplo, el par y el impar, y de todas aquellas
propiedades que los relacionan entre sí, como, por ejemplo, la que existe entre
números iguales y desiguales, múltiplos y divisores, el ser o no ser proporcionales, el
ser o no ser semejantes, el ser conmensurables o inconmensurables.

Además se ocupa [la aritmética teórica] de las propiedades de la suma de
los números entre sí, de su multiplicación, de su resta y de su división; de sus
potencias, como, por ejemplo, el cuadrado y el cubo, y en los números compuestos,
como el rectangular, o del de tres
dimensiones, perfecto o no perfecto. De
todo esto, pues, se ocupa y de las
propiedades por las que los números se
relacionan entre sí, y enseña, además, el
modo con que se deduce un número de otro
conocido, y, en resumen, de todas las
operaciones que resultan de los números.

La ciencia designada con esta
palabra es de dos clases: geometría
práctica y geometría teórica.

La geometría práctica estudia
líneas y superficies [materiales], el cuerpo
madera, si el que la emplea [la geometría]
es carpintero; el cuerpo hierro, si es herrero
[41]; el cuerpo pared, si es albañil; las
superficies y medidas de las tierras, si es
agrimensor; y lo mismo todo geometra
práctico, pues solamente se imagina las
líneas, las superficies, los cuadrados, los
triángulos y las circunferencias en cuerpo
de las materias que son los objetos de esta
ciencia práctica.

Theoretical arithmetic deals with abstract numerical relations such as, odd
vs. even, factor vs. divisor, equal vs.
unequal ratio, etc.

It is also concerned with sums,
products, quotients, exponents such as the
square and the cube, perfect and imperfect
numbers, and numbers that describe shapes
of three dimensions such as rectangles, etc.;
in sum, all of the operations that result
from numbers (Alfarabi & Gonzalez,
1953).

Geometry
The science of geometry is also
divided into practical and theoretical
classes.

Practical geometry is concerned
with lines and surfaces as they relate to
materials; for example, wood for the
carpenter, iron for the ironworker, wall
brick for the mason; land for the farmer; in
La geometría \textit{teórica} solamente estudia las líneas, las superficies y los cuerpos en abstracto y en general [por su figura], y bajo el respecto por el cual comprende a las superficies de todos los cuerpos. Se imagina las líneas en el aspecto más general en que no se piensa en qué cuerpo estén, y lo mismo se imagina las superficies, los triángulos, los cuadrados y los círculos bajo su aspecto más amplio, sin pensar en qué cuerpo estén; en este mismo aspecto general considera los cuerpos geométricos sin concretarlos a una materia o a algo sensible; antes, por el contrario, los considera en abstracto, sin pensar que un cuerpo geométrico determinado es madera, pared o hierro, sino la forma común a éstos.

Esta última clase [la teórica] es la que entra en el conjunto de las ciencias, y se ocupa de las líneas, superficies y cuerpos geométricos en abstracto, de sus figuras, de sus medidas, de sus igualdades, de sus desigualdades, de sus posiciones, de su orden y de todas sus propiedades, como el punto, los ángulos, &c. Trata además de los [cuerpos] proporcionales y de los que no son proporcionales, de los conmensurables, de los incommensurables, de los racionales e irracionales [42] y de las clases de estos dos últimos.

Enseña el modo de construir todas y cada una de las figuras y cuerpos que constituyen el objeto de la Geometría, y de qué modo deduce todo lo que es propio que deduzca de ellas; enseña, además, las causas de todo esto y por qué ello sea así, con demostraciones apodícticas que nos dan la ciencia cierta, en la que no es posible duda alguna.

sum, any and all lines, surfaces, squares, triangles, and circumferences insofar as they relate to physical materials.

Theoretical geometry studies only lines, surfaces, and bodies in abstract form. Lines are considered in the most general way possible unlinked to any particular body. The same applies to triangles, squares, and circles in their most magnified aspect, without thought as to what body they might pertain. In general, all geometric shapes are to be studied apart from any tangible material. They should be considered in the abstract and not in conjunction with any material such as wood, brick, or iron; rather, in accordance with the forms that are common to all of these.

It is the theoretical class that enters into the realm of the sciences and that deals with lines, surfaces, and the geometrical bodies in abstract form; their shapes, sizes, similarities, dissimilarities, positions, order, and all other properties, such as points, angles, etc. Further, it determines which bodies are proportional and which are not; which are commensurable or incommensurable, rational or irrational.

It teaches how to construct each of the different geometrical shapes and bodies; how to deduce what is proper to each and what cause makes each shape
Esta ciencia tiene dos partes: una parte que estudia las líneas y las superficies, y otra parte que estudia los cuerpos. La que estudia los cuerpos se subdivide según las especies de los cuerpos, como, por ejemplo, el cubo, el cono, la esfera, el cilindro, los prismas, ¿las secciones cónicas? El estudio de todo esto se hace bajo dos respectos: primero, que se estudie cada uno de ellos en sí, como el estudio de las líneas, de las superficies, del cubo, del cono separadamente; segundo, que se estudien estos cuerpos y sus propiedades en cuanto que se relacionan unos con otros; y esto, bien en el caso de que unos se midan por otros, en el cual se estudiará su igualdad, su desigualdad u otras propiedades distintas, bien en el caso que algunos se coloquen en el otro y se fijen, como si se coloca y se fija una línea en una superficie, o una superficie en un cuerpo, o una superficie en otra superficie, o un cuerpo en otro cuerpo.

Conviene hacer notar que la Geometría y la Aritmética tienen bases y principios, y las demás cosas se derivan de estos principios. Los principios son cosas definidas; lo que se deriva de estos principios, cosas indefinidas. En el libro atribuido a Euclides [p. 36] [43] el Pitagórico se encuentran los principios de la geometría y de la aritmética; es el llamado Libro de los elementos. El estudio de esta materia se puede hacer por dos métodos: analítico y sintético. Los más antiguos que se ocuparon de esta ciencia reunieron en sus libros estos dos métodos, excepto Euclides, que en su libro emplea solamente el método sintético.

Ahora es preciso determinar la what it is. It does all of this with apodictic certainty so that there can be no doubt as to the truth of the conclusions.

This science has two parts: one that studies lines and surfaces and the other that studies bodies. The part that studies bodies is subdivided according to type; for example, the cube, the cone, the sphere, the cylinder, the prism. These shapes are studied in two ways: First, according to the lines and surfaces that are unique to each; second, in terms of how each form relates to another of a different type so that by measuring one against another, we are able to discern their similarities, dissimilarities and other distinct properties. Also, we may perceive how some properties may be fixed upon others such as a line upon a surface or a surface upon a body or a surface upon another surface or a body within another body.

It is worth noting that both geometry and arithmetic have principles and that other things derive from these principles. Principles are defined things; what derives from the principles are undefined things. In the book attributed to Euclid the Pythagorean (the Elements), we find the principles of geometry and arithmetic. The study of this material can be done according to two methods: analytic or synthetic. The ancients employed both methods, except for Euclid, who used only the synthetic
ciencia de los aspectos [óptica] y ver si abarca la totalidad de lo que trata la geometría, puesto que la mayor parte de las cosas que por necesidad estudia la geometría, en cuanto que tienen algún respecto de figura, de posición, de orden, &c., vienen a convertir estos respectos en lo contrario cuando se los mira.

Y así, aquellas cosas que en realidad son cuadradas, si se las mira desde una cierta distancia, se ven redondas; las que están juntas se ven separadas; las que están separadas se ven iguales; muchas de las que están colocadas en un mismo plano, parecen unas más bajas y otras más altas; parte de las que están delante parece que están detrás, y cosas semejantes a éstas [que se citan].

El arte permite al hombre medir la distancia de las magnitudes lejanas, a las cuales no se puede llegar, y la cantidad de las distancias respecto de nosotros y las distancias entre sí; y esto, por ejemplo: la altura de los árboles grandes y de las paredes, la anchura de los valles y ríos, la altura de los montes, la profundidad de los valles y los ríos después que se ha dirigido la vista a sus extremos; las distancias de las nubes, &c., del lugar en que estamos y enfrente de qué lugar de la tierra están; y sus cantidades en cuanto que es posible que se los mire según la inclinación del que los contempla; y, en resumen, toda magnitud cuya cantidad o cuya distancia de algo se pretende medir, después que se ha mirado. Unas cosas se hacen con instrumentos, para certificar la vista a fin de que no yerre, y otras se hacen sin instrumentos. Y todo lo que se mira y se

(Alfarabi & Gonzalez, 1953).

**Optics**

It is important to determine to what degree the science of optics follows the science of geometry since most of what pertains to geometry—figure, position, order, etc. is reversed or inverted when seen from various angles or distances.

Likewise, those things that are in reality square appear from a certain distance as circular; those that are joined appear separated; those that are placed on the same plane appear to be on different levels, some lower, some higher; those that are in front appear to be in back, and other such things (Alfarabi & Gonzalez, 1953).

