Journal of the Northern Renaissance

http://northernrenaissance.org | ISSN: 1759-3085

Issue 6 (2014) - Numbers

The Number of Motion: Camillo Agrippa's Geometrical Fencing and the Enumeration of the Body

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[1] Camillo Agrippa (c. 1520–1600) was a sixteenth-century architect, engineer, and natural philosopher. Born in in Milan, he spent the majority of his career in the hothouse of patronage and politics that was Renaissance Rome, where he was associated with Farnese and Medici circles and was also a member of the Confraternity of St. Joseph of the Holy Land, itself a centre for artisans and artists (Anglo 2000; Mondschein 2014: xxi–xxiii; Lincoln forthcoming 2014). It is not Agrippa's hydraulic engineering, his plan to move the obelisk to St. Peter's, his navigation, or his tomes of natural philosophy that proved his most enduring legacy, but rather his first-published work, the 1553 *Treatise on the Science of Arms*. Though written, like all his books, in Italian, the *Treatise on Arms*, which was dedicated to Cosimo I de' Medici, was not only popular and read throughout Europe — several copies appear, for instance, in the library of the dukes of Saxony (von Bloh 2012: 207)— but also a major influence on the fashion and style of the northern Renaissance. In this work, Agrippa explains a new system for using the 'wearing sword' then carried as a sidearm and indispensible article of dress by all men of rank. Within a generation, works appeared in France, Holland, Germany, and England explaining fencing after Agrippa's principles, and the fashionable sidearm had lengthened and narrowed into what we know today as the rapier. Though usually not as explicitly mathematical as Agrippa's original treatise, the education of a young man of means would still include instruction on how to act as Mercutio describes Tybalt in *Romeo and Juliet*: as someone who 'fights as you sing prick-song: keeps time, distance, and proportion. He rests his minim rests: one, two, and the third in your bosom' (II.3.18-20).

[2] The Bard's jibing was rooted in reality: Agrippa explained his system of fencing by reducing not just all possible actions, but the human body itself, to mathematical symbols, giving possible actions and responses in the language of Euclidian geometry. As he tells us, 'this pursuit is ultimately governed by points, lines, times, measures, and so forth, and comes from thinking in a mathematical — which is to say, a geometrical — fashion' (Agrippa 1553: I.2; trans. Mondschein 2014: 10: *…in fine questa Professione si governa solamente con punti, linee, tempi, misure, et simili, et nascono in certo modo da consideration' mathematica, o sia pur sola Geometria*). Furthermore, since as Shakespeare noted, fencing takes place not only in space ('distance'), but also in time, Agrippa explains when to perform one's operations by using the Aristotelian conception of time as the 'number of motion with respect to the before and after' *(Physics,* IV.11).

[3] Moreover, in the astronomical dialogue appended to the treatise, he makes the implicit argument that because of his mastery of number in space and time (that is, the classical quadrivium), he has the authority to speak on any subject whatsoever. According to Agrippa's way of thinking, both astronomy and the movements of the human body are the union of number in space (that is, geometry) and number in time. Number, in other words,

unites the macrocosm and the microcosm — what Steven Shapin in his synthesis *The Scientific Revolution* calls the 'animistic' tendency of Aristotelian knowledge (Shapin 1996: 29). By applying this use of number to a subject of concern to both the ruling classes and those who aspired to such status, Camillo Agrippa both reflected and contributed to the vernacularization of a mathematical conception of the world and the idea of number as the underpinning of reality. This accords well with the 'Zisel thesis,' which posits that the scientific revolution was enabled by formally educated members of the elite coming into contact with the upper strata of craftsmen. Pamela Long, in her recent and acclaimed revitalization of this idea, identifies 'artisan-practitioners' as key to the production and spread of scientific knowledge — a category that certainly encompasses fencing masters (Long 2011).

[4] Agrippa participated in the pedagogical changes of the sixteenth century in other ways, as well. Whereas earlier authors had their students follow patterns, much as medieval artists copied models or writers copied letters, Agrippa emphasizes a deductive approach to fencing pedagogy. He also rejects dogmatic authority, replacing it with his own experience and reason and so we can see in fencing a parallel to changing ideas of education. Likewise, with the increasing emphasis on fencing as a 'science', masters after Agrippa presented their works as 'discourses' or 'reasonings' (*ragiomento* or *ragione*) — a whole new way of thinking that presents an argument, discourse, or dialogue on a subject, rather than merely acting as a memory-book, as had earlier fencing works.

[5] Of course, Agrippa did not come *ex nihilo*. Rather, he was situated not only in scholastic and humanist traditions, but also in a court culture that had for several generations merged the martial with the numerical. Writers on arms in Italy from the fifteenth century onwards had deployed conceptions of a mathematical construction of the universe in their explanations of martial arts. (Writers in Germany did so as well, and at an earlier date, though the German style of fencing was neither as fashionable as the Italian, nor came to use such a wide array of mathematical conceptions.) I do not propose in this brief paper to trace the entire history of fencing, or to provide the reader with detailed arguments hinging on obscure technical details, but rather to give a brief overview in plain language of numerical conceptions in Italian fencing-books, and to then discuss Agrippa's contributions and legacy. Finally, I will discuss his successors, especially Girard Thibault and his geometrical system of fencing — and how these enumerations of both the universe and of human operators within the universe, while situated in traditional knowledge, also reflected and helped to spread the on-going Scientific Revolution. Just as Johan Huizinga spoke of chivalry as 'an aesthetic ideal assuming the appearance of an ethical ideal' (Huizinga 1924: 58), Agrippa and his followers invested in an aesthetic-moral apparatus that saw the human world as linked to the divine, operating within a paradigm that expressed itself through instruments as diverse as astronomy, music, and fencing.

Writers before Agrippa

[6] The first Italian fencing writer who explicitly invokes ideas of number is Filippo Vadi, who was born to a noble Pisan family, served as a counsellor to Borso d'Este, Duke of Ferrara, and produced at least one illustrated manuscript dedicated to Guidobaldo da Montefeltro, Duke of Urbino in the 1480s (National Central Library of Rome Cod. 1324: f.

