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## How to Construct a Poem: Descartes, Sidney

Shankar Raman, MIT

This essay explores the intimate bond in early modern Europe between the premier science of forms, geometry, and the premier art of forms, poetry. The connections between these (at least for us) seemingly disparate domains become especially evident in how geometry and poetry re-envisage the relationship of form to content, of the shapes they invent to the matters that constitute their specific concerns. I shall be seeking here to identify parallels that bespeak a broader, shared cultural response across the sixteenth and seventeenth centuries to an inherited Greek tradition, strongly marked by Aristotelian thought, in which what Sir Philip Sidney would later call the relation of “manner” to “matter” played a fundamental role. My argument places René Descartes alongside Sidney as two of the key figures whose contributions to the theory and practice of mathematics and poetry respectively reveal with especial vividness both the nature of this response and its implications for early modern selves and the worlds they sought to make.

Since the breadth of poetry’s cultural aspirations may seem more intuitively obvious than that of mathematics, let me begin with bolstering the latter case. The very opening of Descartes’ 1637 *Discourse on Method* outlines an emerging and influential conception of what it means to be rational:

Common sense [*le bons sens*] is the most equitably divided thing [*la mieux partagée*] in the world, for everyone believes he is so well provided with it that even those who are the hardest to please in everything else usually do not want more of it than they have. It is not likely that everyone is mistaken in this matter; rather, this shows that the power to judge correctly and to distinguish the true from the false – which is, strictly speaking, what we mean by common sense or reason [*la raison*] – is naturally equal [*égale*] in all men. Hence the

diversity of our opinions arises, not because some of us are more reasonable [*raisonnables*] than others, but only because we direct our thoughts along different paths, and consider different things. For it is not enough to have a good mind [*l'esprit bon*]; the principal thing is to apply it correctly [*bien*].<sup>1</sup>

A few features evident in these remarks are worth noting: first, the identification of reason with common or good sense and reasonableness; second, the postulate of a rational capacity presumed to be equally distributed, differences being ascribed on the basis of how this capacity is applied; and, finally, the characterisation of rational capacity as power of good judgement, one able to distinguish the true from the false – indeed, as we shall see, Descartes will seek to re-articulate the very criteria for truth and intelligibility.

For our purposes, moreover, it is necessary to recall the fact that the *Discourse* was originally a prefatory text to three scientific treatises. While usually published (and discussed) today as a free-standing work, it first appeared with the *Optics* [*La Dioptrique*], the *Meteorology* [*Les Météores*], and, last but not least, the *Geometry* [*La Géométrie*]. Its overarching claims about the right way to use one's reason thus envelop these more specific studies. For Descartes' mathematical exposition in particular, the making of geometrical space is closely allied with producing the forms of rationality implied by the passage cited above. And this coupling in turn demands re-forming selves in ways that make them adequate to these new demands. Such relationships take us beyond the more narrowly technical achievements of early modern mathematics, underlining the extent to which a now recognisably modern scientific thinking was bound up from the very outset with ethical considerations in Aristotle's sense of the word, that is, with the settled or characteristic ways human beings act in the world or behave towards others and themselves. Descartes' *Geometry* was never only a signal achievement in the history of mathematics – though it was this too. Its

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<sup>1</sup>René Descartes, *Discourse on the Method* in *The Philosophical Works of Descartes*, trans. and ed. Elizabeth S. Haldane and G. R.T. Ross (Cambridge: Cambridge University Press, 1955), vol. I: 82-3. Translation modified. Subsequent citations indicated by page number in the body of this chapter.

specifically mathematical dimensions are intertwined with the ethical question of how a geometer ought to *do* geometry, how he should comport himself as mathematician towards the nature of the mathematical objects that are his concern.

The broader connections between how one does mathematics and the making of things and selves through mathematics emerge most fully when we consider the extent to which such reformation was understood through the (renovated) Aristotelian lens of *poesis* or making, a term that took on renewed significance in a range of early modern intellectual domains, including literature. An apt literary analogue may be found in a seminal (for the English context at least) sixteenth-century work of literary criticism, in which the assertion of the poet as maker takes centre stage: Sir Philip Sidney's *Defence of Poesy* [or *An Apology for Poetry*]. In a moment that has not drawn much commentary,<sup>2</sup> Sidney defends comedy's predilection to imitate "the common errors of our life" by drawing a parallel with mathematics:

Now, as in geometry, the oblique must be known as well as the right, and in arithmetic, the odd as well as the even: so in the actions of our life, who seeth not the filthiness of evil, wanteth a great foil to perceive the beauty of virtue.

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<sup>2</sup>To the best of my knowledge, Henry S. Turner's *The English Stage: Geometry, Poetry and the Practical Spatial Arts 1580-1630* (Oxford: Oxford University Press, 2006) is the only book explicitly to draw the connection between geometry and poetry in Sidney's *Defence*. My discussion here independently converges at times with Turner's, generally with respect to positions already well-established through the history of Sidney criticism – for instance, the importance of 'invention' or the the question of poetry's epistemological and ethical value. Turner's book is valuable, particularly in its reading of English drama, for setting out the relevance of geometry to early modern poetics. However, its chapter on the relationship between geometry and poetry in Sidney ultimately sidesteps both geometry and poetry. On the one hand, the reconstruction of sixteenth-century geometry's status through title pages, prefaces of books and selective evidence of reading practices omits the technical content of geometry itself. There is little acknowledgment in his book of the momentous change in the very content of geometry – and in its relationship to algebra – from the mid-sixteenth to the mid-seventeenth century. On the other hand, the discussion of Sidney's *Defence* does not attend to Sidney's own poetic practice. This absence is striking in light of the parallel insistence that geometry's assimilation to the practical arts during this period opens up its connection to poetry. The claim regarding geometry's practical bias also needs adjustment: not only because John Dee's much reprinted preface to Euclid, for example, does not fully support the assertion, but because the narrow focus on England leaves out the crucial role of the so-called Republic of Letters. Correspondence networks (exemplified by Marin Mersenne's role as intermediary) were, after all, one of the main modes through which mathematical knowledge – theoretical as well as practical – routinely circulated between (and within) Europe and England.

This doth comedy handle so in our private and domestical matters, as with hearing it, we get, as it were, an experience [of] what is to be looked for . . . .<sup>3</sup>

Sidney posits a curious equivalence between knowing obliqueness or oddness in mathematics and the poetic creation of images of evil: just as we need to understand the odd to perceive the even, the oblique to see the straight (or, as his resonant pun has it, “the right”), so to do the “actions of our life” demand poetic images of evil if virtue is to be visible.

But these images do not simply reflect the external world, for the *Defence* amplifies throughout what is already an undercurrent in the Aristotelian notion of *mimesis*: that imitation is itself a generative process, a making. When Sidney defines Aristotelean *mimesis* as “a representing, counterfeiting, or figuring forth: to speak metaphorically, a speaking picture” (217), each additional term in this concatenation of definitions enlarges the ambit: from re-presenting of what is already there, to making something ‘against’ what is there, to drawing out a new figural reality. The two senses of mimetic production remain in tension in the *Defence*: on the one hand, the poet as a “maker,” as in the famous early assertion that the poet “disdaining to be tied to any such subjection [to nature], lifteth up with vigour of his own invention, doth grow in effect another nature in making things better than nature bringeth forth, or quite anew, forms such as never were in nature” (216); and, on the other hand, the poet as mere “imitator” who “counterfeit[s] only such faces as are set before” him (218), and “deliver[s] to mankind” only that which has “the works of nature for his principal object” (215-16).<sup>4</sup>

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<sup>3</sup>Sir Philip Sidney, *The Defence of Poesy in A Critical Edition of the Major Works*, ed. Katherine Duncan-Jones (Oxford: Oxford University Press, 1989), 230. All subsequent citations indicated by page number in the body of this chapter.

<sup>4</sup>From different perspectives, critics have often remarked upon this tension in Sidney’s *oeuvre*. According to Sherrod Cooper, for instance, the poet swings between the claim that art is a means to the end of “representing nature accurately” and the countervailing position in which inspiration seems all: “[o]bviously,” writes Cooper, “the practitioner and the theorist seem at odds with another.” In: *The Sonnets of Astrophil and Stella* (The Hague: Mouton, 1968), 14 and 17. Kathy Eden’s rich discussion of a similar duality emphasises instead the poet’s complex deployment of key Aristotelian texts: “When Sidney defines poetry not only as an art of imitation but also as an instrument of knowledge, he does so in view of the *Poetics* and its tradition.