This art permits one to measure the distance of faraway magnitudes, of those things that are beyond our reach, their distance from us and their distance from each other. Also, we may measure the height of trees and of walls, the depth of valleys and rivers, the altitude of mountains, the depth of valleys and rivers after we have exhausted the limits of sight, the distances of clouds, the celestial bodies (planets and stars) and their quantity depending upon the angle or inclination from which we contemplate them. For some objects we use instruments to measure precisely what we think we see;
ve, solamente se ve por medio de un rayo que atraviesa la atmósfera y todo cuerpo transparente y aumenta nuestra vista, hasta que se pone sobre el objeto visto

La astronomía matemática se ocupa de los cuerpos celestes y de la tierra en tres formas: 1ª, de sus figuras, las posiciones de unos respecto de otros, su orden en el mundo por respecto a las magnitudes de sus cuerpos [masas], la relación de unos con otros y las magnitudes de sus extensiones unas respecto de otras, y de que la tierra, en su totalidad, no tiene traslación de su lugar ni en su lugar [rotación y traslación];

2ª, de las clases de movimientos de los cuerpos celestes, de que todos estos movimientos son circulares y cuáles de ellos son los que son comunes a la totalidad de los astros, bien sean estrellas o no lo sean, y los que son comunes a todas las estrellas; además, de los movimientos especiales de cada estrella, la cantidad de clases de movimientos, las direcciones en que se mueven, y en qué dirección tiene cada una su movimiento; y enseña el medio de distinguir ciertamente el lugar de cada estrella según las partes del Zodiaco en cada tiempo, en cualquiera de las clases de movimiento. Se ocupa, además, de todos los movimientos inherentes a los cuerpos celestes y a cada uno de ellos en el Zodiaco, de las relaciones de unos con otros respecto a conjunciones y separaciones y posiciones respectivas;

3ª, trata de la tierra en cuanto que está habitada o no habitada, la cantidad de for other objects, the use of instruments is unnecessary. Whatever we look at and whatever we see, we do so by means of a ray that crosses the atmosphere, running through every transparent body, improving our sight and connecting us, ultimately, to the seen object (Alfarabi & Gonzalez, 19532).

Astronomy
Mathematical astronomy deals with celestial and earthly bodies in three forms: 1) their figures and positions with respect to each other; their order in the world as defined by magnitude (mass); the magnitude of their extensions and the relation of these to each other; the fixity of the earth in its place (Alfarabi & Gonzalez, 1953).

2) The second form is concerned with how cosmic bodies move; accepting that all movements are circular but seeking to know which types of circular movements are common to all planets and to all stars; what special movements are peculiar to each star; the quantity of these movements and their direction; how to distinguish with certainty the location of each star according to the parts of the zodiac, in whatever class of movement. Furthermore, to know all of the movements inherent to the cosmic bodies and their place in the zodiac and the relationships between the bodies as regards conjunctions, separations, and respective positions.
la parte poblada, cuántas son sus grandes divisiones, o sea los climas; cuenta los lugares en los que coincide cada clima en un tiempo y dónde está el sitio de cada población y su relación en el mundo;

Se ocupa, en resumen, en dar a conocer las clases de los sonidos, de qué se componen, sobre cuáles puede hacerse la composición y cómo, y por qué estados [variaciones] es necesario que pasen hasta que su modo llegue a ser perfecto y completo. Lo que con este nombre se conoce son dos ciencias: ciencia de la música práctica, y ciencia de la música teórica. [49]

La música práctica es aquella que tiene por objeto encontrar los diversos sonidos perceptibles en los instrumentos que se enumeran, ya sean naturales, ya artificiales. Los instrumentos naturales son: la garganta, la úvula con las cosas que las componen, y, además, la nariz; los artificiales son: las flautas, los laúdes, &c. El músico práctico solamente ejecuta las melodías y sonidos con todas sus propiedades, en cuanto que están en los instrumentos de los cuales se arrancan.

La [música] especulativa da la ciencia de los sonidos, que es inteligible (?), da las causas de todo aquello que entra a componer los sonidos, no en cuanto que están en una materia, sino en absoluto y en cuanto que están separados de todo instrumento o materia; los toma en cuanto que son oídos en general, y averigua en qué instrumento se producen y en cuál no se producen.

3) The third form deals with the earth insofar as it is inhabited or not inhabited, the quantity of the part that is populated, the major divisions and climates of the parts. It counts the areas that share the same climate at one time and the site of each population and its relation to the world (Alfarabi & Gonzalez, 1953).

Music

The science of music, in sum, seeks to know the different classes of sounds, of what they are composed, how they are used to make a composition, and through which stages or variations they need to pass in order to arrive at a perfect and complete state of being. The science of music is of two types: the practical and the theoretical.

The goal of practical music is to find the various sounds that are perceptible in the known instruments, whether these be natural or artificial. The natural instruments are the throat, the uvula (the pendant fleshy lobe in the middle of the posterior border of the soft palate) and its attendant parts, and the nose. Artificial instruments are such as the flute, the lute, and others. The practical musician only performs melodies and sounds by way of these instruments.

Theoretical music is concerned with the science of sounds, how sounds are made, not in connection with any particular material, but in an absolute sense, apart
Se divide la música especulativa en cinco grandes partes: 1ª, el tratado de los principios y primeras cosas que se deben emplear para la deducción de lo que hay en esta ciencia; de cómo se deben emplear estos principios; por qué métodos fue inventada esta arte, y de qué cosas y de cuántas se compone y de cómo conviene que se investigue lo que hay en ella;

2ª, el tratado sobre los fundamentos de esta arte, que abarca el tratado sobre el origen de los neumas, el conocimiento de cuánto es su número, cuántas son sus clases, las demostraciones de la relación de unos a otros y las demostraciones de todo esto; y el tratado sobre las clases de sus sitios y sus órdenes, con los cuales se pone de acuerdo para que tome de ellas cada uno lo que quiera y con ellas componga las melodías;

3ª, el tratado de la adaptación a lo demostrado en los principios, las frases y las demostraciones sobre las clases de instrumentos artificiales que con ellos se preparan, y del invento de todos [los instrumentos] de ellos [los principios, &c.] y su sitio en ellos, según la medida y el orden que se demuestran en los principios;

4ª, el tratado sobre las clases de los acordes naturales que son las medidas de from any instrument; sounds are considered as they are heard in a general way and also in terms of which instruments are capable of producing them and which are not (Alfarabi & Gonzalez, 1953).

Theoretical music is divided into five large parts. 1) The first of these is the discourse on the principles and the propositions, the nature of which is used to derive what is in this science; the way in which these principles are applied; how this art [again Farabi refers to as an art what he had earlier termed a science] is discovered; from which things and from how many things it is joined; and how an investigation into this art should be conducted.

2) The second part is the discourse on the rudiments of this art; and the discourse on the derivation of the notes; and the knowledge of how great their number is and how many species of them there are; and the explanation of the proportions between one and another, and the demonstrations for all of that; and the discourse about the species, their composition, and the arrangements of them by which they become concordant, for one chooses from them what one wants and composes melodies from them.

The third part is the adaptation of the rudiments, propositions, and demonstrations to the different classes of artificial instruments; and the production of
los neumás;

5ª, acerca de la composición de las melodías en general; además, acerca de la composición de las melodías completas, que son las utilizadas en frases poéticas compuestas según orden y regla; y acerca de la cualidad del arte de ellas, según cada una de las intenciones de las melodías; y la enseñanza de las melodías con las cuales se hacen más perfectas y más eficaces para la consecución del fin para que fueron compuestas.

Considera lo propio de los pesos de dos modos: o tratando de los pesos en cuanto que miden o se mide con ellos, y esto es el examen de los fundamentos del tratado de las balanzas, o tratando de los pesos que se mueven o con los que se mueve, y esto es el examen de los fundamentos de los instrumentos con los que se elevan las cosas pesadas y sobre los cuales se las traslada de un lugar a otro.

Las ciencias de los ingenieros son aquellas que dan los modos del conocimiento en las direcciones y los métodos en la facilidad [para remover los obstáculos] para la invención de esta arte y su exteriorización in actu en los cuerpos físicos y sensibles.

La ciencia de los ingenios una es all of the notes in these instruments according to the calculations and arrangements that are explained in the rudiments.

The fourth part is the discourse on the species of natural rhythms which are the measures of the notes.

The fifth part is on the composition of melodies in general and on the composition of the perfect melodies, which are those that are set in poetical statements composed according to arrangement and regularity and in the manner of their art. By virtue of being set in poetical statements, these melodies become more profound and effective in the attainment of the purpose for which they are composed (Alfarabi & Gonzalez, 1953).

Weights

The science of weights consists of two parts: the weights that are themselves measured or that are used to measure other things, and these are fundamental matters concerning scales; and, the principles of instruments by which heavy bodies are lifted and on which they are moved from place to place, and these are the fundamental matters of instruments used to lift heavy things and to transport them from one place to another (Alfarabi & Gonzalez, 1953).

The science of tool—making (the making of simple machines and instruments for use in various arts sciences, such as astronomy and music)

Engineering sciences are those that provide the means of knowledge through instruction and method, removing obstacles and facilitating invention and practical
La ciencia aritmética, y tiene muchos respectos, y otra es la ciencia conocida [52] entre nosotros por Álgebra y Mocábala y lo semejante a esto.