15r; Mele and Porzio 2002: 4–5). Vadi's work is clearly derived from the earlier manuscripts of Fiore dei Liberi (fl. c. 1350–1420) in the Estense library (Mondschein 2011). However, whereas dei Liberi only makes passing reference to scientific theory, such as that 'heavy things are great impedances to light ones' (Aristotle, *Physics* VIII.4; Mondschein 2011: 47–d), Vadi gives a detailed argument that fencing, like music, is a science, arguing that the sword is subject to Euclidian geometry:

> Geometry divides and separates
> with infinite numbers and measures
> that fill pages with knowledge.
> The sword is under its purview
> since it is useful to measure blows and steps
> in order to make the science more secure.
> Fencing is born from geometry
>
> ….
>
> Music adorns this subject
> song and sound together in art
> to make it more perfect by science.
> Geometry and music together
> combine their scientific virtue in the sword
> to adorn the great light of Mars.
>
> *La geometria che divide eparte*
> *Per infiniti numeri emisure*
> *Che impie di scientia le sue carte.*
> *La spade e sotto posta a le sue cure*
> *Convien che si mesuri i colpi e i passi*
> *Acio che la scientia tasecure*
> *Da geometria lo scrimir se nasce*
>
> ….
>
> *La musica ladorna esa sugetto*
> *Chel canto elsono senframette in larte*
> *Per farlo di scientia piu perfecto*
> *La geometria e musica comparte*
> *Le loro virtu scientifiche in la spada*
> *Per adornare el gran lume de Marte*
>
> (NCLR Cod. 1324: f. 4r; Mele and Porzio 2002: 42–43)

[7] One might rightfully ask how, exactly, we are supposed to 'measure' the chaotic movements of a sword-fight: The measure that saved you one day might kill you the next. The answer, not explicitly given in any treatise but understandable in context if one is an experienced fencer, is that we measure space not absolutely, but relatively —that is, space is

measured not with some fixed metric (which is an Enlightenment idea in any case), but rather by comparing one measurement with another. Thus, no matter what angle at which a blow arrives, it should always be crossed obliquely. This is measurement in the sense of the reckoning of magnitude, not in the sense of referencing an absolute metric — in other words, Shakespeare's 'proportion'. It is geometrical measurement of the sort used in architecture and, as Fiore had before him, Vadi deploys dividers, the icon of rationalized measurement, to represent the mental skills required to become a proficient fencer. These are seen over the head of the figure in his *segno*, an allegorical diagram showing the attributes a swordsman must possess.

Figure 1: Vadi's segno, showing the qualities needed by a swordsman. Courtesy Wikimedia Commons and the Wiktenaeur.

[8] Dividers thus symbolize not only the measurement of space, but also of time, since one must also measure one's actions and execute them at the proper moment. Feint to the left; in the length of time created by the adversary covering the imagined attack, strike him on the right. In other words, like space, we are to measure one time relatively against another, after the Aristotelian dictum that time is 'the number of motion with respect to the before and after' (*Physics* IV.11). Agrippa's Florentine contemporary, Francesco Altoni, who worked in the Medici court, even explicitly says that 'time is nothing more than the space of motion' (Altoni 2007: 76: *il tempo non è altro che spatio di moto*). To be successful, an action must be made in a shorter 'space' than the opponent's counteraction, and Altoni, Vadi, and other writers all make use of terms describing the Aristotelian proportional measurement of time such as 'half-time' and 'double time'—in other words, measuring the space of time relatively, one against the other.

[9] Aristotelian ideas of the measurement of time are seen in fencing literature as early as Germanisches Nationalmuseum Nuremberg Codex 3227a, a commonplace book dated to 1389 and containing not only magic spells and recipes for food, alchemy, and the hardening of iron, but also several fencing texts. Notably, it is the first record of the teachings of the enigmatic (and possibly apocryphal) fencing master Johannes Liechtenaeuer, whose *merkverse* (teaching poem), repeated in a German manuscript and print tradition that

lasted well into the sixteenth century, makes use of explicit Aristotelian terminology: 'Before, after, weak, strong, 'at the same time,' you must remember that word' (GNM 3227a: 17r: *Vor noch swach sterke | yndes das wort mete czu merke*). On the reverse side of the folio, the anonymous scribe makes the Aristotelian connection even more clear:

Motus das worte
schoneist des fechtenseyn
hort und krone

Motion [*motus*], that beautiful word
is to fencing
a heart and crown

(GNM 3227a 17v)

The manuscript context of the fencing book makes its intent clear: By mastering the principles on which the universe operates and learning useful skills, one empowers oneself—and key to learning the art of fencing is undertaking an Aristotelian analysis of time and movement as the 'number of motion with respect to the before and after'.

[10] The similarity of the proportional measurement of time and space is fully congruent with late Scholastic natural philosophy. For instance, William of Ockham (c. 1287–1347) likens measurement of time to measurement of space by saying that we can know a duration of time against a conventionally determined period, just as a yard is a measure of length of cloth. Ockham tells us that as a rough estimate, we can estimate the time in reference to a pre-known quantity — though this second way, however, presupposes familiarity with the first, more precise method (Ockham 1634: IV, 3). Likewise, Jean Buridan (fl. c. 1320–1358) says much the same thing as Ockham: 'by time and by motion, which is time, we indeed measure other motions' (Buridan 1964: IV.13: *per tempus et per motum qui est tempus mensurant bene alii motus*).

[11] These Scholastic glossae of the *Physics* are ultimately derived from Arisotle's observation that, like lines, we must have two times—that is, two 'numbers of motion' — to compare one duration against another (*Physics* IV.12), as well as St. Augustine's observation that we can only know time as the ratio of the duration of observed things as perceived by the intelligent soul: 'In you, O my soul, I measure time' (*Confessions* XI.26: *In te, anime meus, tempora metior*). This sort of comparative time reckoning was common in a world without mechanical timepieces. For instance, medieval people measured how long to cook something by the amount of time it took to say certain prayers, such as occurs many times in *Le ménagier de Paris*; for instance, "boil it in sweet water for the space [of time] it takes to say a *misere*" (*boulir une onde en eaue doulce par l'espace de dire une miserelle*) (Anonymous 1846: 2.244). This is why Agrippa and other fencing writers do not discuss time in distance in terms of integers or formulae — 'number' as we would recognize it: Aristotle and his Scholastic followers saw the geometrical proportional measurement of space and time, which include infinite divisions and irrational measurements, as different from the arithmetical use of number (Evans 1955). Rather, we may consider it as more similar to the comparisons of magnitudes.