That Sidney should evoke mathematical analogies in discussing how comedy functions to produce both knowledge and experience of the ethical and the moral is by no means accidental. Indeed, the poet's correspondence with his friend and preceptor Hubert Languet as well as his brother Robert Sidney documents a sustained interest in the study of geometry.<sup>5</sup> In turn, the implications of "making" or *poesis* teased out by Sidney spill over in the early modern period to the kind of knowledge that comes to characterise mathematics, whereby knowing its "truths" becomes not simply a matter of discovering or imitating what is already there but increasingly that of *producing* those truths. David Lachterman's assertion about modernity in *The Ethics of Geometry* is worth stressing here: modernity's "thinly-disguised 'secret,'" he says, is "the willed or willful coincidence of human making with truth or intelligibility."<sup>6</sup> Such an attitude is central to Cartesian geometry, contributing signally to the alteration in how mathematics would be practiced and understood in the early modern period. Conversely, the emerging mathematical attitude to which Descartes gives especially clear expression is already visible in the theory and practice of poetry espoused by Sidney.

### Two Ways of Completing the Square: Al-Khwarizmi and Descartes

To flesh out the renewed importance of *poesis* or making to the geometrical project, I would like to compare two approaches to what is essentially the same mathematical problem: that of solving a quadratic equation by "completing the square" (described below).

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When, on the other hand, he claims for poetry the special task of feigning images designed to inspire the will to virtuous action, he echoes the *De Anima* and its tradition." See *Poetic and Legal Fiction in the Aristotelian Tradition* (Princeton: Princeton University Press, 1986), 158.

<sup>5</sup>In a 1574 reply to Languet, for instance, Sidney resists the Frenchman's advice that he give up studying geometry, promising to "only look through the lattice (so to say) at the first principles of it." See *The Works of Sir Philip Sidney*, ed. Albert Feuillerat (Cambridge: Cambridge University Press, 1965), vol 3, 84. In a 1580 letter, Sidney further advises his brother to "take delight in the mathematical," and especially in arithmetic and geometry "so as both in number and measure you might have a feeling and active judgement." In: *The Correspondence of Philip Sidney and Hubert Languet*, ed. William Aspenwall Bradley (Boston: The Merrymount Press, 1912), 223.

<sup>6</sup>David Rapport Lachterman, *The Ethics of Geometry: A Genealogy of Modernity* (London, Routledge, 1989), ix.

The first derives from a foundational Arabic treatise on algebra that preserves and builds on Euclidean principles, *The Algebra of Al-Khowarizmi*. Written by the great 9th-century Arab mathematician Mohammed ibn Musa al-Khowarizmi, the work became available in the European world through its twelfth-century Latin translation by Robert of Chester. (Complicating this chain of transmission further, I will cite the twentieth-century translation of the Latin text.<sup>7</sup>) Descartes' 1637 *Géométrie* adopts a very different approach, one that has been credited with inspiring the modern mathematical domain of analytic geometry.<sup>8</sup> Both works proffer an algebraic problem set alongside its geometrical rendition, and I will be considering here the manner in which each text achieves its solution as well as the relationship it posits between algebra and geometry. I pick these two examples precisely because what we might call their "truth value" is the same. In its discussion of quadratic equations, Descartes' algebraic geometry is distinguished from al-Khwarizmi's Euclid-oriented algebra neither by the nature of the problem nor by the method used to

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<sup>7</sup>Robert of Chester's *Latin Translation of the Algebra of Al-Khowarizmi*, ed. and trans. Louis Charles Karpinski, New York: The Macmillan Company, 1915. Citations to this edition will be indicated by page number in body of essay. Karpinski's prefatory material shows how widely disseminated knowledge of Al-Khwarizmi's work was from the late fifteenth century onwards – either directly, as in the case of Regiomontanus and Luca Pacioli – or through Robert of Chester's translation, as with Johann Scheybl, a professor of mathematics at Tübingen who in 1550 transcribed and prepared that translation for publication. Scheybl's manuscript is now in the Columbia University Library. "Mathematical science in Europe," Karpinski writes, was more vitally influenced by Mohammed ibn Musa than by any other writer from the time of the Greeks to Regiomontanus (1436-1476)" (33).

<sup>8</sup>The question of whether Descartes did or did not invent analytical geometry has been much debated by historians of mathematics. There seems little doubt that analytical geometry shares a number of the mathematical techniques developed in the *Géométrie*, but, as Carl Boyer first argued, it remains unclear whether Descartes' mathematical thought was fully compatible with the basic notion undergirding analytical geometry: that algebraic equations define curves in space. See Carl Boyer, *History of Analytical Geometry*, New York: Scripta Mathematica, 102ff. "The analytical geometer," according to Timothy Lenoir, "begins with an equation in two or three variables and, by a suitable choice of a coordinate frame, produces a geometric interpretation of that equation in two- or three-[dimensional] space." In: "Descartes and the Geometrization of Thought: The Methodological Background of Descartes' *Géométrie*," *Historia Mathematica* 6 (1979), 355-79; here, 356. As we shall see, while Descartes admits the necessity of algebra, he refuses to prioritise equations in this way. In fact, as H. J. M. Bos persuasively shows, how curves ought to be understood and represented remained an open question for most seventeenth-century mathematicians, who "did not have a uniform definition of the concept of a curve (nor apparently did they feel the need for such a definition) and therefore... had no standard form for specifying the curves they had in mind." Descartes intervenes here by introducing "a sharp distinction between admissible and inadmissible curves" precisely on the grounds of their constructibility. See Bos, "On the Representation of Curves in Descartes' *Géométrie*," *Archive for History of Exact Sciences* 24 (1981), 295-338: here, 296 and 297.

achieve its solution. Rather, what is new in the *Géométrie*'s approach is how it represents the problem. In Lachterman's words, at issue is "the source of the intelligibility of the figure (or statement)" as such. Thus, the crucial distinction concerns the mode of knowing, which in turn "entails a difference in the mode of being" of what may otherwise seem to be identical mathematical insights.<sup>9</sup>

In the fourth chapter of his treatise, al-Khwarizmi proposes finding the numerical value of a "root," that is, of an unknown quantity, when "squares [of that root] and roots are equal to numbers." The general case is represented through a specific instance. "The question therefore in this type of equation," he says, "is as follows: what is the square which combined with ten of its roots will give a sum total of 39" (71). It is easier for us to understand al-Khwarizmi's *modus operandus* if we translate his verbal description into modern algebraic notation. But I should emphasise that to do so is already to distort the text, since one of its distinctive features is precisely that the problem is stated in prose and eschews mathematical formalisation. His text poses problems and solutions in everyday language and, throughout, uses determinate numbers rather than algebraic symbols. These features reflect the ontological presuppositions of al-Khwarizmi's mathematics. Mathematical objects, such as numbers or geometrical shapes, are in an important sense real objects; their existence is of the same order as ours. Thus, for example, numbers are always positive. There is no conception here of such a thing as a negative number, since the mode of its real existence remains incomprehensible to him – to be a thing is, after all, to have a positive existence.

At any rate, with this caveat in mind, let us nonetheless translate his narrative into symbolic notation. If we represent our "root" or unknown by  $z$ , we are being asked to uncover its numerical value, given the following equation:

$$z^2 + 10z = 39 \tag{1}$$

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<sup>9</sup>Lachterman, *Ethics of Geometry*, ix and xi.



In order to do so, Al-Khwarizmi tells the reader how to complete the square. And this is one way we might do it today. Consider the square of  $(z + 5)$ , which we arrive at by multiplying the expression by itself.

$$(z + 5)^2 = (z + 5) * (z + 5) = z^2 + 5z + 5z + 25 = z^2 + 10z + 25 \quad (2)$$

Now, from the original equation (1), we know that  $z^2 + 10z = 39$ . Consequently,  $z^2 + 10z + 25$  must equal  $39 + 25$ , that is, 64. In short, by adding 25 to each side of the original equation we can “complete the square” to get a numerical value for the expression  $(z + 5)^2$  in (2) above. So, if  $z^2 + 10z = 39$ , then

$$(z + 5)^2 = 64 \quad (3)$$

If we now take the square root of each side of this equation, we get

$$z + 5 = \sqrt{64} = 8 \quad (4)$$

and subtracting five from each side of this equation yields  $z = 3$ , producing a determinate value for the “root”  $z$ .

