

Geometry, Theology, and Politics

Context and Consequences of the Hobbes-Wallis Dispute

The dispute that raged between Thomas Hobbes and John Wallis from 1655 until Hobbes's death in 1679 was one of the most intense of the "battles of the books" that marked seventeenth-century intellectual life. The quarrel began over geometric matters, when Wallis published a lengthy refutation of the mathematics in Hobbes's treatise *De Corpore* (Hobbes 1655) under the title *Elenchus Geometriae Hobbiana*e (Wallis 1655).¹ But as the exchange of polemics dragged on over the years, the list of contested topics grew to include issues in theology and politics, among others. A large part of the significance of this dispute comes from the fact that it involved two of the most influential figures in the English "republic of letters." On the one side was Hobbes, whose 1651 masterwork *Leviathan* had solidified his reputation as a political thinker and controversial proponent of the new philosophy, but who saw his once-considerable scientific and mathematical credentials demolished in the course of the dispute. On the other was Wallis, whose status as Savilian professor of geometry at Oxford and founding member of the Royal Society put him very much at the center of the English scientific scene. Yet his participation in the quarrel did not measurably enhance his standing.

¹ I use the following scheme of abbreviations for Hobbes's works. References to *Six Lessons to the Professors of the Mathematicques* (Hobbes 1655b) use the abbreviation 'SL' followed by lesson number; references to *Leviathan* (Hobbes 1651) use the abbreviation 'L' followed by part, chapter, and page numbers (in the 1651 edition) separated by periods. Citations to the *Opera Latina* (Hobbes [1839-45] 1966a) or *English Works* (Hobbes [1839-45] 1966b) follow, using the abbreviations *EW* and *OL*. References to *The Correspondence of Thomas Hobbes* (Hobbes 1994) use the abbreviation *CTH*.

Despite the importance that this controversy had in its day, and notwithstanding all that it can tell us about the intellectual climate of seventeenth-century England, it has been little studied until the last few years.² In large part, this relative neglect stems from the apparent fact that Hobbes simply got the mathematical aspects of the controversy wrong. Hobbes claimed that his principles had enabled him to solve the great unsolved problems of geometry – notably the quadrature of the circle, the arbitrary section of an angle, and the duplication of the cube. In support of his claims for the superiority of his geometry Hobbes included a circle quadrature and various other geometric efforts in his *De Corpore*; when Wallis promptly refuted these in his *Elenchus*. Hobbes replied with revised efforts and mounted a vigorous counterattack against Wallis’s own geometric principles. The ensuing exchange of polemics acquired a life of its own, and Hobbes found his geometric efforts universally rejected. In a futile attempt to preserve his imagined results from refutation, Hobbes rejected the basic principles on which his opponents’ arguments were based, but his geometric program collapsed into incoherence as he found himself forced to question such basics as the Pythagorean Theorem, the validity of the traditional trigonometric tables, or Archimedes’ bounds for the value of π . Viewing the wreckage to which Wallis had reduced Hobbes’s geometric argumentation, Christiaan Huygens wondered why Wallis had even bothered to expose the errors and incoherence in Hobbes’s geometry. As he put the matter in a 1656 letter to Wallis: “I was amazed that you judged [Hobbes] worthy of such a lengthy refutation, although I read your learned and rather sharp *Elenchus* with some pleasure” (Huygens 1888-1950,

² The controversy has not, however, gone altogether unnoticed in the literature. See Jesseph (1999), Probst (1994), and Sergio (2001) for recent work on the topic.

1: 392). This was, in all respects, a very public debate, and it focused on issues where one might not initially expect a controversy: certain technical questions of mathematics, and particularly the question of whether Hobbes had succeeded in solving the ancient problem of squaring the circle. Public disputes and debates typically have a political aspect, and this was no exception, as it involved matters of political obligation and theology in addition to questions of mathematics. Yet it would be a serious misinterpretation to think that the controversy was entirely political, or entirely theological, or entirely mathematical. The episode illustrates the interplay among a variety of factors, and cannot be reduced to questions of pure geometry or pure politics.

My purpose here is to address two questions. First, what was ultimately at stake in this dispute? Second, how might we (retrospectively, at least) keep score in this conflict and determine who emerged as the winner and explain why he won? The answer to the second question presupposes an answer to the first, since we can't really decide who *won* the battle until we agree about what the fight was all about. My remarks are consequently grouped into three sections: the first takes up the question of what was motivated the controversy, and the second examines the consequences that the controversy had for Hobbes. The brief final section takes up the question of how we can go about determining a winner and loser in this dispute.

1. The Dispute in its Context

The first thing that becomes evident in surveying the Hobbes-Wallis dispute is the fact that it was not a dispassionate search for the truth. This much is obvious from some of the harsh language employed by the disputants, with Wallis denouncing Hobbes's *De Corpore* as a "shitten piece," and Hobbes complaining of the "Levity and Scurrility"

employed by Wallis while invoking “Vespasians law,” or the principle that good manners forbid one from initiating the use of harsh language, but there is no harm in replying in kind (*Due Correction* 3; *SL* 6; *EW* 7: 331, 354). This level of invective shows that the participants in the dispute held quite passionately to their views, and it suggests that there was far more in play than the success or failure of a few geometric demonstrations. Indeed, issues in theology, church government, and politics appear, along with lengthy exchanges over subtle points of grammar and philology.