[12] Though by Agrippa's era the idea of 'tempo' had become a common term of art in Italian fencing — just as, north of the Alps, fencing writers continued to describe actions as happening in terms of the Aristotelian 'before' and 'after' (*vor* and *nach*) —this is not to say that all Italian fencing-book writers incorporated ideas of measurement into their works. Even though the best-selling writer of the early sixteenth century, Achille Marozzo, who published his *Opera nova* in Modena in 1536, came both from the university town of Bologna and from a line of fencing mathematicians, he was not particularly 'scientific' in a sense that a modern writer would recognize. His teacher's teacher, Filippo di Bartolomeo Dardi, was a professor of arithmetic and geometry at the University of Bologna before his death in 1464 (Pantanelli 1930: 45–49). Though Marozzo does use the common idea of 'tempo' (which he assumes the reader understands), he is not a theorist. To learn to fence from Marozzo was to be initiated into a craft-guild, or *mestiero,* and having to swear oaths to God, the Virgin, and St. George. Like a medieval memory-palace brought to life, Marozzo has his students run through a series of postures with colourful mnemonic names, such as the 'guard of the long and extended tail,' 'head guard,' 'face guard,' and 'iron door guard of the boar,' and then put them together into a series of lessons (trans. Mondschein 2014: xvii). In this, it is similar to works such as a Florentine fragment, MS 01020 in the Fisher Rare Book Library at the University of Toronto, from the 1420s, or Royal Armouries MS I.33 from 1320s southern Germany (Forgeng 2010). Thus, though we have fencing books sometimes invoking ideas of number, we do not have enumeration. The quantitative turn that placed control of the universe in the hands of the mathematician-practitioner was absent in this genre until Agrippa's treatise of 1553.

Agrippa, Fencing, and Number

[13] Agrippa's endeavour to reduce fencing to 'mathematical' or 'geometrical' way of thinking went far beyond his use of Aristotelian ideas of time and his application of Euclidian geometry. Not only did he reduce the earlier multiplicity of guard positions to four numbered positions that can cover all contingencies — four being the Pythagorean tetracys — but he reduced all the possible positions of the body to a finite number labelled by the letters of the alphabet (trans. Mondschein 2014: 8).

[14] As far as fencing goes, what does Agrippa actually say to do, and how was this different from other writers? To begin with, Agrippa tells us that, on the theory that the closest distance between two points (i.e., one's sword's point and one's enemy's body) is a straight line, the best guard position is with the point threatening the target and the arm held in front of the body (trans. Mondschein 2014: 16). All four of Agrippa's primary guard positions follow this principle. This is in contrast with other author-practitioners of his generation such as Altoni, who, even if they favoured keeping the point forwards, cock the arm back behind their shoulder to make a stronger, full-arm thrust. Agrippa says that, despite the seemingly exposed position his guard leaves us in, any attempt by the adversary to remove the threatening point will give his student a tempo in which to strike. It also allows one to act in a smaller tempo.

[15] To facilitate this action and minimize one's tempo, Agrippa advocated keeping the right

foot forwards and using a large step to carry the thrust home — in other words, a fencing lunge. This contrasts with the left-foot forward stance often used by other writers with the aim of attacking with a forceful 'passing' step in which one steps forward with the rear (that is the right) foot. In the following diagram, Agrippa gives us a geometric proof of the efficacy of this manoeuvre: The further one extends the arm and bends the knee, the further one reaches (trans. Mondschein 2014: 10–14).

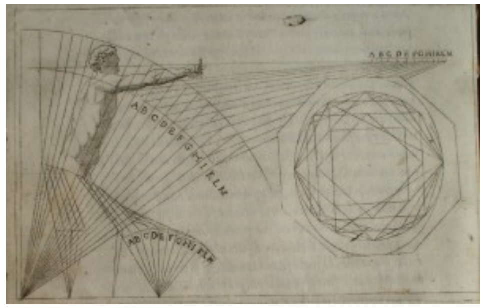

Figure 2: Agrippa's geometrical proof of the lunge.
Courtesy Malcolm Fare.

[16] Agrippa also tells us that if the adversary does make contact with one's sword, then there are a variety of ways to regain leverage and riposte. There are also ways to respond to an adversary's attack in a single tempo, which Agrippa says is best, as the two tempi represented by a parry and a riposte would give the adversary a chance to perform some other action before he himself is struck (trans. Mondschein 2014: 46). Finally, in the second part of the treatise, Agrippa gives a number of tactical scenarios in which his theories are applied.

[17] So, what we have here is reason applied to ordering and training the human body to perform optimally in a real situation. As Evelyn Lincoln (forthcoming 2014) points out, Agrippa can be seen in the context of a Milanese tradition of artist-practitioners who applied their theories to practical arts. In this mathematical imagining, Agrippa was perhaps influenced by Niccolo Tartaglia's *Nova Scientia* (1537) and the nascent science of ballistics; his brother, Giorgio, was an artilleryman (Lincoln forthcoming 2014). Tartaglia's aim was to prove at what angle a cannonball would achieve its furthest range; the comparison between Agrippa's diagram and Tartaglia's ballistic parabolas is obvious.

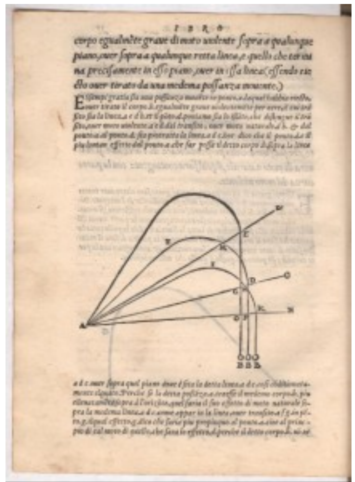

Figure 3: Ballistic parabola from the 1558 print run of the 1550 edition of Tartaglia. Courtesy Max Planck Institute for the History of Science, reproduced by Creative Commons Share-Alike license.

[18] Another likely influence was Cesare Cesariano's edition of Vitruvius. Cesariano, a Milanese military engineer, published a profoundly illustrated and well-received edition of the Roman architectural manual in Milan in 1521, and it is difficult to imagine that Agrippa, who lived in the midst of the construction of St. Peter's Cathedral, was not familiar with it. Cesariano's woodcuts, dealing with constructing the ideal, circular temple from the proportions of the ideal human body, impose a figure upon a grid. In doing so, Cesariano did more than just take the measure of man—he made man into a metric.

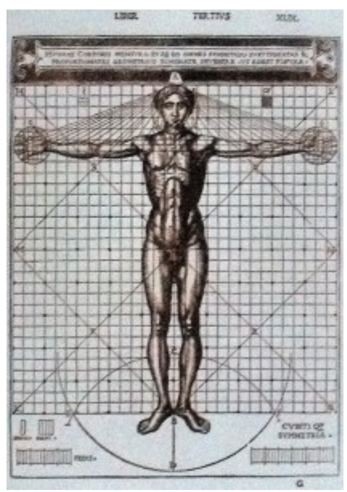

Figure 4: Cesariano's Vitruvian man. Courtesy Wikimedia Commons.