Pues esta ciencia es común con la aritmética y la geometría y se ocupa de los modos de dirección en la invención de los números que se deben usar, según los principios que da Euclides sobre los racionales y los sordos, en la cuestión décima de su libro de los Elementos, y Las:

...ciencias de los ingenios geométricos son muchas, entre ellos el arte de los órdenes de albañiles; el ingenio geométrico acerca de la medición de los distintos cuerpos; el ingenio en el arte de los instrumentos astronómicos y músicos, y el número de los instrumentos de muchas artes prácticas, como, por ejemplo, los arcos y las clases de armas; y el ingenio óptico en el arte de los instrumentos que dirigen la vista para comprender las realidades de las cosas que son vistas lejos de nosotros, y en el arte de los espejos y en la colocación de los espejos en los lugares en los cuales se devuelven los rayos para reflejarse, convertirse o refractarse, y de aquí también la colocación en los lugares en los que se devuelven los rayos del sol a otros [53] cuerpos; y de aquí proviene al arte de los espejos comburnentes y el ingenio acerca de ella; y el ingenio en el arte en los pesos extraordinarios y de los instrumentos de muchas artes.

Estas y cosas parecidas integran las

The chief science of engineers is arithmetic followed by what is known to us as algebra and mocabala and that which resembles these (Alfarabi & Gonzalez, 1953).

This science also holds much in common with geometry and with the principles that Euclid gives in regards to rational and irrational numbers in the tenth book of his Elements and of that which is not [italics mine] cited in this book.

The sciences of geometrical devices are many; among them the art of masonry, the measurement of distinct bodies, the art of astronomical and musical instruments, and many other practical arts such as archery and the use of arms; and the use of optical devices (lenses) that so as to comprehend the reality of things that are far away.

Also, the art and placement of mirrors so that they reflect or refract images or divert rays of the sun onto other bodies. From here we proceed to the art of combustible mirrors [presumably Farabi is referring here to the use of mirrors to kindle combustible matter at a distance] and to the lifting of extraordinary weights.
ciencias de los ingenios, que son los
principios de las artes civiles prácticas, que
se emplean respecto de los cuerpos, las
figuras, los sitios, el orden y la medida,
como las artes de los albañiles y
carpinteros, &c.

Los cuerpos físicos unos son
artificiales y otros naturales. Artificiales
son, por ejemplo, el cristal, la espada, la
cama, la tela, y, en resumen, todo aquello
que existe por el arte y por la voluntad del
hombre; naturales son aquellos que existen
no por el arte o por la voluntad del hombre,
como los cielos, la tierra y lo que hay entre
ellos, las plantas y los animales. La
disposición de los cuerpos naturales en este
respecto es como la disposición de los
cuerpos artificiales, es decir, que los
cuerpos artificiales tienen cosas en, de, por
y para las que existen; y estas cosas se
manifiestan más claramente en los
artificiales que en los naturales. [56]

Los [accidentes] que existen en los
cuerpos artificiales son, por ejemplo, el
lustre de la tela, el brillo del sable, la
transparencia del cristal y el tallado de la
cama. Las cosas para las que existen los
cuerpos artificiales son los fines y las
intenciones por las que se hacen: por
ejemplo, la tela se hace para vestir, el sable
para herir al enemigo, la cama para
preservarse con ella de la humedad de la
tierra, y para las demás cosas para las
cuales y por las cuales se hace la cama, y el
cristal para guardar en él lo que en otras
vasijas no es de creer que se transparente.

Los fines y las intenciones por las

These and other similar things
constitute the science of engineering and of
the civil and practical arts and are used in
respect of physical bodies, figures,
positions, order and measurement in the
context of masonry, carpentry, etc.

Such are the mathematical sciences
and their kind (Alfarabi & Gonzalez,
1953).

Examples of artificial bodies are
glass, swords, beds, cloth; in short,
everything that exists by virtue of the art
and will of man. Natural bodies are those
that exist not by virtue of the art and will
of man, such as the sky, the earth, and that
which is between these, and plants and
animals. Most of the principles of
artificial bodies and of their accidents are
better known than the principles of natural
bodies and their accidents. Most of the
principles of artificial bodies can be known
through sense perception, either directly, as
in the case of a garment, or indirectly, as in
the case of the healing power of medicine.

The accidents that exist in artificial
bodies are, for example, the brightness of
cloth, the gleam of the sabre, the
transparency of glass, and the frame of the
bed. Artificial bodies exist according to
the purpose for which they were made; for
example, cloth is made for clothing to
wear, the sabre to injure the enemy, the bed
que existen los accidentes que están en los cuerpos artificiales son, por ejemplo, el brillo de la tela para que con ella se embellezca, el refulgir del sable para espantar al enemigo, el tallado del lecho para embellecer su vista, la transparencia del cristal para que se vea lo que se pone dentro de él.

Las cosas por causa de las cuales existen los cuerpos artificiales son los artistas y los constructores, por ejemplo, el carpintero, por el que existe la cama; el bruñidor, por el que existe la espada. Las cosas por las cuales existen los cuerpos artificiales son dos en cada cuerpo artificial, por ejemplo, respecto de la espada; la espada existe por dos cosas: el ser puntiaguda y el hierro, pues el ser puntiaguda es su figura y su forma y por ello cumple su acto, y el hierro es su materia y su sujeto, que es como el que sostiene su forma y su figura; la tela también existe por dos cosas: por el hilo y por el enlace de su trama en la urdimbre; el tejido es su forma y su figura y el hilo es como el sostén del tejido y su sujeto y su materia; la cama también existe por dos cosas: la cuadratura y la madera; la cuadratura es su forma y la madera es su materia, lo que sostiene la cuadratura; y lo mismo sucede con el resto de los cuerpos artificiales. Y por la reunión de estas dos cosas y su acuerdo resulta la existencia de cada una de ellas dos in actu y perfectamente y su esencia.

El ser y los accidentes de cualquier to guard one against the wetness of the earth and for other things, and glass so as to be able to see what is inside, unlike other vessels that are not transparent.

The accidents of the artificial bodies have their purposes as well. For example, a bright cloth is beautiful, a resplendent sabre will frighten the enemy, a finely carved bed is handsome, and a glass jar will allow one to see what is inside.

Artificial bodies also exist for artists and builders. For example, the bed exists for the carpenter, the sabre for the polisher. Artificial bodies depend upon two things for their existence. [These two things would correspond to “form” and “matter.”] For example, the sword exists because it is sharp and because it is made of iron; the sword’s sharpness gives it its shape and purpose [to cut]; the iron gives the sword its substance and sustains its form and figure. Likewise, fabric has two parts to its existence: the thread and the stitch of the weave in the loom; the stitch constitutes the form and figure and the thread holds the form together. Likewise, the bed exists according to two things: the frame and the wood. The frame constitutes the form and the wood makes up the matter that sustains the frame. The same applies to all the rest of the artificial bodies. The essence and perfection of each thing are a result of the union of form and matter.

Each thing works, is made, or is used, in function of that for which it was formed, when its form adheres to its matter. For example, the sword is only perfected when
cuerpo natural depende de dos cosas: una, la que en él hace las veces del ser puntiaguda en la espada, que es la forma de aquel cuerpo natural; otra, la que en él hace las veces del hierro de la espada en la espada, que es la materia del cuerpo natural, y el *substratum* y como el recipiente de su forma también; con la única diferencia que la forma y las materias de la espada, la cama, la tela y los demás cuerpos artificiales se comprueban con la vista y con los sentidos, como el ser puntiaguda la [58] espada y su hierro, la cuadratura de la cama y su madera.

La forma de las cualidades y las materias de los cuerpos naturales no son sensibles, y solamente nos consta de su existencia por el raciocinio y la demostración apodíctica, lo mismo que ocurre también con muchos cuerpos artificiales, que no tienen formas sensibles: por ejemplo, el vino, que es cuerpo que se fabrica artificialmente, y la virtud que tiene de embriagar no se aprecia por los sentidos y sólo se conoce su existencia por sus actos: esta virtud de embriagar es la forma del vino, y hace respecto del vino las veces del ser puntiaguda respecto de la espada, puesto que por esta virtud es por lo que el vino perfecciona su acto [de embriagar].

Otro tanto ocurre con las medicinas compuestas por arte de la medicina, v. gr., la triaca y semejantes; ellas sólo obran en el cuerpo humano por la virtud que en ellas resulta de la composición, y esta virtud no es sensible, sino que se comprueba por los efectos físicos que de ella se derivan. Toda medicina es tal medicina por dos cosas: la mezcla, de la cual se compone, y la virtud, por la cual desarrolla su acto [de curar]: la mezcla es la materia, y la virtud por la cual

The being and accidents of any natural body whatsoever depend on two things: 1) that thing resident in the body which serves the same purpose as the sharpness of the sword, i.e., the “form” of that natural body; and 2) that thing resident in the body which is like the iron of the sword, that is, the “matter” of the natural body, the substratum. It is like the carrier of the form of the artificial bodies except that the form and the matter of the sword, the bed, the clothing, and the remaining artificial bodies are verified by the sight and the senses.

