KENELM DIGBY'S *TWO TREATISES* AND THE RECEPTION OF THE GALILEAN SCIENCE OF MOTION

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When Paolo Galluzzi investigated what he called the «second Galileo *affaire*» in 1993, he looked at the negative reactions to Galileo's laws of motion after his death in 1642. Following the first *affaire*—the clerical condemnation by Roman clerics of 1633—this second *affaire* was focused on Paris, and the circle of Marin Mersenne. In his study Galluzzi lists the main protagonists of the *affaire*: the Jesuits Pierre Le Cazre and Honoré Fabri, Ismaël Bouilliau, Gilles de Roberval, Jacques Alexandre Le Tenneur and—to a lesser extent—René Descartes and Pierre de Fermat.[1] In Galluzzi's view the debate was started by Pierre Gassendi's presentation of Galileo's theory in *De motu impresso a motore translato*, composed in 1640 two years after the publication of the *Discorsi*, and published in Paris in 1642. Omitted from Galluzzi's list of protagonists are the names of two Englishman living in Paris in the 1640s, who were both part of Mersenne's extended network: Thomas White and Kenelm Digby. This omission is particularly regrettable given that these two Englishmen were also in the orbit of Thomas Hobbes, who was also in Paris at this time, and it seems likely that Hobbes formulated his own natural philosophical ideas, at least in part, in reaction to the ideas of his English contemporaries, who had both published natural philosophical

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[1] PAOLO GALLUZZI, *Gassendi e l'affaire Galilée delle leggi del moto*, «Giornale Critico Della Filosofia Italiana» 72 (1993), pp. 86-119, translated as *Gassendi and l'Affaire Galilée of the Laws of Motion*, in JÜRGEN RENN (ed.) *Galileo in Context*. Cambridge, Cambridge University Press, 2001, pp. 239-275: 240.

treatises during Hobbes's residence.[2] Digby's name is also absent from the fine collection of essays edited by Carla Rita Palmerino and Hans Thijssen, *The Reception of the Galilean Science of Motion in Seventeenth-Century Europe*, published in 2004, a survey which—as Palmerino notes in her introduction—is «inevitably incomplete».[3] This paper examines another significant reception of Galileo's theories of motion in 1640s Paris, that of Kenelm Digby in his *Two Treatises*, published in Paris by Gilles Blaizot in 1644.[4] In what follows we will outline the substance of Digby's reception of Galileo's theories, and introduce for discussion and further research a valuable manuscript which records late additions to his work in progress made whilst he was in Paris.

[2] KENELM DIGBY, *Two Treatises. In the one of which, the Nature of Bodies; in the other, the Nature of Mans Soule; is looked into: In way of Discovery, of the Immortality of Reasonable Soules*, Paris, Gilles Blaizot, 1644. THOMAS WHITE, *De mundo dialogi tres*, Paris, Denis Moreau, 1642. Both had been mentioned, along with Hobbes, by Marie Boas Hall and Stillman Drake in their brief overviews of the English influence of Galileo: MARIE BOAS HALL, *Galileo's Influence on Seventeenth-Century English Scientists*, in ERNAN MCMULLIN (ed.), *Galileo: Man of Science*, New York, Basic Books, 1967, pp. 405-14: 408; STILLMAN DRAKE, *Galileo in English Literature of the Seventeenth Century*, in MCMULLIN (ed.), *Galileo: Man of Science* (cit. n. 2), pp. 415-31: 423-5.

[3] CARLA RITA PALMERINO, *Introduction* in CARLA RITA PALMERINO AND J. M. M. H. THIJSSEN (eds.), *The Reception of the Galilean Science of Motion in Seventeenth-Century Europe*, Dordrecht, and Boston, Kluwer, 2004, pp. 1-11: 2. Cees Leijenhorst's article in this volume sets out to examine «Hobbes' account of free fall in *De motu* and *De corpore*, respectively, in the light of these discussions [of Galileo] within the Mersenne Circle», although he does not consider the work of Digby. See CEES LEIJENHORST, *Hobbes and the Galilean Law of Free Fall*, in PALMERINO AND THIJSSEN, (eds.) *Reception*, pp. 165-184: 166. There is also no discussion of Digby's *Two Treatises* in Gregorio Baldin's recent study of Hobbes and Galileo and the science of motion. GREGORIO BALDIN, *Hobbes e Galileo: Metodo, materia e scienza del moto*, Florence, Olschki, 2017.