[19] Agrippa's numerical fencing also mirrored contemporary ideas of art. His contemporary and fellow Milanese, the art theorist Giovan Paolo Lomazzo, claimed that Carlo Urbino, to whom Erwin Panofsky attributed the Codex Huygens, was the engraver of copperplates for Agrippa's fencing treatise (Marinelli 1981: 218; Panofsky 1940). The Codex,

a copy of Leonardo's notebooks, contains not only perspective studies, but mechanical studies of human motion. The human body, measured according to the Vitruvian schema, is considered mechanically, its movements considered according to geometrical analysis. Agrippa takes this artistic study and applies both number and morality to it by means of a stick and a geometrical diagram:

> ....let me explain that it is there to encourage by word and example those people who, because of their makeup or some other inherent indisposition, think themselves unfit for this exercise. A piece of wood, taken unfinished from a tree or shrub and not having had any work done to it, provided that it is straight and strong enough to be used with a light hand, is quite sufficient to make all sorts of geometrical figures such as circles, squares, triangles, octagons (from which you can similarly make a proportional sphere), which you can see alongside the figures of the four guards, and so on. Similarly, anyone who has their eyes open will see that I am right when I say that a man, governing himself with reason and art, ought to perform this activity well.
>
> *....Mi pare il dovere che si notifici il Perche: et cosi facendo, dico, haverla messa quì per questo fine, ciò è per inanimire in questo principio con tal essempio molte persone à la profession' de l'Arme, le quali per la complessione, o per altra indisposition' naturale, paiono à se stessi inhabili per tal essercitio: perche si come un'legno simile senza industria alcuna, o ragione di qual arte si volglia, tolto cosi rozzo, & incomposto da l'arbore, o sterpe, o qual altra cosa che sia, pur che tanto stia retto, & saldo in se quanto possi sustentare una mano leggerissima per effettuar l'intento suo, basta, & è bono, anzi in proposito, per fare una moltitudine di figure di Geometria, come sono Circolo, Essagono, Triangolo, Ottangolo (dal qual si fa con esso medisimamente una Sfera proportionatissima) & diverse alter, le quali si postranno veder' in compagnia e le figure de le Quattro Guardie, cosi intromesse à posta, accio' che (venendo capriccio à à qualch'uno di farne la prova) potesse vedere che di quallo ch'io dico non sia altro, che parte di verità, debitamente un'homo governandosi con ragione, & con arte, potra fare in questa professione cio che si conviene.*
>
> (Agrippa 1553: I.4)

Figure 5: Agrippa's First Guard. Courtesy Malcolm Fare.

[20] In other words, just as the stick is sufficient to draw all the geometrical figures, which in turn give us the principles for finding out the structure of the universe, the human body, that is the proportional mirror of the universe, is good enough to execute all the necessary actions of fencing. It is, in other words, a sort of divider, the very essence of proportional enumeration. Agrippa is here taking the theoretical Vitruvian ideas of geometry and the unity of the macrocosmic and microcosmic and turning them into a sort of technology.

[21] Agrippa was also certainly familiar with contemporary optical theory, such as that of Alberti, as he also makes use of the mathematical 'science' of perspective. In this diagram, he shows that, just as the eye-rays can only look in one direction, so, too, can one move one's body out of the way of an oncoming attack.

Figure 6: Agrippa's counterattack. Courtesy Malcolm Fare.

[22] In describing how to move out of the way of an attack, Agrippa likens the human body to a ball (trans. Mondschein 2014: 52). In this, he uses a idea of the spherical human form, an idea found not only in Vitruvius, but also in Alberti's *Intercenales*: 'Nothing is more capacious [than a circle], nothing more whole in itself, nothing stronger, nothing more able to shrug off shattering blows because of its angles, nothing freer in its motion. Therefore, we must remain within the circle of reason, that is of humanity, which is connected and complicit with virtue, and God to virtue, which comes from God' (Alberti 1890, 232: *circulo nihil capacious, nihil integrius, nihil robustius: nam est quidem ex se totus angulus ad omnes impetus fragendos accomodatissimus, suoque in motu omnium liberrimus; quasi igitur in tutissim liberrimoque circulo rationis ipsos non habendos nobis, hoc est humanitati, cui connexa et complicita virtus est; virtuti vero Deus, nam ex Deo est*). The idea of the circular nature of the human body is also found in the Hippocratic text *De Locis in Homine*, which had been published in Latin translation in Rome in 1525 by Fabius Calvus: 'The beginning of a circle cannot be found. If one wishes therefore to find a first and absolute beginning in the human body, then all is the beginning, and all the end…' (*De Locis in Homine* I.1: *Circulo enim descripto principium non reperitur. Vult siquidem in humano corpore nullum reperiri principium primum & absolutem, sed Omnia principium esse, & omnia finem…*) The circular conception of the human body is also very similar to the use of geometrical analysis in the Codex Huygens to consider the human body from different perspectives.**[1]**

[23] Agrippa also deploys Aristotelian ideas of tempo. Though he is not explicit on this account, this is made clear in context as he explains his ideas on how to use a sword. The

idea of tempo, as explained above, had long since been part of the technical language of fencing, and remains so today. One can easily see why Agrippa was so interested in astronomy, which is more than the measure of objects in space and time— it also reveals the structure of the macrocosmic universe, and thus, the microcosm of men (and their duels). His astronomical treatise is, unsurprisingly, non-Copernican, and gives no new revelations to historians of astronomy: rather, he explains the equant, the Ptolemaic idea of the centre of the planetary epicycles. It serves, however, the rhetorical purpose of showing that Agrippa has the mastery of natural philosophy to speak 'reasonably' on any subject whatsoever. Rather than relying on tradition, Agrippa proudly tells us, he is an independent operator, able to figure out things for himself by observation and reason without formal university education. Such an attitude, as examples as diverse as Galileo and Menocchio (Ginzberg 1980) show us, would have been dangerous after the Council of Trent, but Agrippa's disinclination to say anything heterodox ensured his book's being kept from the Index.

[24] Agrippa's attitude is encapsulated by two allegorical scenes, one used as a frontispiece, and one before the dialogue. In the former, Agrippa disputes with a group of confounded-looking university professors, who have nothing to back them up save for their tomes of ancient knowledge. Agrippa, however, has an armillary sphere and a pair of dividers — a model of the world and the tool for measuring at it. A sword is at his side, his foot is perched on a globe, and a geometrical diagram and sword are on his side of the floor. Above him are measuring instruments — dividers, as well as a protractor or quadrant of the sort that a geometer or artillerymen might use. Governing all is the hourglass of time. As Anglo says, 'The author… is using both pure and applied mathematics to place personal combat upon a scientific basis' (Anglo 2000: 25). Even if he was in actual fact indebted to traditional knowledge as much as any medieval philosopher had been, Agrippa's rhetorical stance was that he was a new sort of man rejecting the dogmatism of the past in favour of a new sort of experiential learning—a learning that was, as in surveying, ballistics, and other emerging technologies, based on an enumeration of the world.

