

John Dee's "Mathematicall Praeface": A Sixteenth Century Classification of the Mathematical Arts and Sciences

CHARLES ST. CLAIR, Norman

Interest in the classification of knowledge is centuries old. Various philosophers, each seeking to encompass all knowledge in one system, have devised their own universal classification. Representative of such attempts are the divisions of knowledge traditionally made by Platonists—physics, ethics, and logic¹—and the Aristotelian classification of knowledge into practical, productive, and theoretical.² Both systems have been modified and elaborated repeatedly by subsequent philosophers; moreover, aspects of the Platonic or the Aristotelian classifications are found in most later classifications of knowledge. Examples of later, dependent classifications are those of Martianus Capella (flourished ca. 470), Cassiodorus (ca. 490-ca. 580), Isidore of Seville (ca. 560-636), Bede (ca. 673-735), Hugh of Saint Victor (ca. 1096-1141), Francis Bacon (1561-1626), René Descartes (1596-1650), and Auguste Comte (1798-1857). Among the philosophers of the sixteenth century who promulgated classifications of knowledge were Mario Nizolio (flourished ca. 1553), Peter Ramus (1515-1572), and Thomas Campanella (1568-1639) on the European continent, and Robert Recorde (died 1558) and John Dee (1527-1608) in England.³

John Dee was educated at St. John's College, Cambridge, from which he graduated in 1546. After that, he traveled and studied in France and the low countries and then settled near London in 1551. He had a contemporary reputation, gained principally from his mathematical ability, as a scholar of the highest caliber. Dee was partial to mathematics and natural science, but he was widely read in all areas of learning. In later life he became interested in crystal gazing and alchemy. His seances and his experiments in natural magic became the only expressions of his lifelong optimism in the powers of science and mathematics. The last decade of his life was spent in senility, obscurity, and universal neglect.⁴

As a result of his studies, Dee wrote nearly eighty treatises. Most of them were never printed, and many are known today only by title, the original treatises having been lost. Dee's best known work is the preface for the first English-language edition of Euclid's *Elements*, published in 1570.⁵ The "Mathematicall Praeface," as it was called, afforded him a measure of contemporary fame among later sixteenth century students of mathematics; it was reprinted in 1651 as a preface to Thomas Rudd's edition of the first six books of the *Elements*.⁶ The preface is a systematic enumeration of many of the mathematical arts and sciences, their mutual relationships, and the state of their development by 1570. It is also a classification of knowledge. Compared to other sixteenth century classifications of knowledge, Dee's classification is incomplete since he did not discuss some areas considered important by contemporary writers.

In describing and classifying the various arts and sciences, mechanical and liberal, theoretical and practical, Dee included many generally accepted notions of what comprised a classification of knowledge. His system shows the mathematical element identified with Platonic classifications and the dichotomous practical and theoretical divisions of knowledge identified with Aristotelian systems. Superficially, Dee's classification appears to be an accumulation of separate sciences—astronomy, geography, etc.—molded into a co-ordinate arrangement. But it is more than that. Dee had a novel twist; he chose to make mathematics the essential principle of being, common to all things and thus fundamental to all knowledge. In Dee's system, mathematics assumes a primary role. It is

not just one of several co-equal branches of knowledge as was usual in other classifications of knowledge. In Dee's ontology, anything that has being is supernatural, natural, or mathematical. Natural things have material substance, supernatural things have spiritual substance, and mathematical things are non-substantive. The spiritual and material substances exist independently of one another, but super-imposed on each substance is the ordering principle of mathematics. Mathematics, although non-substantive, has an objective, absolute existence. It is not derivative nor dependent; it is mathematics *per se*.⁷ Mathematics, applicable equally to all subjects, is the basis of a universal wisdom, the discovery of which, Dee maintained, should be the ultimate purpose in studying the sciences.

Dee illustrated his ontology with the metaphor of a tree. He compared mathematics to the trunk of the tree and the sciences and arts to branches on that trunk, but the branches were to be considered as grafts of another substance upon the main trunk. In the metaphor each of the sciences and arts is represented by a branch of a different material because each science and art has its own assumptions and chain of deductive reasoning; however, all are linked, as branches grafted to a tree, to mathematics. Although of different substance, all grafted branches are dependent upon the main trunk. So, according to Dee, are all sciences and arts dependent upon mathematics. The metaphor illustrates the dependence of all things on mathematics; it also illustrates the duality of natural and supernatural things and the unity of mathematical things. Dee carefully avoided mentioning how the non-substantive mathematics could be compared to the substance of a tree trunk.⁸

Dee did not sharply divide the world of the divine from the world of nature. In his system both worlds exist independently but are brought together by mathematics. Mathematics is the principle whereby material, natural substance is ordered and whereby immaterial, supernatural substance is ordered. Mathematics, the universal essence of all material and spiritual things, is built into the fabric of both worlds. There could be nothing more reasonable, for mathematics is "the principall example or patterne in the minde of the Creator."⁹ Through mathematics all arts and sciences are conjoined and interdependent. As a result, Dee saw mathematics as the road to the esoteric, universal wisdom, a sort of universal mathematics, that could place one in command of both heaven and earth. The pursuit of one area of knowledge would be helpful in pursuing any other area of knowledge due to the mathematical link between them. The universal nature of mathematics would enable one to descend to natural understandings as well as to ascend to supernatural understandings. Universal mathematics is not restricted, as are the different sciences, to a special subject. It, therefore, excels in utility and simplicity all of the sciences, which are subordinated to it, because it can deal with all the objects of which the sciences have cognizance and many more besides. Dee believed that an examination of the method of mathematics could reveal to one the nature of that universal mathematics. Dee thought that by means of analysis in the natural world one obtains facility with and understanding of mathematics, and then by means of synthesis one arrives at universal mathematics.¹⁰

Classification systems frequently include logic and rhetoric as parts of knowledge, although they may also be considered as instruments of knowledge, that is, regulative laws of thought, and not a part of knowledge. Plato, for example, included logic as a co-ordinate science, but Aristotle, considering logic as an organon, excluded it. Dee never explicitly designated logic as an instrument, without being and hence not a part of knowledge, but he implied this when he said a person handling differently the same subject matter that he treated would be called a "logicien" or a "rethoricien."¹¹ With one sentence he dismissed the difficult problem of

the place of logic and rhetoric in a system of knowledge, and he left his reader in doubt as to their role.