The forms of qualities and the matters of natural bodies are not tangible. We are certain of their existence only by syllogism and apodictic demonstration. The same is true of the many artificial bodies which lack a tangible form: For example, wine, which is a substance that is made artificially for the purpose of inebriation, is not perceptible to the senses; we become aware of its existence by virtue of its action. The inebriating quality of wine is its form just as the sharp pointedness of the sword is its form. The same is true of medicines which have been devised according to the art of medicine, such as antidotes and their like; these only have an effect on the human body by virtue of their composition; and
cumple su acto es la forma; y si se anula esta virtud para ser medicina, es como si se le quita a la espada el ser puntiaguda, que entonces ya no será espada, o como si a la tela se le quita la urdimbre de sus hilos en la trama, que dejará al momento de ser tela.

De esta misma manera conviene que se entienda la forma y la materia de los cuerpos naturales; pues siendo tales que no se comprueban al exterior, los [59] efectos vienen a ser como las materias y las formas, con cuyos efectos se comprueba la existencia de las materias y de las formas en los cuerpos artificiales. Sirva de ejemplo el cuerpo ojo y la virtud que en él hay para la visión; o el cuerpo mano y la virtud que tiene de coger; o cualquiera otro de los miembros del cuerpo humano: pues la potencia visual no se ve ni se comprueba con ninguno de los efectos sensibles posteriores, sino que solamente se comprende intelectualmente.

Se divide la ciencia física en ocho grandes partes:

1ª Trata de aquello en que convienen los cuerpos naturales todos, tanto simples como compuestos: todo ello se trata en el [libro de] naturali auditu.

2ª Se ocupa en si existen los cuerpos simples, y en caso afirmativo, de cuáles cuerpos sean y cuánto su número. Es, pues, el estudio del mundo: qué sea, cuáles sus partes primeras y cuántas, si en total son tres o cinco; y el estudio del cielo y su distinción de las demás partes del mundo, y que su materia es una sola: esto they are not perceptible by the senses except as they produce a physical effect. All medicine is such as it is for two reasons: the mix, from which it is composed, and the virtue (means) by which it effects its cure. The mix is the material (matter) and the virtue is the form; and if the curative power of the medicine is removed, it is as if the sharp—pointedness were removed from the sword or the weave removed from the fabric. These things would cease to be what they were.

In this way we should understand the form and matter of natural bodies. We perceive them not from the outside but through their effects; their effects become their matter and form and verify their existence. Other examples would be the eyeball and its capacity to see or the hand and its capacity to grasp, or any other member of the human body; for the visual potential cannot be verified by any tangible side effect; it can only be apprehended intellectually (Alfarabi & Gonzalez, 1953).

Physics

The physical science is divided into eight major parts:

1) the first treats of that which is common to all natural bodies — simple bodies as well as those compounded of elements. All of this part is included in the book entitled Physics by Aristotle.
se trata en la parte primera del tratado primero del libro *de coelo et mundo*.

Examina luego los elementos de los cuerpos compuestos; si están en los simples cuya existencia se ha demostrado, o son cuerpos distintos salidos de aquéllos; si están en aquéllos y no es posible que hayan salido de ellos; si son el todo o sólo parte de ellos, y si son parte, qué parte de ellos son; estudia también si se pueden comprobar o no, y las demás cosas que se comprenden hasta el fin del tratado primero del libro *de coelo et mundo*. Trata después de aquello en que convienen todos los cuerpos simples, qué cosas son elementos y principios de los cuerpos compuestos y qué otras cosas no son elementos de ellos: es el estudio del cielo y de sus partes, y está en el principio del tratado segundo del libro *de coelo et mundo*, hasta cerca de sus dos terceras partes. Estudia después lo que es propio de las partes que no son elementos, de los principios y los accidentes que llevan consigo: esto es la materia del final del tratado segundo, y del tercero y cuarto del libro *de coelo et mundo*.

3ª Se ocupa acerca de la generación de los cuerpos naturales y de su corrupción en general, y acerca de las cosas inherentes a éstos; estudia cómo se engendran los elementos y cómo se corrompen, y cómo después se engendran de ellos los cuerpos compuestos, y de los principios de todo esto, que es objeto del libro *de generatione et corruptione*.

4ª Trata de los principios de los accidentes y de los efectos propios de los

This part is concerned with whether simple bodies exist, and if so, what kinds of bodies they are. Thus, it is the study of the world, what the world is, what kind and how many are the prime parts of the world, and whether they are three or five in number. It is also the study of the heavens and their distinction from the rest of the world, establishing that the matter of the heavens is only one. All of this is treated in the first book of the Book of the Heavens and Earth (of Aristotle).

It then examines the elements of the compound bodies, whether they exist in the simple bodies whose existence has been demonstrated, or are distinct bodies derived from them; whether they exist in the simple bodies but are not derived from them, or whether they constitute all or only a part of the simple bodies. It then examines what the simple bodies fit into, what things are elements and principles of the composite bodies, and what are not.

It is the study of the sky and its parts (treated in the second book of Aristotle’s *On the Heavens*). It studies then the properties of the parts that are not elements [of the composite bodies?] and of the principles and accidents inherent in these. This is the material of the second, third, and fourth book of *On the Heavens* (Alfarabi & Gonzalez, 1953).

3) This part is concerned with the generation of natural bodies and their corruption (i.e., their passing away), as well as with the things peculiar to them. It
elementos únicamente, con exclusión de los compuestos de ellos: materia ésta del tratado primero de los tres del libro de impressionibus superioribus.

5ª Se ocupa en el estudio de los cuerpos compuestos de elementos: estos cuerpos son: unos de partes semejantes y otros de partes desemejantes; los de partes semejantes son también de dos clases: unos, aquellos de cuyas partes se componen los de partes desemejantes, como la carne y el hueso; otros, los que no son parte que sirva de fundamento a un cuerpo [62] natural de partes desemejantes, v. gr., la sal, el oro y la plata. Estudia, además, aquello en que convienen todos los cuerpos compuestos de partes semejantes, bien sean sus partes de partes desemejantes, bien no lo sean. Todo esto figura en el tratado cuarto del libro de impressionibus superioribus.

6ª Contenida en el libro de los minerales, considera los cuerpos compuestos de partes que no son partes desemejantes; éstos son los cuerpos minerales, las piedras y sus distintas clases y las diversas especies de minerales, y lo que es propio a cada especie de ellas.

7ª Contenida en el libro de las plantas, trata de aquellas cosas en que convienen las especies de plantas, y de aquellas cosas que son propias de cada especie; lo cual es una de las dos partes del estudio acerca de los compuestos de partes desemejantes.

8ª Contenida en el libro de los animales y en el libro del alma, estudia aquello en que convienen las diversas especies de animales y lo que es propio a cada una de ellas, y es la parte segunda del

studies how the elements are engendered, how they are corrupted, and how compound bodies are afterwards engendered from them. And it is concerned with the principles of all that which is contained in the Book of Generation and Corruption (of Aristotle).

4) The fourth part treats of the principles of the accidents of elements and the peculiar effects of those elements considered individually in exclusion of those bodies which are compounded of them. This matter is treated in the first three books of The Superior Impressions (i.e., the Meteorology of Aristotle).

5) The fifth part deals with the study of bodies compounded of elements, as follows: Some of these bodies are of similar parts, some of dissimilar. Those of similar parts are of two classes. There are some whose parts are composed of dissimilar parts, like meat and bone. Others have no part but serve as a basis for a natural body of dissimilar parts, for example, salt, gold, and silver. All of this figures in the fourth book of The Superior Impressions [by Aristotle].

6) This part is contained in the Book on Minerals. It treats of bodies which are not composed of dissimilar parts. These are mineral bodies, stones, and the various species of minerals and stones. It considers that which is peculiar to each of their species.

7) The seventh part is contained in
estudio sobre los compuestos de partes desemejantes.

Da, pues, la ciencia física en cada especie de estos cuerpos sus cuatro principios y los accidentes que siguen a estos principios.

Este es el resumen de lo que estudia la ciencia física, y éstas son sus partes y todo lo que se refiere a cada una de ellas.

Demuestra seguidamente que estas ciencias, según su multitud, se elevan desde las más imperfectas hasta las más perfectas, y que las más perfectas llegan hasta un límite último de perfección, más allá del cual no es posible ya que se encuentre algo más perfecto ni es posible que haya cosa alguna que sea fundamento o causa en semejante grado de su ser, ni tenga igual ni contrario; hasta llegar al ser primer uno, antes del cual no es posible que exista ninguno otro, al ser precedente, al cual no es posible que lo preceda otra cosa alguna, al ser cuya existencia no es posible que se tome de otra cosa alguna que sea su causa. Este es el ser eterno y primero en absoluto, el único.

...el que da unidad a todos los demás seres fuera de él; que aquel ser es la verdad primera, que da la verdad a los demás seres que tienen verdad. Y demuestra también cómo hace esto; y que en aquel ser no es posible la pluralidad por ninguna causa ni manera, todos.

Demuestra que El, en sus operaciones, no tiene injusticia, ni defecto, ni duda, ni mala conducta, ni mal proceder.