It therefore should be obvious that there was more at issue than some technical results in geometry. This much becomes clear even in the title of one of Hobbes’s polemics, which denounces the “Markes of the Absurd Geometry, Rural, Language, Scottish Church-Politics, and Barbarisms of John Wallis, Profesor of Geometry and Doctor of Divinity (Hobbes 1657). I will have more to say about the range of topics addressed, but it should be evident from the very outset that there was more at stake here than purely geometric questions.

One might be tempted, in the face of this sort of evidence, to think that the mathematical aspects of the dispute were insignificant, so that at the most fundamental level the *real* issues were those concerning politics and religion. Viewed in this light, the controversy would have involved geometric matters almost by accident, and geometry would have mattered only to the extent that it provided the disputants a convenient arena in which to trade polemics. Proponents of the “sociology of scientific knowledge,” especially those such as David Bloor, who embrace the old “Strong Programme” for the sociology of science, would insist that the geometric aspects of the dispute were a kind of cover for more basic differences about the proper ordering of society. As I hope to

show, there is little to be said in favor of such a reading of the controversy, although there is one respect in which this sort of sociological reading gets things right: there were certainly social factors at work in the Hobbes-Wallis dispute, and we can't hope to understand the controversy without attending to them.

In trying to determine what was ultimately at stake in this controversy, we can usefully begin by taking Huygens' question seriously: why, indeed, did Wallis go to the trouble of publishing lengthy and detailed refutations of Hobbes's geometric efforts? One might think that Wallis's decision to attack Hobbes's geometry could be explained entirely in terms of his quarrelsome temper. Wallis was, as Richard Westfall put it, "a bellicose character engaged in endless quarrels and controversies" (1958, 18). In fact, the catalog of Wallis's polemical writings is quite extensive, covering all manner of scientific, mathematical, and theological subjects.³ There can be little question that Wallis relished the role of polemicist, but it would be a mistake to think that his interest in the refutation of Hobbesian geometry was exclusively the consequence of his combative temper. One should note, for instance, that the English theologian and natural philosopher Thomas White published a circle quadrature in his 1658 work *Exercitatio geometrica. De geometria indivisibilium, & proportione spiralis ad circulum* (White 1658). The level of argument in this piece was no better than anything to be found in Hobbes, but Wallis did not bother to attack it.⁴ We are left to conclude that there was something significant in Hobbes's philosophy that motivated Wallis to engage in the lengthy and vitriolic denunciation of all things Hobbesian.

³ See Jessep (1999, 353) for an account of Wallis's long list of polemical and controversial publications.

⁴ See Jones (1974) for an account of the controversy engendered by White's failed quadrature.

In point of fact, Wallis made no great secret of his motivations for attacking Hobbes's geometry, and the presence of theological and political motives is well attested in a 1659 letter to Huygens. He wrote:

But regarding the very harsh diatribe against Hobbes, the necessity of the case, and not my manners, led to it. For you see, as I believe, from other of my writings how peacefully I can differ with others and bear those with whom I differ. But this was provoked by our Leviathan (as can be easily gathered from his other writings, principally those in English), when he attacks with all his might and destroys our universities (and not only ours, but all, both old and new), and especially the clergy and all institutions and all religion. As if the Christian world knew nothing sound or nothing that was not ridiculous in philosophy or religion; and as if it has not understood religion because it does not understand philosophy, nor philosophy because it does not understand mathematics. And so it seemed necessary that now some mathematician, proceeding in the opposite direction, should show how little he understood this mathematics (from which he takes his courage). Nor should we be deterred from this by his arrogance, which we know will vomit poison and filth against us. (Wallis to Huygens, 11 January, 1659; Huygens 1888-1950, 2: 296-7)

The threats that Hobbes supposedly posed to the universities, the clergy, and all religion are a consequence of his political and theological doctrines. Hobbes's political theory requires that the power of the civil sovereign be absolute and undivided. As a consequence, such institutions as universities and the clergy must submit to the dictates of the sovereign in all matters. This extends, ironically enough, to geometry, since

Hobbes notoriously claimed that the sovereign could ban the teaching of the subject and order “the burning of all books of Geometry” if he should judge geometric principles “a thing contrary to [his] right of dominion, or to the interest of men that have dominion” (*L* 1.11, 50; *EW* 3: 91). In the area of church government, Hobbes’s doctrines are a decisive rejection of the claims of Presbyterianism, which holds that questions of theological doctrine is to be decided by the elders of the church – the presbytery – without reference to the claims of the sovereign. As a Presbyterian minister, a doctor of divinity, and professor of geometry at Oxford, Wallis found abundant reason to reject this political theory.