[25] In the scene before the dialogue, Agrippa is beset by academics dressed in shabby robes who seek to clobber him with a quadrant as his fashionable and sword-armed supporters come to his rescue. In the background is an obelisk inscribed with emblematic hieroglyphics. It is in reference to this that he mentions, in the dialogue, his two sources—'if some students of Euclid or of Aristotle want to drag my name through the mud, I will defend myself as best I can, both on my own and with the help of my patrons' (Agrippa *Dialogo*; trans. Mondschein 2014: 103–4: *se non che forse alcuni allevi di Euclide, o di Aristotile, vorrano imputar mi, di quel ch'io dico, & io col mio aiuto, & d'altri miei Patroni mi diffenderò*).

Figure 7: Allegorical Scene. Courtesy Malcom Fare.

Figure 8: Allegorical Scene. Courtesy Malcom Fare.

[26] Who were these patrons? Who was Agrippa writing for? Some clues are provided by the men he name-drops in his book, all of whom were artists and intellectuals in the circles of Cardinal Alessandro Farnese: Alessandro Corvino, Francesco Siciliano, Gerolamo Garimberto, Alessandro Ruffino, Alessandro Cesati, Francesco Salviati, Fillipo Archinto, and Annibale Caro, who is Agrippa's interlocutor in the astronomical dialogue. These are men whose *habitus* included reverence for antiquity, a taste for art, a knowledge of hieroglyphic emblems (albeit inaccurately derived from Horapollo), and the Vitruvian geometry that was then being used to plan St. Peter's.

[27] They were not, however, either on the cutting edge of natural philosophy or men who wanted to topple the structure of the world. We must therefore take Agrippa's self-proclaimed revolutionary nature with a grain of salt. Despite his use of number, Agrippa is not Copernican. Nor is he even particularly mathematical. He is vernacular, writing on a subject of interest to the aristocracy and deploying the fashionable paradigm of the day to explain his method. Despite his 'proofs,' no mathematics are needed to follow

him (though an understanding of geometry helps if one is to follow the first part of the dialogue). Rather, we are dealing here with a symbolic use of number in an almost animistic sense — a sort of *pneuma* of the world-spirit, connecting the human and heavenly realms, how that which is above is like that which is below. Furthermore, unlike astronomers, Agrippa does not give us a quantitative analysis in his analysis of fencing, but rather a relativistic one — we are still dealing with 'number' in the sense of proportional measurement, rather than as an absolute quantity. (Even in astronomy, concepts of absolute space and time would not be widely accepted until Newton, but measurements of degree and time against the celestial sphere do give us a sort of absolute yardstick.)

[28] Though Agrippa's is an early metaphorical deployment of number as the bridge between macrocosm and microcosm in a work on a physical art, he is hardly unique in his conceptions. Leonardo's notebooks and the works derived from them, such as the Codex Huygens, are filled with such conceptions. Similarly, in the unattributed portrait of Luca Pacioli (1445–1517) below, the mathematician, flanked by a noble patron or student, sketches a triangle (evoking the Trinity) in a circle (evoking the unity of God and man) — one hand on a book, one on his chalk, his eyes fixed on a heavenly geometrical figure half-filled with water so as to refract its surroundings, and instruments for measurement, including dividers and an angle, before him on the table. Pacioli, besides being an acquaintance of Leonardo's, also notably worked in the court of Urbino (the ducal palace is even reflected in the pendant rhombicuboctahedron), and this is, the same milieu from which Vadi came.

Figure 9: Luca Pacioli, c. 1495. Courtesy Wikimedia Commons.

[29] On the other hand, we must avoid seeing Agrippa's fencing as solely the manifestation of fashionable ideas of number lying behind the structure of reality — all thought, and no practical action. The duel of honour was a very real phenomenon in Agrippa's lifetime. At the risk of committing a syllogism, the reason why his work was so popular is because it presents a very practical method of using a sword in personal combat. This is not to say that he was not a mirror of his times, but also that we must see his invention as something meant to be used in the real world. His fencing system is both fashionable and practical.

[30] While Agrippa may be more groundbreaking in fencing than he is in natural philosophy, what he does do successfully is provide a very cogent analysis of fencing actions,

reducing a very complicated practice to a set of core principles that are seen in a numerical and geometrical light. He, in other words, gives an effective analysis of a natural phenomenon in order to reproduce effects according to his will — the very essence of theory as applied to technology. He applied this approach to a matter of interest to the European aristocracy, and so helped to spread an idea that mathematical analysis is a powerful tool for understanding the world. Agrippa's science is also very much an applied one — experiment in the sense of actual sense experience, as opposed to thought-experiment. He is thus a bridge of sorts between an allegorical deployment of number and a scientific one.

Writers after Agrippa

[31] As the first real fencing theorist, Agrippa's impact on the field was profound. Not only did he articulate the basis for what would eventually become codified in the modern sport of fencing, but no fencing book after him was complete without some discussion of the nature of art and science — though most showed the application of this theory rather than its causes. Ridolfo Capo Ferro, in his treatise of 1610, even argued that fencing was an art, not a science, because fencing does *not* examine 'eternal and divine things going beyond the will of humans,' but an elevated 'art of doing' (as opposed to a craft or trade) whose products are ephemeral and whose rules are both universally true and well-ordered (Capo Ferro 1610: 5; trans. Leoni 2011: 8). His teaching consists mostly of examples of tactical actions. Likewise, Salvator Fabris, fencing master of Christian IV of Denmark, whose *Lo Schermo* was printed in Italian in Copenhagen in 1606, protested his poor learning and that he would not use fancy geometrical terms and proofs — though the art was founded in geometry — and that he would, instead, explain it in plain language (Fabris 1606: A4; trans. Leoni 2005: 2).

[32] Most late sixteenth and early seventeenth-century Italian fencing books only had the barest traces of numerical and geometrical imaginings, such as Capo Ferro's lunge, above, and his instructions that the sword should be the length of the lunge, which is turn based off the proportions of the body. Even Giacomo di Grassi, who is very un-Agrippan in his fighting system, gives us a geometrical diagram to show that in certain circumstances a cut is more direct than a thrust and another to show that, like a gun-sight, holding a buckler far away gives more cover than holding it close to one's body.

Figure 10: Capo Ferro's lunge. Courtesy the Wiktenaeur.