As we shall shortly see, this logic, in its general form, can be applied in virtually the same manner to the problem that Descartes’ *Geometry* will pose. But for the moment, let us linger with al-Khwarizmi. Notably, our Arab mathematician does not seek to explain algebraically – as I have sought to do above – why completing the square yields the correct result. Instead, his statement of the problem is followed immediately by a description of procedure:

The manner of solving this type of equation is to take one-half of the roots just mentioned. Now the roots in the problem before us are 10. Therefore take 5, which multiplied by itself gives 25, an amount which you add to 30, giving 64. Having taken then the square root of this which is 8, subtract from it half of the

roots, leaving 3. The number three therefore represents one root of this square, which itself, of course, is 9 (73).

What al-Khwarizmi provides is a step-by-step route to the desired solution – it is fitting, then, that the word algorithm derives from his name. As his many examples later in the book suggest, such instructions make the mathematical “truth” operational, by allowing them to be applied to mercantile transactions, the dividing of estates, and so on. However, explanatory force does not lie in algebra itself. The truly mathematical domain is not that of application but of demonstration.

That privilege is reserved for geometry. Corresponding to each of Al-Khwarizmi’s algorithms is a set of geometrical diagrams aimed at proving the validity of the algebraic procedure – and once legitimated thus, the method is freed as a practical technique useful for everyday transactions. Thus it is that the treatise soon recognises that it has “said enough, . . . so far as numbers are concerned” about different types of quadratic equations, and signals instead its turn to geometry in the interests of verification: “Now, however, it is necessary that we should demonstrate geometrically the truth of the same problems which we have explained in numbers” (77).

The “proof” of the equation discussed above is ingenious, and testifies to the authoritative power of Euclidean geometry as an enduring model for establishing mathematical truth.<sup>10</sup> To this end, Al-Khwarizmi first seeks to represent the terms on the left-hand side of original equation – that is,  $z^2 + 10z$  – spatially. The term  $z^2$  can simply be visualised as the area of square with side  $z$ , as in Fig 1.

To add an area corresponding to  $10z$  to this figure, Al-Khwarizmi attaches four rectangles to this square, each of which has one side of the square as its longer side and

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<sup>10</sup>As Karpinski points out, the “Greek influence on Arabic geometry is revealed by the order of the letters employed on the geometrical figures.” These letters follow the natural Greek order rather than the Arabic, and “the same is true. . . [for] the letters in the geometrical figures used by Al-Khwarizmi for verification of his solutions of quadratic equations. . . . The Arabs were much more familiar with and grounded in Euclid than are mathematicians today, and it was entirely natural in constructing new figures that they should follow the order of lettering to which they had become accustomed in their study of Euclid” (21).

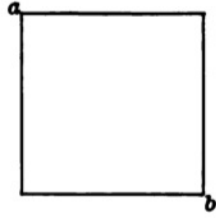


Figure 1: Square of side  $z$ , with area  $z^2$ . From the Columbia ms. of Johann Scheybl's 1550 transcription of Robert of Chester's *Algebra*.

one-fourth of ten as its shorter. That is, each constructed rectangle has an area of  $2.5 \cdot z$ , and the four taken together yield the requisite term  $10z$  of the original equation. The re-

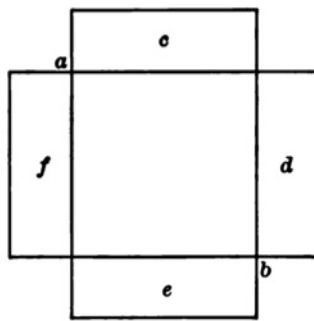


Figure 2: Constructed Figure representing  $z^2 + 10z$ . From the Columbia ms.

sulting Fig. 2 thus represents  $z^2 + 10z$  geometrically, and its total area is 39, in accordance with the original equation.

Finally, we simply complete the square of Fig. 2, by filling in the four small squares at each corner. The side of each of these squares is the same as that of the rectangle to which it is adjoined, namely, 2.5. Consequently, the area of each small square is 6.25, and the combined area of all four is 25 (see Fig 3). Recalling that the area corresponding to  $z^2 + 10z$  – represented by the diagram in Fig 2 – is 39, the area of the completed square in Fig 3 must be  $39 + 25$ , that is is 64, which means in turn that the completed square has a side of 8. A quick look at Fig 3 shows that this side comprises the side of the original square of Fig 1 plus two of the sides of the small squares used to complete Fig. 2, that

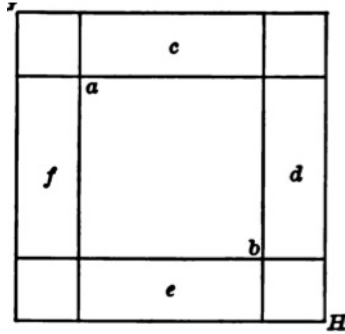


Figure 3: The Completed Square with side  $z + 5$ . From the Columbia ms.

is to say, the completed square has a side whose length  $z + 5$ . Therefore we can see that  $z + 5 = 8$ , and it follows that  $z = 3$ .

Now, let us turn to Descartes' *Géométrie*, which begins, too, with solving a simple quadratic equation by completing its square. Unlike Al-Khowarizmi however, Descartes does use algebraic symbols from the outset, and is, in theory, indifferent to whether a number is positive or negative. Thus his ontological assumptions, be they in respect to algebra or to geometry, are different from his Arabic predecessor's. For instance, whereas the latter's Euclidean geometry is tied to the ontology of three-dimensional space, Cartesian geometry does not specify the nature of the being of its mathematical objects.<sup>11</sup> The same holds true for numbers as well – the symbolic language re-presents the numbers but without specifying any further the nature of their existence as mathematical objects.

<sup>11</sup>Michael Mahoney states the case most forcefully, insisting that Descartes' essential contribution to algebra was that of abstracting mathematical operations from visual or physical space. Descartes' mathematics, he claims, is a science of "pure structure," without any ontological foundation. See Michael S. Mahoney, "Die Anfänge der algebraischen Denkweise im 17. Jahrhundert," *Reze* 1, 15-31: here, 29. This is perhaps too strongly put, but there is no denying that Descartes seeks to separate his mathematics from the reference to physical space that underlies Euclidean geometry. Thus, for example, the multiplication of two lines in the *Géométrie* yields not a square (as in Al-Khwarizmi's algebra) but another line. In the *Discourse on the Method*, Descartes locates his initial success in overcoming the unsound reasoning of mathematicians and thinkers before him in the decision to consider "the various relations and proportions subsisting among . . . objects . . . in the most general form possible, without referring them to any objects in particular, . . . [so] that afterwards I might be the better able to apply them to every other class of objects to which they are legitimately applicable." Further, he begins to treat all such relations as "subsisting between straight lines, than which I could find no objects more simple, or capable of being more distinctly represented to my imagination and senses. . . . In this way I believed I could borrow all that was best both in geometrical analysis and in algebra, and correct all the defects of one by help of the other."

Descartes uses  $z$  to symbolise what Al-Khwarizmi calls the “root” of the quadratic equation – that is, the unknown whose value is to be determined. However, rather than using numbers for the known quantities in an equation, Descartes represents these symbolically as well, using  $a$  and  $b^2$  to designate the quantities corresponding to 10 and 39 in Al-Khwarizmi’s case. These may be thought of as, to use a felicitous distinction, the “known unknowns” in the equation. In other words, while also symbolically represented through letters,  $a$  and  $b^2$  are quantities whose value can be decided upon by the mathematician, and thus they can be treated as if they are numbers whose value is already known. The task, then, is determine the value of  $z$  – the true unknown – in terms of what are taken to be given:  $a$ ,  $b^2$ , and ordinary numbers.