The Book of Plants. It is concerned with those things that the species of plants share and those things that are peculiar to each species.

8) The eighth part is contained in the Book of Animals and in the Book of the Soul (both of Aristotle). It studies that which the different species of animals share and that which is peculiar to each species.

Such then is a summary of what is studied in the science of physics, and these are its parts and all that refers to the parts (Alfarabi & Gonzalez, 1953).

Metaphysics
Part three also demonstrates that the universe is a unity and is hierarchically ordered.

... the sciences, according to their multitude, rise up from the most imperfect to the most perfect, and the most perfect arrive at an ultimate limit of perfection, beyond which it is not possible to find anything that is more perfect ... wherein is located the first being, before whom nothing else can have existed and besides whom nothing can have derived its cause. This is the first being, the absolute, the one and the only ...
y, en suma, que no hay defecto o imperfección ni mal alguno en estas operaciones.

Refuta, por fin, las opiniones erróneas acerca de Dios (¡multiplíquense sus alabanzas!) y de sus operaciones, de las cuales opiniones resulta una imperfección en Él y en sus actos, y en las esencias que Él ha creado; y todos estos errores los destruye esta ciencia con demostraciones que alcanzan tal certeza que los hombres no pueden abrigar duda alguna, ni tener preocupación siquiera de sospecha, ni posibilidad de apartarse de Él por causa alguna.

Arte del Derecho es aquella por la cual el hombre puede hallar la determinación de cualquier cosa no [73] incluida paladínamente por el legislador en su definición de la ley, por medio de otras cosas en ella determinadas y definidas, y escoger la justificación de esto respecto del fin del autor de la ley dentro de la religión que originó al fijar la ley para el pueblo.

En toda religión hay que distinguir dogmas y operaciones. Los dogmas son, por ejemplo, las afirmaciones establecidas respecto de Dios (¡glorificado sea!) o de sus atributos, o respecto del mundo y cosas semejantes; las operaciones son, por ejemplo, los actos con los cuales se honra a Dios (¡glorificado y ensalzado sea!) y aquellos otros con los cuales se obtienen

the uniter of all other beings that are outside of him, the first truth, that gives truth to all other beings that have truth; and that demonstrates how this is done, and in whose being it is not possible that there be any plurality, nor for any cause nor reason;

…that demonstrates that He, in his actions, has no injustice, nor defect, nor doubt, nor bad conduct, nor bad proceeding …

And, repudiates, at last, all erroneous opinions about God (May his praises be multiplied!); and destroys those errors with demonstrations that achieve such certitude that men can harbor no doubt, nor preoccupation, nor suspicion, nor possibility of separating themselves from Him for any reason (Alfarabi & Gonzalez, 1953).

Jurisprudence

Farabi defines the art of jurisprudence as: that by which man can make a determination in respect of anything that is not heroically included by the lawgiver in his definition of the law; by means of other things which were explicitly determined and defined by the lawgiver.

A jurist should strive to infer correctly the intention of the lawgiver who legislated for the nation to which he gave that religion.
las ordenanzas de las ciudades. Por esta causa la ciencia del Derecho tiene dos partes: una que trata de los dogmas; otra que se ocupa en las operaciones.

Además, la única manera de que el hombre saque alguna utilidad de la religión y de la revelación está en que no las comprenda por su entendimiento y no disminuya su inteligencia por ello; de no ser así, no tendría la revelación ningún sentido ni utilidad alguna, puesto que el hombre sólo aprovecha lo que conoce y lo que es posible, cuando lo medita, que lo comprenda por su entendimiento. Y si fuese así, los hombres confiarían en su inteligencia y no tendrían necesidad de la profecía ni de la revelación, pero tampoco ejercerían en ellos estas dos cosas efecto alguno. De todo lo cual se deduce que conviene que los conocimientos que las religiones enseñan al hombre sean algo cuya comprensión no esté al alcance de nuestros entendimientos. Pero no es esto sólo: sino que también sean algo que nuestras inteligencias no lo repugnen, pues cuanto más repugnante [a nuestro juicio] es, tanto es más provechoso.

En efecto, aquellas cosas, que las religiones establecen, de las que repugnan a la razón y detestan nuestros prejuicios, no son en realidad dignas de ser negadas ni absurdas, sino que son verdaderas según el entendimiento teológico; pues el hombre, aunque alcance el límite de la perfección en lo humano, viene a ser respecto del que está dotado de entendimiento teológico como el niño y el joven inexperto en relación con el varón perfecto; y así como muchos niños y hombres inexpertos niegan por su entendimiento muchas cosas que en

In any religion, there are dogmas [opinions] and operations [actions]. Dogmas are, for example, the affirmations established in respect of God (glorified be his name!) or his attributes, or in regard to the world and similar things. The operations are, for example, the acts with which one honors God and those other things by which one obtains the compliance of the cities. For this reason, the science of law has two parts: That which treats of dogmas; and the other which treats of operations (Alfarabi & Gonzalez, 1953).

**Kalam**

Besides, the only way that man can profit from religion and from revelation is by not comprehending them through reason and by not diminishing his intelligence in this way; otherwise, revelation would have no point or use whatsoever, since man only profits from what he knows and from what [he believes] is possible when he meditates upon it and understands by way of his reason. And, if it were thus, men would have faith only in their intelligence and would need neither prophecy nor revelation nor would either of these exert any sort of effect upon them. From all of this, one may deduce that it is right that knowledge of the religions teaches man something whose comprehension is beyond our understanding; and not only this: but, rather that it be something that our intelligence does not repudiate, for the more repugnant (in our judgment) it is, the more beneficial (Alfarabi & Gonzalez, 1953).

In effect, those things, established by the religions, that offend our reason and our principles, are not in reality worthy of
realidad no se deben negar, ni son imposibles y a ellos les ocurre que lo son,

así es la situación de quien ha llegado al límite de la perfección en el entendimiento humano respecto de los entendimientos teológicos. Lo mismo que el hombre, antes de que se eduque y se instruya, niega muchas cosas y las detesta, y se imagina que son absurdas, y cuando se educa en las ciencias y se instruye con la experiencia, deja de tener tales opiniones, y las cosas que le parecían absurdas se transforman y vienen a ser necesarias, y ahora, al definirlas, se maravilla de lo contrario de lo que antes se maravillaba.

Otros, cuando ven que las tesis por las cuales se quieren defender dogmas como éstos, no bastan para certificar con ellas tales dogmas con certeza completa, hasta el punto de hacer callar a sus contrarios con la confesión de su certidumbre y con la incapacidad de su contradicción verbal, tornan entonces a emplear con el adversario cosas que lo injurian hasta obligar a cesar en su contradicción, o por rubor, o por cansancio, o por temor de algún peligro que le pueda sobrevenir.

Otros, considerando a su propia religión verdadera y no dudando acerca de su verdad, opinan que deben defenderla respecto de los demás, elogiándola como la mejor y suprimiendo lo que en ella hay de reprovable, y rechazando a sus enemigos con cualquier cosa que les ocurra, sin preocuparse de emplear la mentira, el sofisma, la calumnia o el desdén, pues, a su being denied nor are they absurd; but, rather, they are true according to theological understanding. This is so because man, though he reaches the limit of human perfection is, with respect to one blessed with theological understanding, like a child and fledgling youth in relation to a perfect boy; and, as such, like many boys and men who lack expertise, denies many things that, in reality, should not be denied, that are not impossible, though he believes that they are (Alfarabi & Gonzalez, 1953).

This, then, is the situation of those who arrive at the limit of human perfection in relation to theological understanding. The same occurs when man, prior to becoming educated, denies many things and detests them, and imagines that they are absurd; and when he is educated in the sciences and receives instruction through experience, he leaves behind such opinions, and the things that appeared to him as absurd are transformed and are seen as necessary; and now, having defined these things, he wonders at the contrary of what he had at first wondered (Alfarabi & Gonzalez, 1953).

Others, when they perceive that the tenets with which they wish to defend religious dogma, are insufficient to completely certify such dogma, to the point of silencing contrary opinion with the force of argument, they then seek to injure the opponent and to secure his compliance by inducing shame, fatigue, or fear of some danger that might befall him.
juicio, quien se opone a ellos o a su religión, una de dos: o es enemigo, y entonces es lícito emplear la mentira, y el sofisma para rechazarlo y vencerlo, como ocurre en la guerra santa o en la guerra ordinaria, o no es enemigo, pero que ignora, por la escasez de su inteligencia y de su discernimiento, la felicidad, que obtendría practicando aquella religión, y entonces es lícito procurar al hombre su propia felicidad, aunque sea por la mentira y el error, como se hace con las mujeres y con los niños.

Muy glorificado sea el Dador de la ayuda e inteligencia, como de ello es digno.

Others, considering their religion to be true and having no doubt as to its truth, are of the opinion that they must defend it against the others by praising it as the best and suppressing those things in it which are reprehensible, and rejecting its enemies by any means that may come to mind. They do not worry about using lies, sophism, calumny or disdain (to achieve their aims) because, in their judgment, those who oppose their religion are either their enemy, in which case it is permissible to employ mendacity and sophism to reject and defeat them, as would occur in a holy war or in an ordinary war; or, if they are not an enemy, they nonetheless ignore, because of their scarce intelligence and discernment, the happiness that would accrue to them by practicing the religion; it is therefore legitimate to procure for them their own happiness, even by way of lies and equivocation, such as are used when dealing with women and children [a questionable ethical practice, certainly!].