Hobbes’s metaphysics provided even more to provoke Wallis’s antipathy. Hobbes embraced a thoroughgoing materialism that was inconsistent with any traditional notion of the Deity, and he was widely suspected of endorsing principles that implied atheism, even though he frequently insisted that his views were in conformity with the tenets of Protestant Christianity.⁵ Wallis and the proponents of traditional theology held that God is to be understood as an essentially immaterial spirit, radically distinct from the world of material bodies. Hobbes, however, notoriously declared that the expression *immaterial substance* is insignificant because it combines “two Names, whose significations are contradictory and inconsistent,” (*L* 1.4.17; *EW* 3:33) while also insisting “that which is not Body, is no part of the Universe: And because the Universe is All, that which is no part of it, is *Nothing*; and consequently *no where*” (*Le* 4.46.371; *EW* 3: 672). Hobbes reserved some of his harshest words for the proponents of “school divinity” or professors, like Wallis, who worked out complex and subtle theories on the

⁵ Whether Hobbes’s materialist philosophy can be consistently combined with theism is considered in detail in Jesseph (2002).

nature of God and the relationship between God and the world. School divines, Hobbes held, were agents of the “Kingdome of Darknesse” whose doctrines are an amalgam of false and pernicious philosophy that rest on “canting and fraud,” the intent of which is “to entangle shallow wits” and mislead them (Hobbes 1657, 4; *EW* 7: 385). If Hobbes had his way, Doctors of Divinity such as Wallis would be cast out of the universities and their teachings would be outlawed.

Needless to say, Wallis saw Hobbes and his philosophy as a threat, not merely to his livelihood but to his entire vision of a well-ordered society. If Hobbes’s doctrines were allowed to go unchallenged, the consequences for religious belief, political stability, and his own position were potentially catastrophic. Yet Wallis also found himself in something of a delicate position. He was, after all, a proponent of the “new philosophy” that sought to overthrow the traditional Aristotelian-Scholastic approach to nature. As a leading figure in the founding of the Royal Society, and as a visible exponent of the mathematics, mechanics, and astronomy associated with the “moderns” against the traditionalists, Wallis needed to show that the benefits of the new philosophy could be had without danger to piety and true religion. As Wallis’s associate Joseph Glanvill would put the matter in 1665, it was alarming that “divers of the brisker *Geniusses*, who desire rather to be accounted *Witts*, then endeavour to *be so*, have been willing to accept *Mechanism* upon *Hobbian* conditions, and many others were in danger of following them into the *precipice*” (Glanvill 1665, Preface b1). The corrective to such a danger lies in showing that the mechanistic principles of the new philosophy can be harmonized with traditional Christian teaching, so that “the meanest intellects may perceive, that *Mechanick Philosophy* yields no security to *irreligion*, and that those that would be

gentilely learned, and ingenious, need not purchase it, at the *dear* rate of being *Atheists*” (Glanvill 1665, Preface, b1).

Sensitive to the difficulty of showing that embrace of the mechanistic new philosophy did not require a commitment to Hobbes’s radical materialism Wallis, undertook the refutation of Hobbes’s geometry as a way of showing that the philosopher from Malmesbury lacked the intellectual standing to hold forth on weighty matters of religion or politics. One could phrase this by saying that the struggle over questions in geometry was ultimately a struggle for intellectual capital. By refuting Hobbes’s geometry, Wallis hoped to show that the Hobbesian philosophy was rotten to the core, and that “whoever stumbles so horribly in geometry, where demonstrative proofs have a place, can hardly be thought to walk more securely in other matters” (Wallis 1655, 4). Commenting on the dispute many years later, Wallis remarked that “as things then stood, [the refutation of Hobbes’s geometry] was something that had to be done, when he had set himself up in the guise of a great geometer and dared to offer false suggestions to our unsuspecting youth in matters of religion” (*OM* 1: sig. a4). In the letter of dedication to the *Elenchus*, he made a similar point, claiming that once Hobbes’s geometry had been refuted, “that man, so full of airy talk, might be quite deflated and others, less skilled in geometry, may know that there is nothing more to be feared from this Leviathan” (Wallis 1655, epistle, sig. A3). The result is that the controversy between Hobbes and Wallis was a very public affair. Further, it was promoted to the public by Wallis and his associates with the explicit understanding that the refutation of Hobbes’s geometric undertakings would lessen his authority in matters of politics and religion.

2. Consequences of the Dispute

From the account given thus far, it should be tolerably clear that Wallis's decisive motivation in attacking Hobbes's geometric efforts can be found in his fierce opposition to Hobbesian political and theological doctrines. Had Hobbes been simply another circle squarer on the model of Thomas White, it is hardly likely that Wallis would have gone to the trouble of attacking his geometric endeavors. The assault on Hobbes's geometry was not, for Wallis, an end in itself, but rather a means to the more noble end of discrediting Hobbes's metaphysics, methodology, and politics. For his part, Hobbes's replies to the attacks launched by Wallis were dictated by his own desire to defend, not merely the details of his geometry, but every aspect of his philosophical system. This fact accounts for the wide range of topics covered in the dispute – from the nature of ratios to the role of the Christian ministry, from the ontology of mathematics to the foundations of algebra.