In sum, Descartes proposes to solve the equation

$$z^2 = az + b^2 \tag{5}$$

By subtracting  $az$  from each side of the equation, we can rewrite it in a form comparable to Al-Khwarizmi’s  $z^2 + 10z = 39$ :

$$z^2 - az = b^2 \tag{6}$$

Now, we simply proceed in the manner already described earlier. Consider first the square of  $(z - \frac{a}{2})$ , that is,  $(z - \frac{a}{2})$  multiplied by itself:

$$(z - \frac{a}{2})^2 = z^2 - \frac{az}{2} - \frac{az}{2} + (\frac{a}{2})^2 = z^2 - az + (\frac{a}{2})^2 \tag{7}$$

But we know from equation 6 that  $z^2 - az = b^2$ . Therefore, completing the square by adding  $(\frac{a}{2})^2$  to both sides of equation 6, we get an expression for square of  $(z - \frac{a}{2})$  in terms of the given quantities  $a$ ,  $b^2$ , and ordinary numbers:

$$(z - \frac{a}{2})^2 = b^2 + (\frac{a}{2})^2 \tag{8}$$

Finally, taking the square root of each side, we get:

$$\left(z - \frac{a}{2}\right) = \sqrt{b^2 + \left(\frac{a}{2}\right)^2} \quad (9)$$

And this result allows us to express  $z$  in terms of the known quantities, yielding

$$z = \frac{a}{2} + \sqrt{b^2 + \left(\frac{a}{2}\right)^2}. \quad (10)$$

While I have spelt out the algebraic logic of Descartes' solution in some detail, he himself skips over this exercise entirely, not even deigning to provide the kind of algorithm that Al-Khwarizmi had offered. Instead, Descartes immediately seeks to give the original equation 5 a geometrical interpretation and 'solve' the problem through an appropriate geometrical construction. But the use and implication of geometry here are very different from what obtains in Al-Khwarizmi's example, where, as we saw, geometry was the locus of verification, and the geometrical completion of the square the means whereby to prove the truth of the algebraic procedure. In contrasting these two mathematical approaches separated by more than half a millenium, I want to emphasise what has changed in the relationship between algebra and geometry, not so much in the technical content of the problem (which is essentially the same) but in how the problem is understood and represented.

But before turning to this relationship, let me quickly recount Descartes' equally ingenious geometrical solution. Unlike Al-Khwarizmi, who uses the areas of squares and rectangles, Descartes relies on straight lines, circles and triangles (see Fig 4). This is how he describes his geometrical approach to the equation  $z^2 = az + b^2$ :

I construct a right[-angled] triangle NLM in which the side LM is equal to  $b$ , the square root of the known quantity  $b^2$ , and the other side LN is [equal to]  $\frac{1}{2}a$ , [that is,] half the other known quantity which was multiplied by  $z$ . Then,

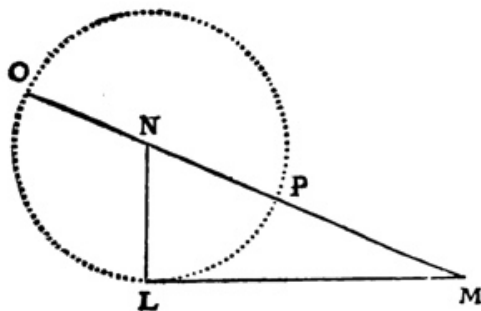


Figure 4: Descartes' Construction, from his *Géométrie*

prolonging MN, the hypotenuse of this triangle, to O, such that NO may be equal to NL, [then] the whole [line] OM is the searched-for line  $z$ . And it is expressed in this manner:  $z = \frac{a}{2} + \sqrt{b^2 + (\frac{a}{2})^2}$ .<sup>12</sup>

Since  $LM = b$  and  $NL = \frac{1}{2}a$ , Pythagoras' theorem tells us that the side  $NM = \sqrt{b^2 + (\frac{a}{2})^2}$ . Thus NM represents the second term in the algebraic solution – see (10) – to the given equation. To represent the unknown  $z$  as a line, we have to add to NM a geometrical equivalent to the first term in the algebraic formula for  $z$ , that is,  $\frac{a}{2}$ . Since we have constructed the line NL with the length  $\frac{a}{2}$ , we need only to construct a circle centred on N, with radius NL (see Fig 4). This construction ensures that the extension of the NM to touch that circle will be a line whose length corresponds to  $z$  in the algebraic solution. In other words, OM represents  $z$  and has the desired length of  $\frac{a}{2} + \sqrt{b^2 + (\frac{a}{2})^2}$ , as in (10).

For Al-Khwarizmi, the geometrical construction demonstrated the truth of the algebraic procedure; it showed *why* that procedure worked. By contrast, Descartes' constructions do not seek to prove the validity of the algebraic formula. Instead, they show that, given a type of quadratic equation, we can *produce* its solution geometrically by constructing a right-angled triangle out of the known coefficients and extending the hypotenuse of that

<sup>12</sup>René Descartes, *The Geometry of René Descartes*, trans. David Eugene Smith and Marcial L. Latham (London: The Open Court Publishing Company, 1925), 13. Translation modified. Further citations indicated by page number in body of essay.

triangle appropriately. The resultant line OM is the geometrical result that corresponds to the algebraic solution, and the construction reveals how that result can be generated through geometry. As Lenoir puts it, “[t]he only object of concern [for Descartes] was the geometric construction, and equations were employed simply as a shorthand way of performing time-consuming geometrical operations. Equations themselves had no ontological significance. They were only a useful symbolic language in which one could store geometrical constructions.”<sup>13</sup> The primary focus of Descartes’ *Geometry* is his solution to the so-called Pappus problem, which he claimed had hitherto not been properly solved using the appropriate geometrical means. But in this preliminary discussion of quadratic equations, the mathematical attitude underlying Descartes’ mathematical approach to that complex locus problem is already visible. There, as here, “the justification for his solution [lies] in the fact that each algebraic manipulation he made... corresponded to a definite geometrical operation.”<sup>14</sup>

In other words, for Descartes too the domain where truth resides is geometry. However, the diagram does not *prove* the validity of the algebraic formula (or, as in Khwarizmi’s case, of the algebraic process) in an Euclidean manner. Rather, the appropriate geometrical constructions – of drawing a triangle, extending the hypotenuse and so on – *produce* the truth by making real or actualising a knowledge of the unknown. The otherwise opaque algebraic formula is thus externalised through process of “solving” the problem geometrically, and the act of construction produces truth as intelligibility, making evident to the geometrician what the solution is. In this sense, construction transposes “mathematical intelligibility and certainty from the algebraic to the geometric domain, from the interior forum of the mind [namely, the purely mental sets assumptions that assign unity to a line, or associate line lengths with algebraic variables, and so on] to the external forum of space and body,”<sup>15</sup> that is, into the evidentiary clarity of the geometrical diagram.

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<sup>13</sup>Lenoir, “Descartes and the Geometrization of Thought,” 356.

<sup>14</sup>Lenoir, “Descartes and the Geometrization of Thought,” 358.

<sup>15</sup>Lachterman, *Ethics of Geometry*, viii.



Thus, while the association of algebra with *techne* evident in Al-Khwarizmi's treatise holds true for Descartes as well, the primacy of geometry is very differently conceived. For there is a fundamental, qualitative difference for Descartes between those who employ mathematics properly, doing it the right way, and those "arithmeticians" who emphasise only formal procedures, focusing on narrowly directed mechanical processes of calculation and proof. Briefly put, he draws a crucial distinction between acting mathematically and merely performing mathematical acts. The value of algebraic symbolisation lies in its allowing us to see parts of the problem that would disappear were we to rely only on actual numbers. The representational language enables us to follow the connection from one step in a solution process to another, by showing us how something develops and how it depends on what has been given or already established. But without care algebraic manipulation becomes a mere craft, simply a mode of calculation. Thus, even though algebraic symbolisation is certainly an important step because it frees calculation from an attachment to specific numbers, it is not enough on its own. As we shall see, algebra's importance is as much social as it is conceptual – by helping us act mathematically, it potentially differentiates us from those who simply perform mathematical acts. But, ultimately, algebra remains too close to the idea of an algorithmic procedure in al-Khwarizmi's sense to be able to sustain the philosophical, social and ethical distinction so important to Descartes.

Consequently – and in contrast to al-Khwarizmi's celebration of algebra's power to solve a variety of practical problems – Descartes suppresses the algebraic process entirely. He will not "pause here," he tells us, "to explain this in greater detail, because I should be depriving you of the pleasure of learning it for yourself, as well as the advantage of cultivating your mind by training yourself in it, which is, in my opinion, the principal advantage we can derive from this science [of algebra]" (18). Instead, he simply supplies the outcome of the algebraic manipulation: a formula. But the formula has no significance in and of itself. As Jones notes, it is linked by Descartes to a mechanical compass that

he himself has invented, and whose task it is turn that formula into geometrical reality.<sup>16</sup> Given a particular equation, the compass allows one to construct its solution, producing a curve that translates the abstract algebraic result into a concrete, immediately graspable image. I will return towards the end of this essay to suggest the relevance of Descartes' compass to Sidney's poetical practice (and vice versa), but for the moment we need only retain its importance as an emblem for a fundamental aspect of Cartesian epistemology, its insistence upon such geometric visualisation as the model for the clarity and distinctness that are the primary characteristics of true knowing.