The major portion of Dee's work is a description of the mathematical arts and sciences, all of which are derived from theoretical arithmetic and theoretical geometry. In this way he hoped to illustrate his view that mathematics is the unifying principle of being. He said:

God . . . hath Created all thynges, in Number, Waight, and Measure: So, to vs of hys great Mercy, he hath reuealed Meanes, whereby, to attayne the sufficient and necessary knowledge of the foresayd hys three principall Instrumentes: Which Meanes, I haue abundantly proued vnto you, to be the *Sciences* and *Artes Mathematicall*.¹¹

The derivative arts and sciences referred to, which he discussed, are vulgar *Arithmetike*, the art of manipulating and comparing numbers; vulgar *Geometrie*, the art of measuring anything; *Perspectiue*; *Astronomie*; *Musike*; *Cosmographie*; *Astrologie*; *Statike*; *Anthropographie*, the science of man; *Trochilike*, the art concerned with all circular motions; *Heliocosophie*, concerned with the properties of spiral lines; *Pneumatithmie*, pneumatics; *Menadie*, concerned with the multiplication of forces; *Hypogelodie*, concerned with the correlation of surface features of the earth with subterranean features; *Hydragogie*, the art of getting water to where it is wanted; *Horometrie*, the study of time; *Zographie*, the graphic arts, especially painting; *Architecture*; *Naigation*; *Thaumaturgike*, the art of mechanical illusions; and *Archemastrie*. The last, *Archemastrie*, is the art of practical mathematics, which to Dee meant supreme skill in applied arts and sciences.¹²

In the preface as in life, Dee's accomplishments fell considerably short of his visions. He had a strong belief in the unity of all knowledge, and having accepted the Neoplatonic idea of the transcendental importance of mathematics, he not unreasonably accounted for the unity he knew to exist by subordinating all being, and therefore all knowledge, to mathematics. But his thoughts were disconnected, his digressions were legion, and his materials borrowed. His originality was limited more to proposing a few new arrangements of old ideas than to innovations. Dee thought mathematics was the key to all the secrets of the material world, and throughout the preface he cited examples of the utility of mathematics. Nevertheless, he believed in the ultimate superiority of contemplative rather than practical mathematics; the contemplative alone could show the way to immutable and eternal knowledge, to a knowledge of God. Dee's survey of the mathematical arts and sciences, presented in the "Mathematicall Praeface," is one man's sketch of the intellectual world of the sixteenth century. It indicates many areas of knowledge that had been acquired by the human mind, and points a prophetic finger in the direction of some conquests still to be made, but as a classification of knowledge it is an incomplete picture of the intellectual world of the sixteenth century.

NOTES

¹Plato *Republic* vii.

²Aristotle *Metaphysics* 1025^b. 25-27.

³See Robert Flint, *Philosophy as Scientia Scientiarum and a History of Classifications of the Sciences* (New York: Charles Scribner's Sons, 1904), pp. 67-131; Harry Austryn Wolfson, "The Classification of Science in Mediaeval Jewish Philosophy," *Hebrew Union College Jubilee Volume*

(1875-1925), ed. David Philipson, et al. (Cincinnati: Hebrew Union College, 1925), pp. 263-315.

*See Charlotte Fell-Smith, *John Dee (1527-1608)* (London: Constable & Company, Ltd., 1909); Thompson Cooper, "Dee, John (1527-1608)," *The Dictionary of National Biography Founded in 1882 by George Smith*, ed. Leslie Stephen and Sidney Lee, Vol. V (1937), pp. 721-29.

*Euclides, *The Elements of Geometrie of the Most Auncient Philosopher Euclide of Megara. Faithfully (Now First) Translated into the Englishe Toung, by H. Billingsley, Citizen of London. Whereunto Are Annexed Certaine Schooles, Annotations, and Inuentions, of the Best Mathematicians, Both of Time Past, and in This Our Age: With a Very Fruitfull Praeface Made by M. I. Dee, Specifying the Chiefe Mathematicall Sciēces, What They Are, and Wherunto Commodious: Where, Also, Are Disclosed Certaine New Secrets Mathematicall and Mechanicall, vntill These Our Dales, Greatly Missed* (London: Iohn Daye, [1570]). The running title of Dee's preface is "Iohn Dee His Mathematicall Praeface." The preface will be cited hereafter as Dee, "Mathematicall Praeface."

*Eva Germaine Rimington Taylor, *The Mathematical Practitioners of Tudor & Stuart England* (Cambridge, England: Cambridge University Press, 1954), pp. 170, 358.

'Dee, "Mathematicall Praeface," p. [] .iii.j.verso.

'*Ibid.*

'*Ibid.*, p. * .j.recto.

'*Ibid.*, pp. a.ij.verso-a.ii.j.recto.

'*Ibid.*, p. a.ii.j.verso.

'*Ibid.*, p. A.iii.j.verso.

'*Ibid.*, pp. * .j.verso-A.ii.j.verso.