Nevertheless, there remains the question of how the ultimate outcome of the dispute was determined. After all, it is one thing to explain why the parties went to war, and quite another to account for the factors that resulted in success or failure. On this point, it will become clear that Hobbes lost in the geometric aspects of the dispute because he was simply and spectacularly wrong about matters of considerable mathematical importance. Resolute persistence in his mathematical errors caused Hobbes to lose significant intellectual prestige, irrespective of the politics or first philosophy with which his mathematical blunders were associated. Indeed, by being wrong as consistently and catastrophically as he was in geometric matters, Hobbes saw his once-considerable reputation as a mathematical *savant* utterly destroyed at the hands of Wallis.

Despite his evident triumph in the geometric realm, Wallis's hopes of thoroughly discrediting the Hobbesian philosophy went unfulfilled. His thorough triumph over Hobbes's geometry did not (as he had expected) lead the reading public to dismiss Hobbes's philosophical system *in toto*. One might sum this situation up by saying that, if we keep score in the contest purely by attending to who got the geometrical questions right, then Wallis was the obvious victor in the contest. Yet Wallis failed to achieve his broader goal of discrediting the entire Hobbesian philosophical enterprise because the readership in the "republic of letters" was prepared to detach Hobbes's political theory and general philosophy from his geometry. As a result, Hobbes's devastating loss of intellectual capital on the geometric front – a loss amounting to outright bankruptcy – was not matched by a similar loss on other fronts. Hobbes remained a respected (if controversial) political theorist and proponent of the "new philosophy" even as his status as geometer plummeted to nothing, and he exercised an influence in philosophy and methodology even after his many geometric efforts had been consigned to the dustbin.

There is, however, an oddity here, and it is one about which I will have something to say shortly, although it is worth a brief mention here. Hobbes himself seems to have accepted the proposition that persistent failure in geometry must be symptomatic of deeper, more general inadequacies in his philosophical system. In fact, Hobbes seems to have conceived of his philosophy as a tightly interconnected whole, in which false geometric results must ultimately arise from a false first philosophy of methodology, and the rejection of one must require the rejection of the other. As Hobbes put the matter: "it is in Sciences, as in Plants; Growth and Branching is but the Generation of the Root continued; nor is the Invention of Theoremes any thing else but the knowledge of the

Construction of the Subject prosecuted” (*SL* epistle; *EW* 7: 188). Thus, Hobbes was prepared to stake his philosophical credibility on his success in mathematics, because he thought that the principles set forth in *De Corpore* were sufficient to solve any problem in mathematics, first philosophy, or natural philosophy.

I propose to illustrate these points by examining some of the details of the dispute as it unfolded in the 1660s and 1670s. In particular, I want first to consider the role of geometry in Hobbes’s campaign for admission to the Royal Society, after which I will investigate his attempt to stave off geometric defeat by appealing to the verdict of mathematicians from the European continent. The results of this exploration will, I hope, give a better idea of how we might go about determining winners and losers in this contest.

2.1 Hobbes, Wallis, and the Royal Society

One of the salient outcomes of this dispute between was Hobbes’s exclusion from the Royal Society. The Society was founded in 1660, but grew out of a series of informal meetings of English natural philosophers in Oxford in the 1640s – a group that included Wallis, as well as Seth Ward (another enemy of Hobbes who had published a lengthy denunciation of the Hobbesian philosophy in 1656). Hobbes apparently longed to be admitted to the Society, and his scientific contributions were certainly more significant than those of others who were elected fellows.⁶ Hobbes’s writings on optics, in particular, were important, while other of his writings in support of the “new philosophy” exemplified the outlook that the Society hoped to promote. In the course of events, however, Hobbes was denied admission. His contemporary biographer John Aubrey tells

⁶ On Hobbes and the Royal Society, see Malcolm (1988) and Skinner (1969).

us that Hobbes “had a high esteem for the Royal Society, having said that ‘Natural Philosophy was removed from the universities to Gresham College’, meaning the Royal Society that meets there; and the Royal Society (generally) had the like for him: and he would long since have been ascribed a member there, but for the sake of one or two persons, whom he took to be his enemies” (Aubrey 1898, 1: 371).

The grounds for Hobbes’s exclusion from the Royal Society are no doubt complex, but chief among them was his reputation as a proponent of atheistic materialism. Michael Hunter has argued that

Atheists were seen as people who denied the existence of God, either directly or by implication. It was axiomatic that unbelief would be sustained by views – usually materialistic – of a natural world that had originated without a beneficent creator in in which God’s activity was limited or completely absent. But in addition, numerous other arguments were seen as part of the atheists’ armory: a denial of the immortality of the soul and of any absolute morality; a skepticism about the text of the Bible, based either on its internal inconsistencies or on the supposed irreconcilability of Holy Writ with pagan history; or on the opinion – which orthodox polemicists repeatedly tried to turn back on itself – that religion had first been introduced as “*a meer politick Contrivance*” (Hunter 1990, 441)

Hobbes, it should be noted, subscribed to all of these “atheistic” views. He championed materialism, rejected providential history, denied the immortality of the soul, described a state of nature devoid of the usual moral absolutes, challenged the authenticity of much of Scripture, and notoriously defined religion as “*Feare of power invisible, feigned by the mind, or imagined from tales publiquely allowed*” (*L* 1.6.26; *EW* 3: 45).