The knowledge produced by geometry is not as in al-Khwarizmi limited to a single concrete example which we then generalise by analogy to similar cases, but underpins the exuberant claim which comes at the end of Descartes' treatise: of being able to generate (as the formula already implicitly does) the solutions to an infinite number of related problems:

But it is not my intention to write a thick book. Instead, I am trying rather to include much in a few words, as perhaps you will judge that I have done, if you consider that having reduced all the problems of a single class [*d'un mesme genre*] to a single construction [*une mesme construction*], I have at the same time given the method of reducing them to an infinity of other different problems, and thus solving each of them in an infinity of ways. . . . We have only to follow the same method in order to construct all problems to an infinite degree of complexity. For in terms of mathematical progressions, once we have the first two terms, it is not difficult to find the others. (240)

In a sense, without deciding upon the numerical values for the known unknowns  $a$  and  $b$ , we cannot actually carry out the required construction. But the imagined geometrical operations produce for Descartes an intuitive grasp of the general solution represented

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<sup>16</sup>See Jones, *The Good Life*, 34ff.

by the algebraic formula, and bring with it a mastery over the entire class of particular solutions generated by the infinite set of numerical values which can be ascribed to  $a$  and  $b$ . Central to Descartes' endeavour here is the notion that geometrical construction functions as a creative or generative source, infinitely capable of producing truth.

In Descartes' approach to the quadratic equation we begin to see a close link between constructibility – the geometrical equivalent of *poesis* – and the existence or objective reality of mathematical concepts. The construction he asks us to perform is a deliberate instrumental or mental operation aimed at producing an individual figure that is accessible to the intuition. This intuition bestows objectivity on the mathematical concept, bringing it in a manner of speaking into existence in a way that would not be possible without the construction. The distinction between the evidence of a proof and its formal certainty that Jones underscores in his reading of Descartes speaks centrally to this issue. As Jones puts it, “formal demonstrations, like syllogisms or other logical forms of proof, could, in [Descartes'] eyes, produce a kind of certainty. They did not, however, make *evident* the connections on was proving.”<sup>17</sup> And for Descartes, all knowledge has to have the clarity and intuitive obviousness that our knowledge of the simplest truths possesses – and such knowledge is not simply there, in the nature of the object, but has to be constructed; it demands the operation of the mind, its inventiveness, to make the mathematical concept real, and indeed bring it into being. It does not suffice to assent to the truth of something; it is necessary above all for that truth to be grasped with an intuitive immediacy.

Thus, Descartes' geometry shifts the very status of mathematical objects in ways that reflect the tension I have pointed out to above in discussing Sidney's use of mimesis – briefly, the question of whether poetry (or in this case, geometrical construction) re-presents or re-makes the natures to which it relates. This tension can be traced back to the foundational text of Western geometry, Euclid's *Elements*. One indication of an ultimately unresolved double perspective emerges in the two ways in which Euclidean propositions conclude:

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<sup>17</sup>Jones, *The Good Life*, 29.

usually, QED [*Quod erat demonstrandum* or, in the original Greek, *hoper edei deixal*], but sometimes QEF [*Quod erat faciendum* or *hoper edei poesai*]. While Euclid himself does not explicitly comment on this distinction, it nonetheless implicitly raises two important questions that are still alive for Descartes: (1) what share should fall to making or poesis in the progressive unfolding of mathematical theorems or problems, and (2) how does the temporality of making bear upon the being of mathematical concepts themselves?<sup>18</sup>

An indication that construction plays a different role in Euclidean geometry is suggested by the fact that the *Elements* almost invariably use the present perfect imperative to describe the constructive operation, so that bisecting a line segment is expressed as “let it have been cut in two,” and so on. In other words, rather than giving the reader instructions (as Descartes does above) in how to carry out the operation, the text insists on the impersonality of what is being done. Moreover, the perfect tense marks the relevant construction as already having been executed prior to the reader’s encounter with the proof. As Lachterman puts it,

In a Euclidean proposition nothing moves or is moved save our eyes and, perhaps, minds as we follow the transition from step to step. . . . The diagram we see exhibits the antecedently executed operations the outcome of which is now confronting us. . . . The temporality figured in the student’s coming to know the truth of a proposition by moving through its parts is not, or so it seems, inherited from a temporality intrinsic to the [mathematical] “beings” on which Euclidean *mathesis* is focused.<sup>19</sup>

While Euclid is notoriously reticent in terms of providing philosophical interpretations or details that would allow us to pin him down, the implication of these aspects of his *Elements* is that the movements of graphic constructions do not “‘create’ or ‘realise’” the nature of the geometrical objects they deal with, but rather they “‘evoke or allow it to make its

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<sup>18</sup>I draw here on Lachterman’s detailed analysis of Euclid in *The Ethics of Geometry*, 25-123.

<sup>19</sup>Lachterman, *Ethics of Geometry*, 66-67.

intelligible presence ‘felt’<sup>20</sup> In Descartes’ *Géométrie*, by contrast, despite the wariness with regard to technical procedure (as in his suspicions concerning algebra), the constructions nonetheless partake of the making, the poetic force of technical operations, and are thus closely allied to the creation or realisation of the mathematical concepts.

### **Making Poetry**

The idea that public spaces we inhabit and share depend upon the right way – whether through geometry or literature – of making objects, and thereby ourselves, leads us back to Sidney. The English poet consistently sees the arts and the sciences as fundamentally *human* endeavours, and therefore necessarily directed towards the same ends:

Some an admirable delight drew to music, and some the certainty of demonstration to the mathematics; but all, one and other, having this scope: to know, and by knowledge to lift up the mind from the dungeon of the body to the enjoying his own divine essence. (219)

However, knowledge is not valuable for its own sake. Rather, what is important is that knowledge be directed towards virtuous action. In noting that the “mathematician might draw forth a straight line with a crooked heart” (219), Sidney distinguishes between the local ends of a particular knowing and the final cause it serves: as with other modes of knowing, mathematics is directed to the “highest end of mistress knowledge, . . . which stands . . . in the knowledge of a man’s self, in the ethic and politic consideration, with the end of well-doing, and not of well-knowing only” (219). What he voices, then, is an understanding of mathematics as a profoundly ethical and moral domain – and it is on this basis that Sidney asserts poetry’s superiority, as the art most apt to combine theory and practice, and by so doing shape human nature — thereby producing judgment not simply as a formal knowing but as “lively knowledge”:

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<sup>20</sup>Lachterman, *Ethics of Geometry*, 121.

A perfect picture, I say, for he yieldeth to the powers of the mind an image of that whereof the philosopher bestoweth but a wordish description which doth never strike, pierce nor possess the sight of the soul so much as that other doth. . . . Or of a gorgeous palace, and architector . . . might well make the hearer to repeat, as it were, by rote all he had heard, yet should never satisfy his inward conceit with being witness to itself of a true lively knowledge. But the same man, as soon as he might see . . . the house well in model, should straight-aways grow without need of any description to a judicial comprehending of [it]. (221-22).

Geometry is poetic in that it makes just such an image, and it is the ethical force of such making that connects Descartes and Sidney, linking mathematics and poetry as productive of an ethos that will ultimately demarcate of the boundaries and conditions of entry of a public space. As human beings, we are subject of course to inevitable limitations: “the final end is to lead and draw us to as high a perfection as our degenerate souls, made worse by their clayey lodging, can be capable of” (219). Nevertheless, mathematics and literature, in their Cartesian and Sidney-an guises respectively, not only posit the shared capacity as human beings to reach toward knowledge, but also instantiate poetic modes through which we re-form ourselves so as to be capable of creating and entering the spaces of public life.