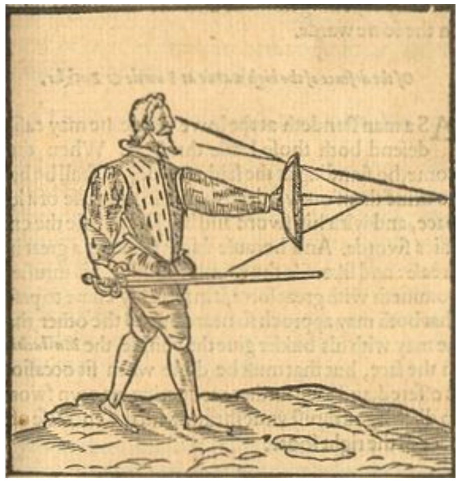

Figure 11: Di Grassi's 'gunsight'. Courtesy the Wiktenaeur.

[33] What Fabris, Capo Ferro, and other writers do share in common with Agrippa is a sense of ordering their pedagogy from first principles to complex actions. Most earlier writers did not explain principles or define terms of art, but rather simply explained chains of action. (Vadi, who has some preliminary material, is the one exception). Later rapier masters almost universally give a sense of the basic building blocks —distance, timing, etc. — and only then proceed to how these are applied in combat. They, in other words, fulfil the Aristotelian 'knowing a thing by its cause' — the logical analysis of physical phenomena (*Physics* I.1; Carranza 1582: 12r). This is a particularly Western way of looking at a problem: first the principles (which, according to Capo Ferro, are universally true), then application. This mentality can be contrasted to the pedagogy of Chinese martial arts, which emphasize rote repetition of technique and forms in memorized traditional choreographies.

[34] One Italian who made great use of geometrical proofs was Frederico Ghisliero, a military man who also wrote (now-lost) works on the mathematical arts of siege craft, fortification, and artillery, but who is perhaps best-remembered today for hosting Galileo at a dinner party during the latter's period of Copernican crusading. In 1587, Ghisliero published a book with a geometrical consideration of fencing derived from Agrippa — though Sydney Anglo considers him more a student of Jerónimo de Carranza than of Agrippa (Anglo 2000: 68–71). Showing a great deal of Vitruvian influence, Ghisliero uses radii of circles to describe distance, and gives us images of his fencer in 'scientific' perspective. He even begins (as Copernicus did, Newton would later, and my writers did in between) with two chapters on geometrical principles.

[35] The Carranza mentioned above is the inventor of the Spanish 'destreza' school of fencing — an amazing late-Scholastic, intertexual, Aristotelian edifice. Influenced by Agrippa's work, Carranza came up with his own geometrical system of fencing in the 1560s. This school was thereafter continued by his disciple-cum-critic Luis Pacheco de Narvaez (Anglo 2000: 67–69; Fallows 2012: 218–235; trans. Mondschein 2014: ixxx–xxx). Carranza was a captain in the Spanish army, a client of the Duke of Medina-Sedonia, and associated with the School of Seville. His connections sufficed to earn him the governorships of his hometown of Sanlúcar de Barremeda and of Honduras. Narvaez, for his part, later became

the chief fencing master of Spain, in charge of examining other masters. Again, we are dealing with writers who, far from wishing to challenge the orthodox structure of the world, rather wished to appeal to those in power by translating one element of elite *habitus* — the mathematical underpinnings of the world — into another sphere — martial performance.

[36] What did Carranza and Pacheco teach? Unlike the knees-bent postures taught by the Italians, they felt that the swordsman should stand erect, this being the most dignified position. Combat takes place within an imaginary circle described by the diameter of the swords, with the fencers' movement described as radii, chords, and arcs and an elaborate taxonomy of all possible motions rationalized by the degrees of leverage on the sword. As befitting the conservative Spanish milieu, their explanation of movement is entirely orthodox Aristotelian—an upwards movement is 'violent,' whereas a downwards one was 'natural'. In other words, the Spanish school describes fencing entirely in geometrical and Aristotelian terms. Needless to say, dividers appear both Carranza and Pacheco's author portraits.**[2]**

[37] Carranza and Luis Pacheco were widely known in Europe, and mentioned —usually derisively — by several authors. For instance, Ben Jonson alludes to their geometrical conception of fencing in his *The New Inn*:

> TIPTO: But doth he teach the Spanish way of Don Lewis?
>
> FLY: No, the Greeke Master he.
>
> TIPTO: What cal you him?
>
> FLY: Euclide.
>
> TIPTO: Fart upon Euclide, he is stale, and antique, | Give me the modernes.
>
> FLY: Sir he minds no modernes, Go by, Hieronymo! [an Italian fencing teacher who worked in London in the Elizabethan era]
>
> TIPTO: What was he?
>
> FLY: The Italian, That plaid with Abbot Antony, in the Friars, | And Blinkin-sops the bold.
>
> TIPTO: Aye mary, those, Had fencing names, what is become of them?
>
> HOST: They had their times, and we can say, they were | So had Caranza his: so had Don Lewis.
>
> TIPTO: Don Lewis of Madrid, is the sole Master | Now, of the world.
>
> HOST: But this, of the other world | Euclide demonstrates! he! He is for all! | The only fencer of name, now in Elysium.
>
> FLY: He does it all, by lines, and angles, Colonel. | By parallels, and sections, has

> his Diagrammes!
>
> (*The New Inn*: II.5)

The characters then go on to give odds on imaginary fencing contests of philosophers in Elysium. The Spanish school of fencing is also referred to by Quevedo and Cervantes, and the former actually fought a duel with Pacheco wherein he knocked off the master's hat.

[38] Both the Spanish method of fencing and the Agrippan geometrical turn was taken to their ultimate and most explicit extent by a Dutchman, Girard Thibault, whose book *The Academy of the Sword* (L'Académie de l'*espée*) ranks as one of most sumptuous printed works ever created. As Kate Van Orden points out, we should see it as a counterpart to Antonie de Pluvinel's (also geometrical) *L'Instruction du Roy en l'exercice de monter à cheval*, since both were worked on by the same artists, both were colossal 'atlas' editions, and both were associated with the circle around Louis XIII (Van Orden 2004: 57). Thibault had apparently learned the Spanish school of fencing in Sanlúcar while working as a wool merchant. Besides his skill in fine arts, architecture, and medicine, he studied mathematics at Leiden and, beginning in about 1610, taught his own version of Carranza's school (de la Verwey 1978). This was acclaimed by Dutch fencing masters in 1611, and earned Thibault introductions to aristocratic circles. *The Academy of the Sword* was published posthumously in Paris in 1628 with royal imprimatur.