May great glory be upon the Giver of help and intelligence, for he is worthy of such. (Alfarabi & González, 1953).
Appendix B
Farabi's *Enumeration of the sciences*

Chapter One
On the science of language
1. Science of language
   1. simple expressions
   2. composite expressions
   3. the rules governing simple expressions
   4. the rules governing composite expressions
   5. correct writing
   6. the rules governing correct reading
   7. the rules of poetry

Chapter Two

Logic (ilm al-mantiq). Divided into eight parts:
1. Rules governing simple intelligibles or ideas and simple expressions which signify these intelligibles (corresponds to Aristotle’s Categories).
2. Rules governing simple statements or propositions composed of two or more simple intelligibles; and composite expressions signifying the composite intelligibles (corresponds to Aristotle’s On Interpretation).
3. Rules of the syllogisms which are common to the five syllogistic arts—the demonstrative, the dialectical, the sophistical, the rhetorical, and the poetical (corresponds to Aristotle’s Prior Analytics).
4. Rules of demonstrative proof and the special rules by which the philosophic art is constituted (corresponds to Aristotle’s Posterior Analytics).
5. Rules governing the discovery of dialectical proof (corresponds to Aristotle’s Topics).
6. Rules governing the use of sophistic argument, which turns one away from truth to error and leads to deception (corresponds to Aristotle’s On Sophistic Refutations).
7. Rules governing the art of rhetoric (corresponds to Aristotle’s Rhetoric).
8. The art of poetry (corresponds to Aristotle’s Poetics).

Chapter Three

The propaedeutic (mathematical) sciences

1. Arithmetic, comprised of:
   a. the theoretical science of numbers
   b. the practical science of numbers
2. Geometry, comprised of:
   a. theoretical geometry
   b. practical geometry
3. Science of the heavens, divided into:
   a. judicial astrology
b. astronomy, including the study of:
   i. figures, masses, and relative positions of the heavenly bodies
   ii. motions of the heavenly bodies and their conjunctions
   iii. the earth’s climatic zones

5. Music
   a. Practical
   b. Theoretical

6. Science of weights

7. Science of tool-making

Chapter Four
On the science of astronomy

4. Science of the heavens, divided into:
   a. judicial astrology
   b. astronomy, including the study of:
      i. figures, masses, and relative positions of the heavenly bodies
      ii. motions of the heavenly bodies and their conjunctions
      iii. the earth’s climatic zones

Chapter Five
Physics (sciences of nature)

Physics
1. Knowledge of the principles which underlie natural bodies.
2. Knowledge of the nature and character of the elements, and of the principle by which they combine to form bodies.
4. Science of the reactions which the elements undergo in order to form compounds.
5. Science of compound bodies formed of the four elements and their properties.
7. Science of plants.
8. Science of animals.

Metaphysics (science concerned with the Divine and the principles of things)
1. Knowledge of the essence of beings.
2. Knowledge of the principles of the particular and observational sciences (the “first philosophy” of Aristotle).
3. Knowledge of non-corporeal beings, their qualities and characteristics, leading finally to the knowledge of the Truth, that is, of God, one of whose names is the Truth.

Political Science
1. Jurisprudence
2. Rhetoric (dialectical theology)

Appendix C
We will speak, now, in sum, of what logic is, its utility; the objects of which it treats; the significance of its title, the enumeration of its parts; and what each part contains.

The art of logic, in sum, provides the rules, whose object is to rectify understanding, to guide man directly upon the certain path, and to give him the assurance of truth in all those rational judgments in which he may err; likewise, to give the rules with which to safeguard and protect rational knowledge from fallacy and sophistry; likewise, to give the rules with which to appraise the truth of knowledge in which understanding is liable to err. Because it is of note that among rational judgments, there are those in which fallacy resides, while there are others in which it is not possible that understanding be mistaken in any form whatsoever; to wit, those judgments that man finds engraved in his soul, as though he had been born with certain knowledge of them. Such as these are the following: “The whole is greater than the part.” “Every number three is odd”. There are, besides, those judgments in which it is possible to fall into error and to stray from the truth and to fall into untruth. These judgments are those that are acquired through reflection and reasoning or through syllogism and induction. In order to attain certain truth in these judgments—and not in others—the man who seeks the truth in all his speculations has need of the canons of logic.

The art of logic is analogous to the art of grammar, since between the art of logic and the understanding of ideas there exists the same relation as between grammar and language and words. All of the laws that grammar imparts to language are analogous to those imparted by logic to ideas.

Logic also relates to ideas in the same way as does the art of prosody to verse metrification, such that all of the rules that prosody gives for meter are analogous to those that logic gives us in regards to the intelligibles.

What is more: the canons of logic, which are those instruments with which to assess the value of that intellectual knowledge which may confound understanding or which may lead to an imperfect understanding of the truth, resemble the instruments of weights and measures, which are used to measure many of those bodies about which we do not trust our senses to render us an accurate and precise account. They resemble as well measuring devices like the ruler, which are used to measure straight lines that the senses alone are unable to appreciate without error; or the compass, which is used to measure curved lines that the senses cannot be trusted to appreciate without error.

This is, in sum, the aim of logic, an aim that reveals its great necessity. And, this aim refers not only to those judgments which we ourselves possess and whose truth we wish to confirm, but also to the judgments of others, whose truth we want to assess, or to our own judgments, whose truth others wish to know. Because once we are in possession of those canons, if we want to acquire evidence of something that we do not know and whose truth we
want to appraise within ourselves, we will not permit ourselves to proceed blindly down some path, disregarding any law, adopting spontaneously whatever methods should occur to us—since they may deceive us into believing that which is not true. Rather, we will want to know beforehand what path we wish to follow, what things we wish to study, where we should begin our search, and how we should apply our energies discretely to each item that we wish to examine, such that we arrive, beyond a shadow of a doubt, at the thing which we have proposed to discover. Likewise, we will want to know what traps or obstacles lay in our path before we begin so that we may be prepared for them. Only in this way can we be sure of attaining the truth. Should we fall into doubt or suspect that we have overlooked some essential thing, immediately we can subject our findings to critical scrutiny so that we correct our mistakes and avoid any wrong turn.

This, then, will occur when we attempt to demonstrate the truth of our opinions to others, since in order to give visual evidence of the truth of our opinion, we will want to employ those methods and procedures that we have used to persuade ourselves, and should someone venture to contradict the arguments that support our thesis, we will provide evidence to sustain our assertions.

Likewise, when others wish to demonstrate the truth of an opinion, we will have the means by which to assess the value of their claims, which if demonstratively true, we will see clearly by what reasoning, so that we may admit their truth; or, in the case that they are false, we will discover the cause of their fallacy and error and so condemn and reject them.

Conversely, if we ignore logic, our situation in all of the above cases will be inverted; worse yet, it will be gravely inferior and shameful.

Another utility of logic consists in its allowing us to be on our guard and to take precise precautions against the unexpected; when we want to examine arguments that are contradictory or decide between two adversaries engaged in discussion, or to appraise the value of the arguments and claims invoked by each party in support of his opinion and in refutation of his opponent’s. Because if we ignore logic, we will not be able to certify on whose behalf the truth lies, nor how he who touched upon the truth did so, nor by what reasoning did he ascertain the truth, nor how it is that his arguments demonstrate necessarily the truth of his thesis. So that, in such case, we will expose ourselves, or remain perplexed by all of the opinions, without knowing which is true and which is false, or suspecting that all are equally true, in spite of their being contradictory, or believing that in none of them resides the truth, or resolving to admit some and to reject others, without knowing by what reason we admit or reject them. Therefore, if any of the contenders contradicts something that we have admitted or rejected, we will not be able to demonstrate to them the basis of our reasoning.

And if it should occur that in what we have admitted or denied there is anything that really was such as we thought, we could not be certain, in either case, that such was really as we believed it to be; but rather, on the contrary, we would remain always with the suspicion that all that we believe to be true could just as easily be false or, conversely, that what we have believed false could just as easily be true. Likewise, we could easily return to the contrary opinion in both cases, because it may well be that someone may present to us a new idea or a new idea occur to us, which should incline us to abandon the opinion which presently we had held to be true or false, in order to adopt the contrary. Therefore, in all of these cases, we shall have to conduct ourselves according to the adage: “like the woodsman at night.”
This same danger will occur when some men pretend to pass before us as extremely competent in some science or other. If we ignore logic, we will have no way to judge the value of their pretensions. Or, we will judge that everyone tells the truth, or we will hold everyone in suspicion, or we will hazard to distinguish between one and another; however, in all three cases we will decide based only on mere whim or caprice, without knowledge of the cause and without the assurance that he whom we purport to be a man of science is not in fact a reprehensible fraud to whom we have delivered our assent, who only deserves to be contradicted, and to whom we have given our preference, when we are being made a complete fool of, without our being aware; or, on the contrary it may be that the truthful man is the one whom we have doubted, and so unjustly reject, without realizing it.