But what poets (or philosophers) say is not necessarily what poets (or philosophers) do – or, at the very least, their doing is very rarely transparent to their saying. I would like therefore to turn to an instance of Sidney’s practice, to illustrate one way in which he expresses the alliance between geometry and poetry in the very form of his poetic matter. Let us consider the much-studied opening sonnet of Sidney’s *Astrophil and Stella* sequence – a poem especially memorable for its penultimate image of the pregnant poet, “helpless

in [his] throes, biting [his] truant pen (ll. 12-3).<sup>21</sup>

The poem's opening sestet famously deploys the classical rhetorical figure of the *gradatio* or ladder in the step-by-step movement through which the narrator imagines Stella logically progressing to a stage where she might be willing to "entertain" (l. 6) his desires.

Loving in truth, and fain in verse my love to show,  
That she (dear she) might take some pleasure of my pain;  
Pleasure might cause her read, reading might make her know;  
Knowledge might pity win, pity grace obtain;  
I sought fit words to paint the blackest face of woe,  
Studying inventions fine, her wits to entertain (ll. 1-6)

We begin by assuming a desired objective: a "truth" evident to the poet – loving – needs to be expressed "in verse." However, this "show[ing]" does not aim simply to express the self but to produce a pleasure in the other, since the poet further imagines that the addressee will derive an immediate pleasure from the mere production of the poem itself, seeing (sadistically) in the poetic object as such an index of the writer's pain. As line 3 suggests, this pleasure is prior to actually reading the poem: before all else, the verse "show[s]," the visual and performative implication of the verb being amplified in line 6 when the poet seeks the right language "to paint" his "woe." In short, her act of reading does not automatically follow upon the writing, but has itself to be stimulated by the pleasure she takes another's pain, to which the verse will point. Once the affect is set in motion thus, each successive link in the logical chain seems to follow rigorously upon its predecessor,<sup>22</sup> each action almost algorithmically generating the next, each proposition entailed by the one that came before: pleasure leads to reading, reading to knowing, knowing to winning

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<sup>21</sup>All quotations from Sidney's verse come from Duncan-Jones' *A Critical Edition of the Major Works*, *op. cit.*

<sup>22</sup>I say 'seems' because the strength of the connection between each step is weakened by the reiterated "might," suggesting the residual uncertainty attending every transition. The tension between a strictly logical entailment and the possibility of a failure at each junction is perhaps heightened by the echo of the other primary meaning of "might": power or force.

pity, pity to obtaining grace. Step by step she climbs the ladder, raising him in turn as she advances. All that remains for the narrator is to execute this poetic programme – in all senses of the word – by turning to what others have already written, rifling through their “leaves” (l. 7) to con their “inventions fine” (l. 6).

However, here the projected process breaks down: studious imitation of others not only fails to aid the poet but actively hinders him, their verse stubbornly refusing appropriation: “others’ feet still seemed but strangers in my way” (l. 11). The result is a painful stasis, the poetic birth of the voice is forcibly checked, leaving the poet “helpless in [his] throes.” The “truant” pen refuses to be commanded, and agency is only conceivable in the circular form of self-flagellation, its energy directed entirely inwards. If the circle was, as the long tradition from Aristotle to Kepler maintained, a symbol of perfection, it had also become, especially with the advent of Hindu-Arabic numerals, the cipher of nothingness. And, tragically as well as comically, Sidney looks in both directions: in his end is his beginning (recall the comic conclusion to Sonnet 45, “pity the tale of me”) – and vice versa.

What the sonnet stages, then, before the volta of its concluding line – where his muse steps in to save the day – is an anatomy of failure. What the poem dissects, though, is not merely a contingent failure – that of this particular poet’s endeavour here and now to win over this particular addressee. Rather, it lays before us the failure of a (poetic) mode. The inability to make a poem able to set the imagined algorithm in motion signals a failure internal to – and, indeed, constitutive of – the mimetic paradigm (or at least of one influential understanding of that paradigm) the narrator initially adopts. It needs to be emphasised that the fundamental problem does not lie in the imagined concatenation of dependent events leading to the desired-for “grace.” The centre of the poem focuses instead on the difficulty of the initial construction itself, which is meant to trigger the subsequent algorithmic process.

Captured in that multivalent word “invention” (repeated thrice in lines 6 through 10), Sidney’s difficulty reflects the tension I have identified above in both the *Defense* and in



the contrast between Euclidean and Cartesian construction. On the one hand, to study the “inventions fine” of others in order “to paint the blackest face of woe” construes invention as a discovery of what is already there, a finding-out on the basis of already produced poetic constructions. To invent in this sense is closer to the use of the verb and its variants in contemporary accounting manuals, where the discovery of gains and losses, what was coming in and what was going out, was achieved by taking inventory. Even more pertinently, in this aspect invention is allied with analysis in terms of the classical opposition between analysis as a method of discovery and synthesis as a method of demonstration. In Aristotle’s *Nicomachean Ethics*, for instance – a text with which Sidney was deeply familiar, as his correspondence shows – this distinction is formulated via the contrast between means and ends: analysis assumes the objective or end, taking it to be already given, in order to focus on the means whereby the end may be achieved. And this is precisely the attitude that seems to govern the poem’s first half, where the narrator assumes showing his “truth” – loving – and its practical correlate – obtaining “grace” – as his objectives, to turn his attention instead to the *techne* or *praxis* through which those objectives may be realised. The initial poetic construction – much like its geometrical counterpart in Euclid – is not meant to demonstrate something new – for instance, to show the poetic equivalent of a Euclidean theorem; rather it is a means, that which has to be made in order to achieve a certain end.

But this notion of invention proves itself inadequate, and Sidney’s turn away from copying others’ constructions pre-figures the Cartesian turn away from Euclidean construction. Drawing on Aristotelian terminology, Descartes distinguishes, as we have seen, “between acting geometrically and performing a geometrical act”:

Acting geometrically requires that one perform a geometrical act from knowledge of the underlying interconnections and that one chooses to do so given the end of creating more intuitive knowledge. A formally valid calculation or

geometric construction might either be merely a geometrical act or be a product of acting geometrically.<sup>23</sup>

In other words, for Descartes, formal logical consequence or for that matter a step-by-step sequence in a proof may be necessary for producing certainty but it nonetheless falls short of the kind of clear and distinct evidence that truly characterises knowledge. Even if I am certain of a relationship between A and E because I consent to the series of relations A:B, B:C, C:D, D:E, “I do not on that account see what the relationship is between A and E, nor can the truths previously learnt give me a precise knowledge of it unless I recall them all.”<sup>24</sup> What is further needed is an intuitive – or as Jones puts it, “poetic” – grasp of the relationship between A and E, so that their interconnection possesses the kind of evidentiary vividness or force characteristic of our grasp of any of those intermediate relationships. And the limits Descartes attributes to the formal certainty of mathematical demonstrations – as Sidney does in the case of poetic demonstrations – shape his ambivalent response to the prior labours of others: “In slavishly imitating and assenting to proof, one allows reason to ‘amuse’ oneself and thereby one loses the habit of reasoning.”<sup>25</sup> What Sidney loses in reasoning as he does is the habit of poetry itself.

To break out of the resulting impasse, Sidney must turn invention in *poesis* inside out, as Descartes does construction in geometry, making it instead the avenue of creation, the way of bringing forth something new, a “heart-ravishing knowledge” as the *Defense* puts it, when recounting that the Romans called a poet “*vates*, which is as much as a diviner, forseeer, or prophet” (214). Thus, across its repeated iterations in lines 6 through 10, the meaning of invention shifts: the alliance between study and invention announced in line 6 (“[s]tudying inventions fine”) mutates into disjunction in line 10, where invention as “nature’s child” is opposed to the martinet-like rigour of what has now become the false

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<sup>23</sup>Jones, *The Good Life*, 32.

<sup>24</sup>Descartes, “Rules for the Direction of the Mind,” in *The Philosophical Works*, vol. I, 25.

<sup>25</sup>Jones, *The Good Life*, 27.

mother: “Invention, nature’s child, fled step-dame study’s blows” (l. 10). Sidney’s association of a transformed invention with nature’s fecundity is already hinted by the intervening hope that “[s]ome fresh and fruitful showers” might “flow” upon his “sunburnt brain” (l. 7-8) – and this connection sets up, too, the situation which will result from *not* making use of invention’s natural fertility: a pregnancy that refuses to end, suspending nature’s issue. Indeed, the sonnet elegantly negotiates the shift between these two senses of invention in lines 6 and 10 respectively through the ambivalence expressed in the intermediate line 9: “But words came halting forth, wanting invention’s stay.” The multivalence of both “wanting” – desiring and lacking – and “stay” – delay and hindrance, but also support – captures the dynamic balance between different senses of invention, between mimesis as imitation and as creation.