It therefore appears that the main grounds for Hobbes's failure to gain admission to the Society are the same as those that motivated Wallis to attack his geometry. Noel Malcolm has made the point that Hobbes's reputation for atheism posed problems for his election to the Royal Society precisely because "the aura of religious notoriety clinging to Hobbes meant that any public association with him would be the source of embarrassment to the active members of the Society," given that Hobbes's own version of the "mechanical philosophy" was scarcely distinguishable from that endorsed by prominent members of the Society (Malcolm 1996, 35).

Hobbes, however, seems to have thought that his geometric contributions would be sufficiently grand that they would guarantee his admission to the Society, regardless of the suspicion with which his metaphysical and theological doctrines might be viewed. Evidence for this interpretation comes from an examination of Hobbes's various attempts in the early 1660s to solve the ancient problem of the duplication of the cube, i.e. given a cube, to construct a second cube with twice the volume. The problem reduces to that of finding two mean proportionals between two given lines, and had been studied intently since antiquity, without a successful construction. Of course, we now know that the problem is unsolvable within the constraints of classical geometry, but its solvability was considered an open question in the seventeenth century. In 1661 Hobbes published a French tract *La Duplication du Cube* anonymously in Paris, in which he offered a brief (but fallacious) attempted solution to this ancient problem. The tactic of publishing his work in a foreign language and a foreign capital was intended to disguise his authorship and thereby trick his opponents in the Royal Society (chiefly Wallis) into acknowledging the correctness of the solution. In the face of the previous five years' quarrels, he seems

to have reasoned that irrational, ideological opposition to his mathematics had made it impossible for him to receive a fair hearing from Wallis and his associates; he therefore sought to trick his opponents into unknowingly accepting a Hobbesian result by disguising his authorship.

The ruse was unsuccessful, and Hobbes's authorship of the failed cube duplication was quickly recognized. Undeterred, Hobbes circulated a slightly different version of the same duplication, sending a copy to King Charles II in 1661 with the obvious intent of impressing his sovereign with the power of his mathematical methods. Hobbes evidently calculated that he could gain entrance to the Society by appealing to its patron, and he must have expected that election as a fellow would follow in short order⁷. In this, as in so many matters where mathematics was involved, Hobbes was sorely disappointed. Instead of winning acclaim, his efforts initiated a wave of refutations from fellows of the Royal Society, who seem to have been united by a fervent desire to discredit Hobbes's mathematical efforts and thereby derail his campaign for admission to the Society.

The cast of fellows and associates of the Royal Society who refuted Hobbes's claims is instructive, as it includes such luminaries as Sir Robert Moray, Sir Paul Neile, Viscount Brouncker, Christiaan Huygens, Laurence Rooke, and John Pell. Thomas Birch, and early historian of the Royal Society reports that at a meeting of the Society in September of 1661, "A proposition of Mr. Hobbes, *for finding two mean proportionals between two strait lines given*, was delivered to the society by Sir Paul Neile from the

⁷ The duplication was forwarded by Charles II to Sir Paul Neile, with the instructions that it was to be examined by the Society. This, at any rate, is what Sir Robert Moray reports in a letter to Huygens in September of 1661, when he forwarded a copy of Hobbes's duplication (Huygens 1888-1950, 3: 336).

king, endorsed with his majesty's own hand, and was ordered to be registered; as was afterwards the answer to the problem, by lord viscount Brouncker" (Birch [1756-57] 1968, 1: 42). This was but one instance among several where his cube duplication was exposed as fallacious by members of the Royal Society, and Hobbes's great plans to use it as a means to extract admission to the ranks of the illustrious group failed quite miserably.

The role of the duplication in Hobbes's campaign for admission to the Royal Society is illustrated by a remark of the Danish scholar Ole Borch, who was a correspondent and acquaintance of Hobbes's friend Samuel Sorbière. His journal records a 1664 meeting with Sorbière in which the two men discussed a letter from Hobbes, in which he "tries to show that he has found a duplication of the cube; but Sorbière said there is someone else who thinks that he is playing with a paralogism. To which, however, Hobbes has already replied that the man is not a fellow of the Royal Society, and that it is against that society that Hobbes is arming himself" (*CTH* 2: 584, note to letter 161).

In the course of events, Hobbes's "arming" of himself in order to take the Royal Society by storm was futile. His cube duplication was soundly refuted (although he resolutely refused to acknowledge this fact), and by persisting claiming the adequacy of his solution, Hobbes cost himself what little mathematical credibility he had left. In the course of time, Hobbes became convinced that he must take the dispute beyond the confines of the Royal Society and appeal to a broader public in support of his claims. In the next phase of the dispute, then, we see Hobbes attempting to take his case to a venue that he imagined would be less hostile.