Such are the pitfalls that accompany an ignorance of logic and the utility that knowledge of logic brings.

It is evident; furthermore, that logic is necessary for all those who do not wish to limit themselves to mere opinion in the formation of their judgments and beliefs. After all, mere opinions are those judgments that one forms without the assurance that later on they will not be abandoned for contrary ones. Now, for those who are content to base their judgments on mere opinions, logic is unnecessary.

There are those who pretend that the assiduous exercise of polemics or mathematics, such as geometry and arithmetic, will amply substitute for a study of the rules of logic, supplying one with the necessary faculty to critique any assertion, argument or opinion, or to direct one straightaway to truth and certainty, such that there will be no error in judgment. Those who hold this belief resemble those who think that by reciting and memorizing verses and rhetorical passages one can assimilate the rules of grammar and correct speech and avoid every defect of language while acquiring the faculty to critique the morphology of any word. The answer to those who would substitute for the study of grammar in this way is the same as for those who would substitute for the study of logic.

Likewise, there are those who pretend that the study of logic is superfluous and unnecessary because it is possible to find men, in some instances, so blessed with natural talent that they will never stray from the truth, though they know not a single one of the laws of logic. But, such as these are like those who suppose that grammar is superfluous because, among men, there are those who never will commit a grammatical error, though they are wholly ignorant of the laws of grammar. The answer as to the utility of the rules is identical in both cases.

The objects of logic, that is, that upon which logic gives rules, are the ideas or intelligibles, insofar as these hold a semantic or significant relation with words, or the words with the ideas.

This is so because we cannot assess the truth of a judgment within our soul except by reflecting, examining closely, and fixing within our soul certain ideas and objects whose function is to serve as the means with which to assess the truth of that judgment; and, equally, we cannot demonstrate to others the truth of a judgment, except by speaking to them with words that make them understand those ideas and objects whose function is to serve as the means with which to assess the truth of that judgment.

However, it is not possible to demonstrate the truth of any judgment that occurs to us with any ideas that come to mind, nor may the number of these ideas be something relevant, nor may the ideas be utilized for that aim, be they as they may, and organized and synthesized in
whatever form; but, on the contrary, for each judgment whose truth we wish to demonstrate, we must avail ourselves of certain, determinate ideas, of specific number, organized in a precise manner. To this end, we need perforce rules that will guide us and safeguard against any error in respect of ideas and their expression in words.

The ancients assigned two words—reason and verb (logos)—to the intelligibles (ideas) and the words that express them. However, ideas and words are of two types—internal and external. Internal ideas are those “engraved on the soul” and are expressed according to an inner voice. Their purpose is to confirm the truth of a judgment to the inner mind—a kind of internal reasoning or reflection. Conversely, we speak outwardly of our ideas when we wish to demonstrate their truth to others. We externalize our ideas through speech. The faculty of reason, whether employed internally or externalized through speech, is called syllogism by the ancients and is governed by the rules of logic.

Logic and grammar both supply rules for the use of words. They are distinguished by the fact that grammar prescribes rules only for a particular community of people whereas logic gives the rules of language that are common to all people. That is, logic is universal whereas grammar is provincial. Because it is noteworthy that words contain accidents or ways of being that are common to all peoples, such as, for example, that words are of two categories: isolated and single or compound and linked together; or that single words fall into three categories—noun, verb, and particle; verbs are classified as either regular or irregular, or things that are similar to these. But, there exist other ways of being that are exclusive to a particular idiom. For example, in Arabic, the subject of a proposition must be in the nominative case, the object in the accusative, and a noun already determined by a posterior genitive does not take a definite article. These and other properties are exclusive to the Arabic language. The same is true of other languages—they possess unique properties. Now, it is undeniable that some grammatical properties are common to all languages. However, grammarians will deal with these common properties only insofar as they concern their particular language; for example, the technical terms that Arab grammarians give to noun, verb, and particle (noun, action, letter), or that Greek grammarians give to parts of the sentence in the Greek language: noun, verb, and particle. This division is not unique to Arabic or Greek but is found in all languages; however, the Arab grammarians employ it insofar as is proper to Arabic and the Greek grammarians insofar as is proper to Greek.

Therefore, with respect to each language, grammar is studied only for that which is peculiar or exclusive to the language of that people or that is common to that language and to others; but only the part that is unique to that language is studied. And, this is the difference in the manner of studying words that exists between grammarians and logicians; because grammar gives the rules that are peculiar to words of a certain people and considers the phenomena that are common to a language and to others, not insofar as the common parts are concerned, but as regards that which is observed in said language, for which the grammar has been created.

On the other hand, the rules that logic gives are applicable to those phenomena which are common to the languages of all people and are considered as such. They do not treat what is exclusive only to a specific language. What is more: As regards that which is necessary to study of those phenomena that are peculiar to each language, logic defers to the authority of those men who are expert in that respective grammar.
Therefore, it is evident that the title of logic has been defined to encompass the totality of the aim which it proposes. Logic derives, in effect, from *logos*, a term which held three meanings for the ancients: 1) the word externalized by the voice, by which means the tongue expresses that which the mind holds secret; 2) the word that is engraved in the soul, that is, the idea or intelligible that we know instinctively and that is signified through speech; 3) the spiritual faculty imbued by God in the individual, which we alone possess, in contrast to all the other animals. With this faculty, we acquire the intelligibles or ideas, the knowledge of science, the intuitive capacity, and the ability to perceive beauty and right moral action. This faculty is present in all men. It is present in children as well though in a more exiguous, unrealized form, like a child’s foot while learning to walk, or a low flame before full combustion, as when setting alight the trunk of a palm tree. It exists also in the mentally infirm and the drunkard, though only as the faculty of sight exists in the eye that squints, or the eye that is shut in one asleep, or in the person who suffers a black-out or whose eye is blinded by a cloud or some other analogous thing.

And so: as logic gives the rules for the use of the external word and the internal word, and by means of these rules directs and rectifies reason, which is the essential faculty of man, in order to realize the proper function of the external and internal word in the best possible manner, in the most certain and perfect way; for all of this, a name derived from *logos* has been given, taking this word in all three of its meanings. Many books, that only give rules for the use of the external voice, that is, grammar books, are called by this same name. It is evident, then, that with all the more reason, the name should be given to the science which teaches the right use of the word in its three meanings.

There are eight parts of logic. In effect, the kinds of syllogism and the kinds of speech that can be used to demonstrate an opinion or any question, and the kinds of arts whose proper function (when they are perfect) consists in serving the spoken syllogism, can be reduced, in sum, to five: *apodictic, polemic, sophistic, rhetorical*, and *poetic*.

The function of *apodictic* speech is to produce certain knowledge in the resolution of a question. This applies whether one seeks to answer a question of a personal nature or to answer a question put forth by others. In all cases, the function of the apodictic is the same — to procure certain knowledge. Knowledge is certain when there is no possibility of it being other than it is, when the person who possesses it will not retract it for any reason nor even conceive of retraction as a possibility. Neither will there occur to any mind suspicion of error nor sophistic argument that would oblige a rejection of what is already known, nor doubts nor conjectures.

*Polemic* speech is used in two cases: 1) when one argues on the basis of accepted premises, for the purpose of persuading an adversary of the truth of a thesis, or to defend a thesis from attack. If one is defending or refuting an argument that is not based on accepted premises, then one is not engaging in polemics. 2) when man uses accepted premises as a means to suggest vehement suspicion of error in his own soul or in that of another person, in respect of an opinion whose truth he wishes to confirm, going so far as to imagine certainty where, in reality, none exists.

*Sophistic* arguments are used to purposely induce error in understanding, to confuse and distract, so that one begins to believe to be true that which is not and to hold as an eminent sage one who, in reality, is not, and to ignore as a true philosopher and sage one who truly is.
The word *sophistic* indicates an ability to deceive, to adulterate and falsify the truth by way of words, so far as to make others believe one of these things: that one is in possession of science, of philosophy and of perfection, and that the others are imperfect, though the truth be otherwise; or, that any thesis is false being true, and vice-versa.

It is a Greek word, composed of *sophia*, which means wisdom, and *isth*, which means false. It comes to signify, then: false wisdom. Therefore, all who possess the faculty to adulterate the truth and to deceive through words, about any matter, are designated by this name.

Some have said (though it is not as they suppose) that the name *sophist* is a proper name of a person who lived in ancient times and who habitually negated the reality of every sense perception and of all rational knowledge; and that his partners, those who followed his doctrine and defended his system, were called *sophists*, just as this same name was applied to all those who came after him and who sustained and defended the same idea. But, this explanation is a mere suspicion, audacious and stupid in the extreme, because neither in past centuries did there exist any man whose system consisted in negating the reality of the sciences and of sense perceptions and to whom was applied such a name, nor did the ancients designate as such any particular man because they considered him as follower of a teacher known as *sophist*. On the contrary, if they had called someone by this name, it was only because of the technical ability that he possessed, the special way of speaking that he used, and the ability that he had to deceive and to perfectly confuse any person; just as they designated someone by the name *polemicist*, not because they considered him as follower of a teacher named *polemicist*, but because he possessed the technical ability, the special way of speaking, which consists in the perfect use of the art of discussion with any person. In like manner, therefore, a *sophist* is someone who possesses that virtue and that art; and *sophism* is the same art or technical ability, and its action or performance is also called *sophistic*.