The distinctness and clarity of poetic production in Sonnet 1 is conveyed by both the brevity and tone of the muse’s intervention, when it admonishes the poet by pointing out the obvious: “Fool,’ said my muse to me; ‘look in thy heart, and write’” (l. 14). As in the *Defence*, the evidentiary vividness is located in the heart, for it is only by looking there that one can ‘invent’ the poem, and thereby act poetically (that is, write) rather than merely perform a poetic act (which first six lines of the poem describe, and whose failure the next six recount). If for Descartes, the geometrical construction that follows algebraic analysis converts the formal and symbolic logic of algebraic manipulation into an intuitive grasp of truth akin indeed to divination, the turn inward to the heart in this sonnet likewise achieves a re-vision; it changes the very mode of seeing: from the observation of a series of mechanical movements between causes and effects into an almost vatic insight into the totality of their deeper, underlying connectedness.

But this not mean that the algebraic process, the concatenation of causes and effects in algorithmic fashion, is in itself a mistake. As I have suggested above, this is far from being the case. Indeed, for Descartes, the symbolic representation of geometric lines in order to produce a set of equations that can be solved is a crucial and necessary step, for

it is through algebra that the gaps in the process leading from known things to unknown ones is filled. As Descartes puts it, the algebraic movement does not being into being “a new kind of identity”; instead, it extends “our entire knowledge of the question to the point where we perceive that the thing we are looking for participates in this way or that way in the nature of things given in the statement of the problem.”<sup>26</sup> Algebra is thus a necessary but temporary help to achieve the geometric construction, which truly does bring something new into being, not just visually but in that it produces a vivid knowledge of the interconnection among things, or among a set of geometrical objects.

Hence, Cartesian geometry in a strict sense *repeats* algebraic labour – though in order ultimately to discard algebra as mere *techne*, excessive focus on which blocks understanding. This attitude is best captured by Descartes’ famous compass (see Fig. 5). Descartes

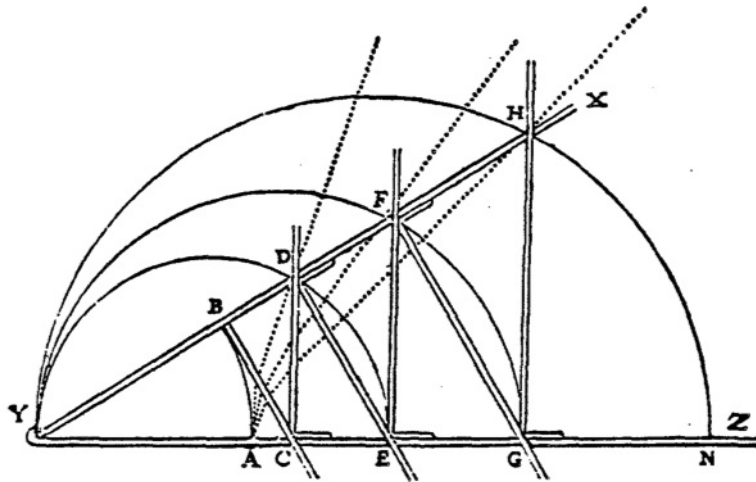


Figure 5: Descartes’ Compass

envisions here a system of linked rulers. A pivot at Y connects the rulers YX and YZ, the latter remaining fixed while the former rotates. The ruler BC is fixed perpendicular to YX at B, while the remaining rulers parallel to it (DE and FG), slide perpendicularly along YX when pushed by DC and FE respectively. As the angle of the instrument is XYZ is

<sup>26</sup>René Descartes, *The Philosophical Writings of Descartes*, trans. John Cottingham *et al.* (Cambridge: Cambridge University Press, 1984-91), vol. 1, 56. Also cited in Jones, *The Good Life*, 33.

opened by rotating YX, “the ruler BC... pushes toward Z the ruler CD, which slides along YZ always at right angles. In like manner, CD pushes DE, which slides along YX always parallel to BC; DE pushes EF; EF pushes FG; FG pushes GH; and so on.”<sup>27</sup> In short, the initial motion generates a series of curves. Point B (which is fixed on XY) traces a circle, while points D, F, and H (which slide along YX) trace other, more complex curves indicated by dotted lines in Fig. 5.<sup>28</sup> By translating the steps of the algebraic equation into appropriate curves through a continuous motion (or through several successive motions, each regulated by those which precede), Descartes’ instrument showed that “however composite a motion is, the resulting curve can be conceived in a clear and distinct way, and is therefore acceptable in geometry.”<sup>29</sup> The overarching epistemological enterprise, in whose service this mechanical instrument was designed, demanded, too, a constructive repetition of algebraic analysis:

Algebraic work produces a formula. The newly created algebraic formula guides the construction of a machine, which draws a curve. This curve/machine complex makes the interconnection among the geometrical objects evident. In this process, algebra enables us to get to this geometric order. An algebraic formula, however, should not substitute for knowledge of the geometric order it can help produce.<sup>30</sup>

This Cartesian production of an epistemological difference in and through repetition points to a final implication of Sidney’s understanding of mimesis and invention, and leads

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<sup>27</sup>Descartes, *Géométrie*, 318.

<sup>28</sup>In terms of Descartes’ insistence on the need to grasp the intermediate terms in a proof sequence connecting an initial term A to a final term E via the series of relations A:B, B:C, C:D, D:E (cited above), the compass generates a series of similar triangles – YBC, YDE, and so on – which make visible these mean proportionals characterising the algebraic equation

<sup>29</sup>Bos, “Curves in Descartes’ *Géométrie*, 310. This was not the only compass Descartes dreamt up, for it only involved straight lines as the moving parts. He also envisioned other, more complex devices that combined the movement of straight lines with the motions of simpler curves.

<sup>30</sup>Jones, *The Good Life*, 34. The compass, as a mechanical device, falls under the same injunction circumscribing algebra’s role. In itself it is no more than an instrument, but through its appropriate use geometry reveals itself as poesis.

to another sense in which Sidney's ends and beginnings are intricately. For we should note that muse's injunction in the sonnet's concluding line returns, through the poet's self-reflection, to the poem's beginning, since arguably the poem we have just read is the product of his having taken the muse's advice to heart. Just as geometrical construction repeats the algebraic, exposing both its truth and its limits in the production of intuitive knowledge, so too what is triggered by looking into the heart is a poem that rehearses its own failure in order vividly to express the difference internal to repetition, the other side of mimesis: invention as nature's child. It is through the dynamic repetition – and disavowal of – their own conditions of possibility that both poetic and geometric constructions themselves come into being, reinventing themselves by inventing the techniques they will ultimately seek to displace.

#### **Coda: Fables to Live By**

Jean-Luc Nancy's rich if elusive essay on Descartes takes its title from Jan Weenix's 1647 portrait of the philosopher, which shows him holding an open book on whose left page is inscribed *mundus est fabula*, the world is a fable. The phrase ought not to be taken, Nancy argues, as repeating the Baroque commonplace that the world around us is illusory, no more real than fable. Rather, it points to the constitutive place of the fable in the Cartesian invention of the thinking subject, upon whose certitude all knowledge of the world is built.<sup>31</sup> The opening chapter of the *Discourse on the Method* makes this fabulatory motive explicit:

Thus my design is not to teach here the method which everyone ought to follow in order to direct his reason well, but only to show how I have tried to direct my own. . . . But, putting forward this work as a history [*histoire*], or, if you prefer, as a fable [*fable*] in which, among a few examples one may imitate, one will

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<sup>31</sup>Jean-Luc Nancy, "Mundus est Fabula," *MLN* 93 (4), 635-653: here 635-37.

perhaps find many others that one will be right not to follow, I hope that it will be useful to some without being harmful to any, and that all will be grateful to me for my frankness [*franchise*] (83; translation modified).<sup>32</sup>

As Nancy perceptively notes, Descartes' text does not itself "imitatively borrow the traits of a literary genre. . . . If fable here. . . is to introduce *fiction*, it will do so through a completely different procedure. It will not introduce fiction 'upon' truth or beside it, but *within* it."<sup>33</sup> This distinction, wherein fiction-making enters into the very interior of truth, ought to be recognisable to us in Sidney's own justification for poetry's aptitude for (truthful) feigning – which is not, he emphasises, tantamount to lying because it never purported to be literally true to begin with. Or, as Descartes defends his invention of the world in *Le Monde*, it is not that one seeks to present "the things that are actually in the true world," but of "feigning one at random. . . that nevertheless could be created just as I will have feigned it."<sup>34</sup>