2.2 The Appeal to Continental Mathematicians

By 1662 Hobbes recognized that he was losing – indeed losing quite badly – in his mathematical war against Wallis and the Royal Society. He did not, however, attribute his difficulties to the fact that he had gotten anything of mathematical substance wrong. Indeed, such an idea seems scarcely to have occurred to him. Although he was prepared to admit error on certain small technical points – which he excused as “errors of negligence” rather than more serious “errors of ignorance” – Hobbes was convinced that his approach to the great questions in mathematics was the only tenable one, and one founded on principles that would make short work of any problem whatever. It is in this sense that he could boast that he had introduced “active principles” whose power vastly exceeded those of his opponents, and claim to be the “the first to have made the grounds of Geometry firm and coherent.”⁸

Hobbes reserved some of his harshest words in his controversy with Wallis for the latter’s reliance on algebraic techniques. In essence, he argues that there is no way to tell whether an algebraic procedure is legitimate unless we know that it corresponds to an admissible geometric construction. But in such a case there is no need to distract ourselves with the study of algebraic symbols, and we should proceed immediately to the construction. Thus, an algebraic demonstration can be rigorous only if it is parasitic on a rigorous geometric demonstration that proceeds from the causes of the objects constructed.⁹ Wallis’s refutations of Hobbes’s geometric claims were typically

⁸The reference to active as opposed to inactive first principles is in the Epistle to *SL* (*EW* 7: 88); Hobbes’s boast about being the first to provide a firm and coherent foundation for geometry is at *SL* 3 (*EW* 7: 242). Hobbes’s distinction between errors of ignorance and errors of negligence is drawn at *SL* 2 (*EW* 7: 212).

⁹ REF to Examinatio; STC/

“algebraic” in the sense that they used various algebraic or trigonometric identities to reduce Hobbes’s claims to absurdity. Faced with this sort of refutation, Hobbes attempted to rescue his results by claiming that algebraic reasoning could never refute a geometric construction.

Aside from expressing contempt for the “algebraists” and their mathematical methodology, Hobbes was persuaded that his opponents’ refusal to accept his results was a consequence of their having been blinded by prejudice. He convinced himself that political and theological issues were the motivation for his mathematical opponents, and he attributed their failure to see the correctness of his geometry to their irrational opposition to his politics and metaphysics. As early as January of 1657, Hobbes could claim in a letter to Samuel Sorbière:

My quarrel with [Wallis] is not like the quarrel between Gassendi and Morin or Descartes. I was dealing at the same time with all the ecclesiastics of England, on whose behalf Wallis wrote against me. Otherwise I would not consider him the least bit worthy of a reply, whatever is thought of his books by certain rather famous geometers – who are also rather ignorant of the art they teach, as will perhaps become more obvious shortly. (*CTH* 1: 429)

Hobbes’s confidence that “famous geometers” would come to see the error of their ways was not borne out, and by the early 1660s he had to face the fact that nobody in England was prepared to accept his geometric arguments. He did not, however, take this as evidence that there might be something amiss with his geometry, but decided that he must overcome irrational prejudice against his views by appealing to mathematicians on the Continent.

Hobbes had some reason to think that his mathematical reputation in Continental Europe was considerably more secure than it was in England. During his long stay in Paris in the 1640s Hobbes was active in the circle of mathematicians and natural philosophers around Marin Mersenne, and he was known to such noteworthy mathematicians as Gilles Persone de Roberval, John Pell, and Descartes. Indeed, in one of the great ironies of Hobbes's mathematical career, his only mathematical publication from the 1640s was a contribution to a work assembled by Pell which intended to refute and silence the circle-squaring efforts of the Danish astronomer-mathematician Christian Severin Longborg, who is better known by his Latinized name Longomontanus.¹⁰

To salvage his reputation in England and find allies who would join him in rejecting the "arithmetical" or "algebraic" refutations of his cube duplication, Hobbes made a direct appeal to the mathematicians of Continental Europe in his 1662 *Problemata Physica*. This work, which defended his 1661 *Dialogus physicus* against the attacks of Robert Boyle and Wallis, included yet another cube duplication, which replied to earlier refutations by Wallis and others. In an unusual appeal "to foreign geometers" placed immediately after the dedicatory epistle, Hobbes declared:

to these physical problems, which aim at nothing higher than verisimilitude, I have added some geometrical propositions that the professors of geometry and many other of our mathematicians do not accept, but think they have confuted by their arithmetical calculations. I alone (at least thus far) contend against them

¹⁰ See Pell (1647), which recounts the circle-squaring efforts of Longomontanus and contains proofs from a variety of mathematicians (including Hobbes) of the central lemma used to refute them. For more on Pell and Longomontanus, see Malcolm and Stedall (2005).