[39] Thibault makes no bones about the numerical relationship of microcosm to macrocosm when he says:

> Man is the most perfect and excellent of all the creatures of the world, in whom is found the other marks of divine wisdom, a most excellent representation of the whole universe, in his whole being and his principle parts, so that he is rightfully called the Macrocosm by the ancient philosophers—that is, the Small World. For besides the dignity of the soul, which has great advantages over all that is perishable, his body contains an abridgement not only of that which can be seen here down on earth, but also yet that which is in Heaven itself, representing all with a harmony so sweet, beautiful, and whole, and with a just accord of Numbers, Measures, and Weight which correspond so marvellously to the virtues of the Four Elements, and to the influence of the Planets, that one can not find anything similar.
>
> The most perfect number of Ten is continually shown before the eyes, in its entirety by his own fingers, and broken equally into two parts by the two hands, each one with five fingers, which are broken into two unequal parts by the thumb and the rest into One and Four, of which on is composed of Two things, and the Four of Three. In this way, this structure always shows him the premier and most excellent numbers 1, 2, 4, 5, and 10, which the illustrious philosophers such as Pythagoras and Plato, and all of their students, held so highly, that they chose to hide in them, and deduce from them, the greatest mysteries of their doctrine.

L'Homme est la plus parfite & la plus excellent de toutes les Creatures du Monde, auquel se trove parmy les autres marques de la sagesse divine, une si exquisite representation de tout l'Univers, en son entier & en ses principales parties, qu il en a esté appellé à bon droit par les anciens Philosophes Microcosme, c'est à dire, le Petit Monde. Car outre la dignité de l'ame, qui a tant d'avantages par dessus tout ce qui est perissable, son corps contient an abbregé, non seulement de tout ce qu'on voit icy bas en terre, mais encores de ce qui est au Ciel mesme ; representant le tout avec une harmonie, si douce, belle, & entiere, & avec une si juste convenance de Nombres, Mesures, & Poids qui se rapportent si merveilleusement aux vertus des Quatre Elements, & aux influences des Planetes, qu'il ne s'en trouve nulle autre semblable.

Le tres-parfait nombre de Dix luy est continuellement representé devant les yeux, en son entier sur ses propres doigts ; & derechef in deux moitiez egales sur ses deux mains, á chascune par le nombre de Cinq doigts; qui sont derechef partis inegalement par le poulce, & par le reste en Un & Quatre, dont l'Un est composé de Deux articles, & les Quatre de Trois : de façon que ceste structure luy met tousiours en veue les premiers & plus excellents Nombres 1.2.3.4.5.10. dont tant d'Illustres Philosophes, comme Pythagoras, & Platon, & tout ceux de leurs Escholes, ont fait tant d'estime, qu'ils y ont voulu cacher, & en deduire les plus grands mysteres de leur doctrine.

(L'Académie de l'*espée*, I.1)

[40] Thibault then proceeds to cite the Vitruvian rule of constructing a temple according to the measure of the human body, even linking this to the dimensions of the Temple of Solomon and of Noah's Ark. After a short oration on the dignity and utility of human proportion, which recalls the study of anatomy then going on at Leiden, he then extols the use of reason in self defence, by which man, seemingly the most helpless of creatures, renders himself master of all.

Therefore, all the abovesaid Artists, Architects, Perspectivists, and others have sought to prove the foundations of their rules by the proportions of the human body, and I have similarly taken the same course, but with better results, and have found with the help of this same compass the true and proportional measure of all the Movements, Times, and Distances necessary to follow my Practice, as will be declared to you in a moment in the explanation of my Circle, where the measures and proportions of man are applied to man himself and to the movements he makes with his own limbs, where the aforesaid proportion is found, and without which it is impossible to perform the least action in the world.

Tout ansi donc que les susdits Artistes, Architectes, Perspectivistes, & autres ont tasché de prover les fondements de leurs regles par les proportions du corps de l'homme, ansi avons nous pareillement tenu la mesme course, mais avec meilleure adresse, & avons trouvé à l'aide de ceste mesme buxole la vraye & proprtionnelle mesure de touts les Mouvements, de touts les Temps, &

> *Distances, necessaires á observer nostre Practique: comme il vous sera semonstré tout á l'instant en la declaration de nostre Circle; où les mesures & proportions de l'homme sont appliquées à l'homme mesme, & aux mouvements qu'il fait avec ses propres membres, où ladite proportion se trouve, & sans laquelle il luy est impossible de faire le moindre action du Monde.*
>
> (L'Académie de l'*espée* : I.3)

[41] Thibault, like Agrippa, then tells us the human body is a circle, and goes on to advise us on the construction of his 'mysterious circle,' by which we learn to perform the proportionate movements of fencing. The circle is based on the proportion of the sword, which is equal to the radius and the cross of which, if the point is placed between the wielder's feet, should reach his navel. The sword itself — the symbol of the enfranchised and potent male, created by his own genius, just as God fashioned his natural limbs, proportional to his body to aid him in self-defence — is thus a sort of measuring-tool. The author's sigil, repeated several times in the art in front matter, unsurprisingly contains a pair of dividers.

[42] Relationships of leverage between the two adversary's swords were conceived of as numerical relationships, with the sword, continuing the proportions as the body, divided into twelve parts. Higher numbers, closer to the hand, have mechanical advantage over lower numbers, closer to the point. Van Orden summarizes, 'Like Kepler and Newton, Thibault conceived of physics according to the precepts of *musica speculativa*' (Van Orden 2004: 62) — in other words, he sees all the possible motions in fencing as a harmonic relationship between two numbers. While I concede that Van Orden is correct in a metaphorical sense, I do not see any explicit deployment of musical theory here — if anything it is more the case that Thibault's description of leverage is more what Vadi made explicit: music and fencing share a common root in number (Anglo, 2007).

[43] Though the martial art expressed in Thibault's atlas-sized edition may seem overly complicated to us, the masters of Amsterdam seem to have found it efficacious as well as aesthetic. The whole school was based on a mathematical understanding of both the world and of fencing. By obeying the numerical principles of time and of proportion — in other words, fencing scientifically — the fencer cannot but conquer his foe. It is a way of explaining how to operate in space and time in accordance with a 'system of the world' — in other words, a technology.

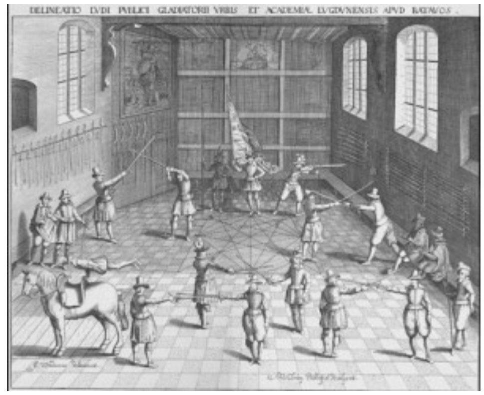

Figure 12: Fencing school at Leiden. Image courtesy Wikimedia Commons.