The motif of the fable also opens a more unexpected connection between Sidney and Descartes. As is well known, in 1595 Sidney's *Defence* also appeared in a different edition and was called instead *An Apology for Poetry*. The implications of this alternate title are rich. Margaret Ferguson points out that the word apology derives from *apo*, meaning away and *logia* or speaking, and thus came to signify "a speech in defense." However, the Renaissance conflated this with the Greek word *apologos*, which meant story or fable, generalising this term to apply to didactic allegories such as Aesop's fables. "[F]or Renaissance defenders of poetry, there was a special link between *apologos* and *apologia*, a link

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<sup>32</sup>The motif of the fable recurs in the *Discourse* – for example, in the ensuing discussion of the learning of the Schools – as well as in *The World [Le Monde]*, which was suppressed from publication by the author upon hearing of the condemnation of Galileo in 1632. In that earlier text, Descartes solicitously tells the reader that he wishes "to envelop a part of it with the invention of a fable" so that "you will find the length of this discourse less tedious." Through this fable, he hopes "that truth will always be sufficiently visible, and that it will be no less pleasant to behold than if I exposed it in all its nakedness." Cited in Nancy, "Mundus est Fabula," 639.

<sup>33</sup>Nancy, "Mundus est Fabula," 638.

<sup>34</sup>Cited in Nancy, "Mundus est Fabula," 639.

suggested not only by the fact that both terms were sometimes translated as ‘apologie’ in sixteenth-century England, but also by a Platonic text that was crucial to Renaissance justifications of poetry,” Plato’s *Republic*.<sup>35</sup>

References to Plato’s banishing of poets from the ideal republic abound in Sidney’s *Apology*. And the very first mention of Plato emphasises the fabulous dimensions of his thought:

And truly even Plato whoever well considereth shall find in the body of his work, though the inside and strength were philosophy, the skin, as it were, and beauty depended most on poetry: for all standeth upon dialogues, wherein he feigneth many honest burgesses of Athens to speak of such matters, that, if they had been set on the rack, they would never have confessed them. . . (213).

Not only does Sidney see the very dialogic form as inherently poetic, but he recognises clearly the extent to which Platonic truth is communicated through invention: feigning their words extracts the “honesty” of the Athenians beyond anything that torture can achieve. Plato’s own recourse to fables and myths at key junctures in his dialogues – Sidney notes the strategic “interlacing” of what might seem “mere tales, as Gyges’ ring and others” (213) – is echoed in the framing fable with which the *Apology* opens. In a gesture that anticipates the ostensible humility of Descartes’ presenting his life as a fable, Sidney self-deprecatingly prefaces his own – unavoidably solipsistic – defense of poetry with the diverting story of John Pietro Pugliano, whose equestrian responsibilities lead him excessively “to exercise[] his speech in praise of his faculty.” “Had I not been a piece of a logician before I came to him,” Sidney muses, “I think he would have persuaded me to have wished myself a horse. But thus much at least his no few words drave into me, that self-love is better than any gilding to make us seem gorgeous wherein ourselves be parties” (212).

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<sup>35</sup>Margaret W. Ferguson, *Trials of Desire: Renaissance Defenses of Poetry* (New Haven: Yale University Press, 1983), 2-3.



It is likewise through the fable of Descartes' own intellectual autobiography that the Cartesian thinking subject shows itself. Descartes refuses the position of authority from which his method can be taught, and even suggests that this frank display of himself may have only a very limited exemplary function as model to be fruitfully imitated. Indeed, a little later the *Discourse* distances itself even further from its potential use as imitative model:

If my work has pleased me enough that I show you its model [*modèle*] here, it is not because I wish to advise anybody to imitate it. Those upon whom God has bestowed more of his graces will perhaps form designs more elevated; but I do fear that for many this [work itself] may already be too audacious. The sole resolve of undoing all the opinions that one has formerly received [*auparavant en sa créance*] is not an example that each man should follow. And the world may be said to be mainly composed of two sorts of minds to which it is not in the least suited (90; translation modified).

Descartes' notion of the private and particular self is itself a product of an awareness of a collective, a "public" for whom the author cannot in any direct sense serve as a model to be copied. Put another way, (auto)biography is itself created in the gesture that posits the subject's life as heuristic fiction.

The Cartesian fable thus appears a paradoxical beast, both exemplary and, in a fundamental sense, inimitable. And this double articulation is, I wish to suggest, distinctive of Sidney as well. To sharpen the paradox, we might say that both writers show themselves as imitable precisely in their inimitability. In other words, simply to copy what they do would be the equivalent of merely performing geometrical or poetical acts – the failure of which the opening sonnet of *Astrophil and Stella* stages. Truly to imitate them, by contrast, would be to take their very inimitability as model, that is to say, to inhabit (as they do) a process of invention whose characteristic is a distinctive internal swerve within inher-

ited traditions, a repetition that produces difference in the form of singularity.<sup>36</sup> As Nancy writes apropos Descartes (in words that we could easily apply to Sidney's poetical practice as well), "if the worlds of fiction and reality are not identical, what instead is identical – yielding Descartes' very identity — is the activity of invention and creation... The subject of true knowledge must be the inventor of his own fable."<sup>37</sup>

Consequently, to put the case in Sidney's terms, what one is enjoined to imitate is less either the "matter" or the "manner" (see p. 248) of their geometrical and/or poetical creations than something more like their attitude with respect to the very relationship between matter and manner. Richard Young aptly describes the poet-lover of Sidney's sonnet sequence as a "Janus-figure... looking in both directions: within the dramatic context toward the lady and beyond it toward a reader."<sup>38</sup> While the dramatic fiction is lent a solidity by Sidney's evocation of his own biography throughout the sonnet sequence, it is equally the sequence itself which invents the life, by creating and re-creating, for instance, the figure of Stella (and, concomitantly, the figure of Astrophel) from sonnet to sonnet. In turn, showing the self through the shapes it creates constitutes the mode of address outward: the singular and virtuoso display of literary imitation turned inside out calls for an audience whose 'imitation' of the poet would ideally take the poet's singularity as model, reading it – to borrow again Nancy's description of Descartes' *Discourse* – as the "fable of the generality of a singular and authentic action."<sup>39</sup> What poesis brings into being for Sidney, as geometrical construction does for Descartes, is the degree to which the making of the verbal (or visual) image produces an exemplarity that is generalisable not via direct

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<sup>36</sup>Gilles Deleuze's distinction between generality and repetition is apposite here: "[I]t is not Federation day which commemorates or represents the fall of the Bastille, but the fall of the Bastille which celebrates and repeats in advance all the Federation days; or Monet's first water lily which repeats all the others. Generality, as generality of the particular, thus stands opposed to repetition as universality of the singular. The repetition of a work of art is like a singularity without a concept, and it is not by accident that a poem must be learned by heart." In: *Difference and Repetition* (London: The Athlone Press, 1994), 1.

<sup>37</sup>Nancy, "Mundus est Fabula," 639-40.

<sup>38</sup>Richard B. Young, "English Petrarke: A Study of *Astrophel and Stella*," in *Three Studies in the Renaissance: Sidney, Jonson, Milton*, 1958, 9.

<sup>39</sup>Nancy, "Mundus est Fabula," 641.

likeness but in the very mode of relating to the world that it exemplifies.

But if the question be for your own use and learning, whether it be better to have it set down as it should be, or as it was, then certainly is more doctrinable the feigned Cyrus in Xenophon than the true Cyrus in Justin, and the feigned Aeneas in Virgil than the right Aeneas in Dares Phrygius (224).

It is worth noting that the Oxford English Dictionary traces the first use of the word individual to signify “a single human being, as opposed to Society, the Family, etc.” to the early seventeenth century.<sup>40</sup> One might say that Sidney and Descartes envisage the creation of this individual precisely through individual creation. And it is on the shifting sands of such a fabulous foundation that their publics would be built.

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<sup>40</sup>The OED cites J. Yates’ 1626 *Ibis ad Caesarem*: “The Prophet saith not, God saw every particular man in his blood, or had compassion to say to every individual, *Thou shalt live*.” Entry under 3a, spelling modernised. My thanks to Diana Henderson for bringing this point to my attention.