that this arithmetic they use is suitable neither for the confirmation nor for the confutation of geometrical claims. I now appeal to you (readers of mathematics who have not yet condemned my works by prejudicial decree) to turn your faculties of reason to this discrepancy between my geometrical calculations and their arithmetical ones, and (in the interest of mathematics itself) most humbly beseech and implore you to approve whichever one appears true. (Hobbes 1662a, sig. A8)

Hobbes's sublime confidence in the soundness and efficacy of his geometric principles, as well as in the security of his mathematical reputation on the Continent, was so great that he even offered to stake the outcome of the controversy with Wallis on the opinion of foreign mathematicians. He declared:

If the geometers into whose hands these things come deem their opinions of these geometric computations worthy of sending to the bookseller whose name and address are to be found on the first page, then in the future either my antagonists will be silent, or I shall be silent. (Hobbes 1662a, 139)

To the surprise of nobody but Hobbes, this appeal produced only more refutations. Christiaan Huygens sent a letter to Hobbes's bookseller, as requested, in which he pointed out elementary errors in the attempted solution.

Contrary to his prior statement of willingness to abide by the decision of Continental geometers, Hobbes refused to give ground to Huygens or anyone else who

pointed out shortcomings in his geometric work. Through the mediation of Sorbière, the Belgian mathematician Rene-François de Sluse was offered the chance to comment on Hobbes's cube duplication and produced yet another refutation in a letter that worked the whole matter out in great detail. Hobbes replied, and de Sluse offered even more agonizing detail. In a noteworthy triumph of hope over experience, Sorbière forwarded a set of objections from de Sluse with the note "Here are the most learned M. de Sluse's objections, to which I should like you to reply in detail. Then I shall send both his objections and your reply to the great M. Fermat, so that he may decide who is the victor" (Sorbière to Hobbes, 30 April 1664; *CTH* 2: 614). Fermat had the good sense to die in January of 1665 before Sorbière's scheme could be put in place.

The failure of his appeal to the mathematicians of Continental Europe left Hobbes with an unpleasant choice: he must either admit error and acknowledge that he had been engaged in a failed geometric program for more than a decade, or he must deny some quite fundamental mathematical propositions in order to deflect the criticisms of his geometry. He chose the latter, and with it he parted company with every mathematician in Europe, and indeed with mathematics itself. This becomes evident in Hobbes's 1666 tract *De Principiis et Rationcinatione Geometrarum*, in which he announces that he writes "against geometers, but not against geometry" (Hobbes 1666, epistle; *OL* 4: 386). He spelled out his predicament in the dedicatory epistle to Henry Benet, Baron Arlington, writing

I dedicate to you a little book, not one ill-mannered, but audacious; for it invades the whole nation of geometers. . . . My reputation faces a great danger, since I

dissent from the opinions of nearly every geometer. Of those who have held forth on the same things as I, either I alone am insane, or I alone am sane. There is no third alternative, unless, as someone might say, we are all insane. (Hobbes 1666, epistle; *OL* 4: 387)

In the course of this work, Hobbes reviewed his points of disagreement with the “nation” of geometers, continuing to insist that his was the only sound metaphysics and methodology for mathematics. After reviewing his putative results and objection to them, Hobbes notes that they all depend upon the application of arithmetic or algebra to geometry. In particular, he observes that his opponents are in the habit of reasoning about the relation that holds between two areas (such as squares, say) by considering equations expressed in numbers. In particular, the famous Pythagorean theorem (proposition 47 of book I of Euclid’s *Elements*) plays a leading role in these sorts of refutation. Hobbes concludes that it must be false, or at least not demonstrated. Furthermore, classical bounds calculated for the value of pi must be incorrect, and the trigonometric tables based on such reasoning are to be cast aside. As he puts it:

If these things of mine are correctly demonstrated, there are some further things that you should consider. First, the greater part of the propositions that depend on proposition 47 of Book I of Euclid (and there are many) are not yet demonstrated. Second, the tables of sines, tangents, and secants are wholly false. (Hobbes 1666, 23; *OL* 4: 462-3)

In the end, Hobbes found himself forced to the mournful conclusion that the whole of geometry as it was currently practiced was based on a series of colossal mistakes. The search for solutions to such famous problems as the duplication of the cube or the quadrature of the circle had been impeded by a whole host of factors that Hobbes summarized:

Therefore the reason that these problems, of measuring the circle, duplicating the cube, dividing the angle, and dividing ratios, and many others have thus far not been solved can be assigned to nothing other than these facts. First, that in solving these problems arithmetic has been misused. Second, that the errors of the ancients, and more recent errors have been excessively venerated. Third, that those who have tried to detect these errors have been deterred by the abuse of those unskilled men, in order that their own blunders are not also detected. All of which, except the last, can be pardoned because of the difficulty of the matter and out of reverence for antiquity; for those who rail and rant are not geometers, but instead insipid, unworthy suitors of geometry. (Hobbes 1666, 78-9; *OL* 4: 483-4)

This is a sad but inevitable finish for Hobbes's geometric ambitions. Having staked his reputation on his ability to solve the great outstanding problems of geometry, Hobbes could not accept the notion that his principles might have led him astray or the problems might be intractable. Instead, he attributed error to his ever-growing list of opponents, and convinced himself that he alone was in possession of a correct and secure geometric method.