*Rhetorical* speech is that whose function is to persuade a person of some opinion, to incline a person to trust in the truth of what one says and to obtain assent, of greater or lesser intensity, because those opinions which are held on the basis of mere persuasion, albeit of lesser intensity than those based on a high degree of probability, are nonetheless admitting of various gradations: Some are more firmly held than others, according to the speech that produces them. For there is no doubt that certain speeches are more persuasive, more efficient, more eloquent, and more trustworthy than others. The same is true of testimonials — the greater they are in number, the more eloquent and efficacious they are for persuading and convincing one of the truth of an assertion and for attaining strong assent. Further, in spite of the various degrees of intensity of persuasion, no form of rhetorical speech is capable of producing assent of so high a probability that it approximates certainty. Rhetoric differs from polemic in this regard.

*Poetic* speech is composed of elements whose function is to stir the imaginative sense towards ways of being or speaking, whether these be of excellent or vile quality, such as, for example, beauty, loyalty, nobility, abjection, or other qualities of this sort.

Upon hearing poetic speech, something occurs in our soul, via the effect on our imaginative faculty, that is analogous to what happens when we see an object that resembles something repellent; no sooner do we see it than our imagination represents it to us as disgusting and we distance ourselves from it immediately, even though we are quite certain that, in reality, the object is not what we imagine. So it goes, then, that even knowing that what is suggested by poetic speech is not in fact real, we behave as though it were because man, in many instances,
behaves in consequence of what he imagines, more than in accordance with what he believes or
knows; and quite often what he believes or knows is contrary to what he imagines. Just this
occurs to us when we look upon images that are representative of something, or upon objects that
resemble something else.

Poetic speech is used solely in directing the word to a man in whom we wish to excite the
inclination, by artfully playing upon his emotions, to do a particular thing or act in a certain
way. But, this cannot occur except under two hypothetical situations: 1) When the person whom
one is trying to influence is lacking in reflective capacity [reason] and therefore must be moved
to act by means of the imagination, in this case a substitute for reflection; or, 2) when one means
to influence someone whose reflective capacity is strong and who is unlikely to act except upon
careful reflection; in this case, one will need to entertain the subject with poetical phrases such
that the imagination supersedes reflection and the subject embraces, precipitously, what is being
suggested before proper reflection can take hold, reveal the consequences of action, and cause
delay or retraction.

It is only poetic speech which is beautiful, ornate, full of emphasis and redundancy, and
polished with the splendor and brilliancy that the resources of logic afford.

It is the case, then, that the kinds of demonstration, the demonstrative arts, the various
manners of speech that are used to prove a thesis in every matter, are five in number: certain,
probable, falacious, persuasive, and imaginative.

Each one of the five arts contains properties which are exclusive to it and
properties which are common to all the others.

Demonstrative speech, whether of the type “engraved on the soul” or that
externalized by the voice, consists, in the first place, of various ideas or intelligibles organized in
such a way as to prove the truth of something; in the second place, of various words, similarly
organized, to give expression to those ideas. The words perform the role of auxiliary to the ideas
for the purpose of demonstrating to the listener the truth of a proposition.

The auditory phrases which consist of fewer elements are composed of only two
words—such as adjective and noun. These correspond to mental thoughts or ideas of similar
number and are called simple.

Demonstrative speech is made up of simple and composite phrases, the simple containing
only two elements, the composite a potentially much greater and undefined number.

All demonstrative speech, therefore, consists of two kinds of elements: the greater
elements, which are the simple phrases, and the lesser elements, which are the elements of the
elements, that is, the isolated ideas and the words that express them.

It may be inferred from here that there are necessarily eight parts of logic, each one of
which is contained in a special book.

Book #1, which contains the rules regarding single ideas and the words that express
them. This book is entitled in Arabic Almaculat (Categorieae) and in Greek Kathgariai (Categories).

Book #2, which contains the rules regarding simple phrases treating of only two isolated
ideas or the two words that express them. This book is entitled in Arabic al—ibara (De
Interpretatione), and in Greek Perihermneias (On Interpretation).

Book #3, which contains the rules by which to evaluate the five demonstrative arts. This
book is entitled in Arabic, al-qiyas (Analytica Priora), and in Greek, Analutika (Prior Analytics).
Book #4, which contains the rules by which to evaluate apodictic (demonstrative) and other statements used to frame philosophical questions so that the most complete, excellent, and perfect answers are obtained. This book is entitled in Arabic, Kitab al-burhan (Analytica Posteriora) and in Greek, Analutika (Posterior Analytics).

Book #5, which contains the rules that are used to appraise the value of polemic speech, the method of objection, and dialectic response and, in sum, all of the rules that systematically comprise the art of controversy, so that these operations yield the most perfect, excellent, and efficacious results possible. This book is entitled in Arabic, Kitab al-mawadi al-yadabiyya (Topica), and in Greek, Topika (Topics).

Book #6, which contains primarily the rules that govern the means by which to distract understanding from the path of truth, deceiving one and leaving one perplexed. This book enumerates all the resources that one uses to alter the truth and to falsify subtly the truth in knowledge and in speech. It enumerates besides the necessary means by which to discover sophistic speech, as used by the falsifier and the fraud; it explains how to resolve [matters] and that which one must reject and how to safeguard man from falling into sophism in his investigations or from inducing error in others. This book is called in Greek, Sofistika (Sophistica), which means false wisdom.

Book #7, contains the rules by which to examine and appraise the value of rhetorical speech, of the various kinds of oratory, of the manners of speaking employed by men of letters and by orators, to determine whether or not they comply with the proper method of rhetoric. These rules enumerate all of the elements that contribute to the art of rhetoric, making known the artificial manner of composition that pertains to this art, and the resources with which to obtain the most excellent and perfect results possible and the most eloquent and effective performance that can be had. This book is called in Greek Texnhphtopikh, which is, in Arabic, al-jitaba (Rhetorica).

Book #8, which contains the rules by which to examine poetry and poetic speech in general, and those particular classes of poetry, according to material. These rules enumerate all of the elements that comprise the art of poetry, how many of the parts there are, how many classes of poetry and poetic speech, the manner with which to compose each of these, what resources to use in the composition, how to ensure that the poetry is of an organic whole, and endowed with the greatest beauty, emphasis, brilliancy, and good taste possible, and, in sum, what qualities must be united in order that its eloquence reaches maximum effect. This book is called in Greek Poieutikh, in Arabic, Kitab al-si ar (Poetics).

These are the parts of logic and the summary of all the materials that each one of the parts contains.

Of all these, the fourth part is the primary and the principal, on account of its nobility and superiority.

The only aim that logic proposes to realize, intentione prima, is that fourth part; all the other parts have been made owing to the fourth, since the three that precede it in order of instruction, are preliminary, introductory, paths to arrive at it; and the four remaining [parts] that follow it obey two causes: the first, that in each of these parts there are rules that serve as aids and auxiliaries, something like instruments for the fourth part, to which some contribute more than others; and the second cause, which is to safeguard against confusion; because if one does not distinguish well between these demonstrative arts, with distinction in practice one from the
others, until able to know the rules of each of them separately, distinguishing the rules of some from others, man will not have the assurance, when he seeks certain truth, of not using dialectical arguments, without knowing what they are, and thus stray from certainty into mere probable opinions; or to employ, unawares, rhetorical proofs, which only lead to persuasion, or to use, without thinking, sophistic reasonings, which either will make him suspect that to be really true what is not, or to remain in a state of negative doubt; or to avail himself, without realizing it, of poetic phrases, and so formulate his judgments, based upon mere imaginative representations. So, in each and every one of these cases, man will obstinately believe that he is following the path to truth, and that he has found what he is looking for, without having actually done so.

In the same way, one who is not able to distinguish between food and medicine and poisons, by means of the signal characteristics which pertain to each, will not know which is which, and will take the poison, believing it to be food, and thus perish miserably.

The aim of these last four parts, intentione secunda, is to provide the technicians with the means needed for each respective art, so that man knows, when he wants to become an able polemicist, how many things he must learn, and what means he must use, to appraise, in his own soul and that of others, the value of his affirmations and to know with these whether he marches upon the path of dialectic. In the same way, if he wants to become an eloquent orator, he will know how many things he must learn, and by what means he will need to examine in himself and in others the character of his affirmations to see whether they exhibit the rhetorical method or another method. Likewise, if he wants to be an excellent poet, how many things he will need to learn for this, and what he will need to know in order to examine in himself and in other poets whether his elocutions follow the poetic method or stray from it into something else. In the same way, he will know, if he wants to possess the faculty of deceiving others, and to avoid being deceived, how many things he must learn for this, and what resources he must use to critique every phrase and every idea, and to ascertain if he deceives himself or if others deceive themselves, and in what point is to be found the error.