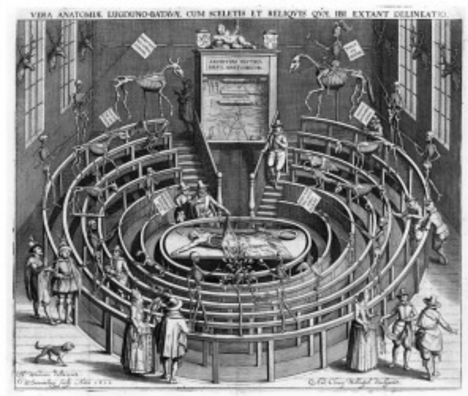

Figure 13: Anatomy theatre at Leiden. Image courtesy Wikimedia Commons.

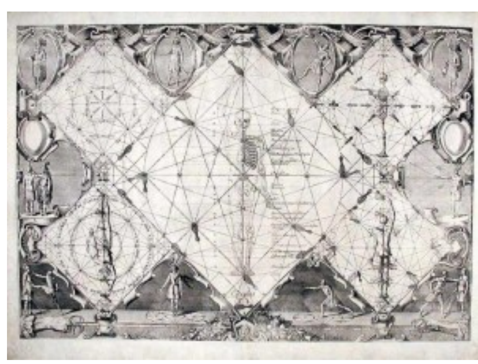

Figure 14: Thibault's circle. The influence of a geometrical floor plan for fencing in the Spanish manner at the University of Leiden (Figure 12), c. 1610—pre-dating Thibault's residence there—and the studies of anatomy taking place at the university (Figure 13), can all be seen in Thibault's circle. Image courtesy Wikimedia Commons.

[44] The contrast between Thibault, the style of Louis XIII, and the style of Louis XIV is extreme. The sceptical turn of mind of the later seventeenth century would find the hermetic constructs of Thibault ponderous and ridiculous. If we had Descartes' lost fencing

treatise, it would perhaps be an excellent illustration of this tendency; however, all we know of this book is a mention by Descartes' biographer Adrian Baillet (Baillet 1691: I.35). We *do* have a work on fencing published in Rennes in 1653 by Charles Besnard, who was possibly acquainted with the philosopher as a young man, since the 18-year-old Descartes had spent the winter of 1612–13 in Rennes practicing the military arts (Baillet 1691: I.35; Brioist, Drévillon, and Serna 2002: 168). However, the tradition that Besnard was Descartes' master is rather specious, and Besnard's treatise is quite different from what Descartes' could have been. Judging from Descartes' having spent much of his life in the Netherlands, his geometrical inclinations, and Baillet's dismissal, the philosopher's fencing might well have been more similar to Thibault's than Besnard's — in fact, Baillet tells us the former 'completely wasted his time' studying riding and fencing in Rennes (Baillet 1691: I.35: *On peut juger par son petit traité d'*Escrime *s'il y perdit entiérement son temps*). Let us, rather, take Besnard's treatise as an example of what physical education would have been like for a young man in the mid-seventeenth century.

[45] Though Besnard's *The Liberal Master-at-Arms* (*Maître des Armes Liberal*) is ultimately based on Agrippa's work (as would be most later fencing), it is greatly simplified. The art is still rationalized, but didactic rather than argumentative, giving principles and best means of operating much as Capo Ferro and Fabris did before him. His postures and actions are greatly simplified; one trusts that there is theory there, as Besnard insists, but the exact details are left for the master. The student's job is to have his body trained and disciplined. In all, Besnard strives for the uniformity and universalism of definition that characterized the Enlightenment. The limits of enumeration have been realized, the idea of sacred harmony has fallen out of favour, and 'Augustinian' fencing, as Peter Gay would have put it — the whole Scholastic-hermetic basis of Agrippa and Thibault—was replaced by a rationalized system of training the body (Gay 1966). The idea that a fencing master could ensure patronage and fame by showing how his system mirrored the cosmos was no more. Fencing, as Diderot and D'Alembert would later characterize it, was not a science, but an art (*L'Encyclopédie* 21:6:1).

Conclusions

[46] Though the sixteenth and early seventeenth centuries were enamoured of enumeration, there was some misplaced enthusiasm about what *could* be explained by number. The fencing masters of this time invested in an aesthetic-moral apparatus that saw the human world as linked to the divine, operating within a paradigm that expressed itself through instruments as diverse as astronomy, music, and fencing. Its substance was humanist, but its principles were still that of the Aristotelian Middle Ages, and its aims were not an objective knowledge, but to show how the operator could use the likeness of that which was above and that which was below to control their world. On the broader scale, this tends to complicate our thinking on the Scientific Revolution, which was much more than just the Copernican Revolution — it was also a revolution of enumeration, of ways of thinking about the world, and of the growing acceptance of physical experiment. It was also not always so revolutionary: As Agrippa and his followers show, one could be a defender of Ptolemy and employ a relativistic, geometrical method ultimately rooted in the Scholastic treatises of the

thirteenth and fourteenth centuries, yet position oneself as a rebel against traditional authority. Fencing texts thus give us insight into how 'progress' is historically situated, contingent, and non-linear.

[47] They also give us insights how knowledge is spread. For these ideas of enumeration to be transmitted to society at large required conduits between centres of intellectual production, such as Renaissance Rome, and the rest of Europe. Fencing masters, who ultimately wrote to please their audience and who certainly fit into Long's idea of 'artist-practitioners', performed this task admirably. By producing treatises that successfully applied the numeric turn to the subjects important or fashionable to those of status, or who aspired to status, writers such as Camillo Agrippa helped to popularize new ideas of human knowledge—at least until the scepticism of the later seventeenth century demanded a new, more didactic method. Still, the proportional methods these writers employed, the enumeration that linked the microcosm and the macrocosm — the enumeration of the dividers, not the meter-stick — was well-suited to fencing and other physical arts, and, as a conceptual tool, was highly successful.

NOTES

[1] The Morgan Library's images of the Codex Huygens is copyright-protected, and so we cannot reproduce any figures; however, the entire manuscript is viewable at http://www.themorgan.org/collections/works/codex/default.asp.**[back to text]**

[2] A true appreciation of *la verdadera destreza* is beyond the scope of this article, and will have to wait for the publication of Mary Dill Curtis' 2012 Ph.D. thesis.**[back to text]**

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