3. Keeping Score: Identifying Winners and Losers in the Controversy

I would like to conclude by addressing the question of what sense it makes to speak of losers and winners in this dispute. I think it should be obvious that, from the standpoint of the mathematics, Hobbes lost and lost quite badly. Taking Hobbes's pronouncements seriously, and subjecting the key terms to the interpretation he intended, we find Hobbes contradicting himself. In rejecting the Pythagorean theorem, in his insistence that algebra cannot impugn a geometric argument, and in denying established bounds for the value of π , Hobbes found himself lapsing into incoherence and self-contradiction. This is best evidenced by the fact that his various circle quadratures yield quite different results – so that if the reasoning behind any one of them were (*per impossible*) true, the rest would be destroyed. Yet Hobbes insisted that they were all correct and properly demonstrated. That counts as getting it wrong.

But in order to make that sort of judgment work out, I need to say a little bit about how we can demarcate between the social and mathematical aspects of the controversy, because I hold that the initial motivation for the dispute is to be found in social, political, and theological differences between Hobbes and Wallis. Some students of controversy notoriously refuse to draw such a demarcation. In particular, proponents of a thoroughgoing sociology of scientific knowledge hold that social factors have explanatory primacy in accounting for the outcome of a controversy, and talk about right or wrong opinions should be swept aside in favor of a completely symmetrical approach that does not privilege “our” beliefs, practices, or concepts.¹¹ If proponents of this sort of view are correct, Hobbes's mathematical failures were not the result of his making

¹¹ This is the approach of the so-called “strong programme” in the sociology of knowledge, most closely associated with the work of David Bloor (1991). Shapin and Schaffer (1984) employ this approach in regard to Hobbes's disputes with Robert Boyle.

mistakes or getting things wrong, but simply a divergence from the practices of the dominant group. Furthermore, this kind of sociological positivism would hold that Hobbes's failure to win adherents to his cause should be explained by social and political factors. In other words, Hobbes's mathematics went down to defeat, not because he got the mathematical facts wrong, but because his political and theological enemies united against him and swept his alternative mathematics from the scent.

I reject all this sort of talk. In fact, I think that in the case of Hobbes's mathematical adventures, it makes perfect sense to speak of right and wrong mathematical principles. A principal basis for my interpreting the controversy in this way is the simple fact there is no interesting set of social, religious, or political factors that can put Hobbes's mathematical opponents into a single camp. By religion, class background, political affiliation, professional training, nationality, or any other social grouping, those who rejected Hobbes's mathematics are a very diverse group indeed. The list of Hobbes's mathematical opponents includes Catholics, Calvinists, Anglicans, Puritans, noblemen, commoners, professors, civil servants, and nearly every other social category in seventeenth-century life. It is, I claim, only by reference to mathematical facts (rather than sociological facts) that one might hope to explain why and how such a diverse group could make common cause against Hobbes's mathematics. Thus, although I agree that the impetus to the Hobbes-Wallis dispute can be found in Wallis's opposition to Hobbesian doctrines in politics and theology, the course of the controversy was determined by the fact that Hobbes simply got the mathematics wrong.

Nevertheless, there is an odd irony here. For, although Wallis was clearly the winner in the mathematical arena, he did not succeed in his principal goal destroying

Hobbes's reputation as a philosopher and political theorist. Hobbes is still read widely today, and his importance for political philosophy is undeniable. Wallis, however, is known only to historians of mathematics. As I mentioned earlier, Wallis was convinced that the refutation of Hobbesian geometry was the way to refute Hobbes's entire philosophy, but in this he seems to have been disappointed. Thus, if we keep score by asking which of our two combatants exercised the greater influence on subsequent philosophy, it seems that Hobbes came out the winner.

Further, Hobbes himself saw his political philosophy as intimately connected to his theory of demonstration, and he accepted Wallis's contention that a refutation of his geometry would be catastrophic for his political theory. He notoriously claimed that both civil philosophy and geometry are demonstrable sciences, since we know the causes that bring about both civil institutions and mathematical objects (*SL*, epistle; *EW* 7: 183-4). Indeed, this is precisely why Hobbes insisted on maintaining the adequacy of his false quadratures and failed cube duplications. To have admitted defeat on this front would have entailed, at least in his mind, the outright demolition of his entire system of philosophy.

The irony is that readers of both Hobbes and Wallis seem not to have shared this view of Hobbes's philosophical project. Hobbes's reputation as a philosopher and political theorist survived, but it did so because his readers were prepared to disregard his claims to have delivered a systematic, unified treatment of first philosophy, natural philosophy, and politics. Citizens of the seventeenth century "republic of letters" were prepared to detach Hobbes's geometry from his political theory and methodology, and in doing so they made his geometric defeat far less significant than it would otherwise have

been. In other words, Hobbes's intellectual reputation survived his battle with Wallis, but it did so because readers took his philosophy in a manner rather different from what its author had intended.

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