[4] KENELM DIGBY, *Two Treatises* (cit. n. 2).

On 14[/24] February 1639[/40], Digby wrote to Mersenne from London. He tells him that he has been constrained to stay in his country house thirty miles from London due to an injury which he sustained when his coach overturned. This, however, has given him the leisure he needed to formulate a treatise he had been devising, which he calls the *Traitté de l'Immortalité de l'ame* (i.e., what would become the *Two Treatises*). He has, he says, formulated the whole work in his mind, and only needs another month in order to write it. He will be obliged he says, to give an account of the whole of philosophy in this work, and plans to strongly contest recent speculations in scholastic philosophy about the nature of qualities and moods, which have been «badly founded and poorly understood, and is nothing but an escape route for those who pretend that they know everything».[5] It is clear that Digby intended to engage critically with Galileo in his projected work, as he intimates as much in his letter. He desires very much to have his work approved of by Mersenne and his contemporaries: «The approval of a Father Mersenne, of a Galileo, and of a Monsieur Descartes, would mean more to me than the rest of the world», he wrote, but he had been discussing Galileo with his friend «mons[ieu]r Blacklo» (i.e., Thomas White).[6] «He very much esteems Galileo's book printed in Leiden [i.e., the *Discorsi*]», he says,

[5] «mal fondée et mal entendue, et n'est qu'une eschapatoire pour l'ignorance de ceux qui pretendent n'ignorer rien», KENELM DIGBY to MARIN MERSENNE, 14[/24] February 16[39[/40], in MARIN MERSENNE, *Correspondance du P. Marin Mersenne, Religieux Minime*, PAUL TANNERY, CORNÉLIS DE WAARD, RENÉ PINTARD, AND BERNARD ROCHOT (eds.), 17 vols., Paris, CNRS, 1945-1988, IX, pp. 119-123: 120-121. Cf. DIGBY, *Two Treatises* (cit. n. 2), VI.1, p. 40: «the qualities and moodes, that some moderne Philosophers haue so subtilised vpon».

[6] «l'approbation d'un Pere Mersene, d'un Galilée, et d'un Mons.r des Cartes me sera plus que tout le reste du monde», MERSENNE, *Correspondance* (cit. n. 5), IX, p. 121. Blacklo[e] was an alias used by Thomas White in

> which bear witness that the author has an admirable wit; but this does not prevent him from seeing that there are many errors and falsehoods which is due, for the most part, to the fact that he is not so well grounded in metaphysics as he is in exact and judicious observer of physical phenomena. But the errors of such men as Galileo and Descartes (due to a certain lack of principles which are not so perfectly understood) are to be more esteemed and are more ingenious than the volumes of the vulgar modern philosophers [i.e., late scholastic writers], who believe themselves to be most subtle and profound when they construct and weave spider webs using terms that they don't understand, and which, in effect, signify nothing.[7]

Although Galluzzi has rightly pointed to the importance of Gassendi's *De motu impresso* in the critical reception of Galileo's theories of motion, which created a «scandal» amongst French natural philosophers, it is quite clear that as early as February 1640, English natural

his theological writings. On White see BEVERLEY SOUTHGATE, *Covetous of Truth: The Life and Work of Thomas White, 1593–1676*, Dordrecht, Kluwer, 1993, and STEFANIA TUTINO, *Thomas White and the Blackloists: Between Politics and Theology during the English Civil War. Catholic Christendom, 1300–1700*, Aldershot, Ashgate, 2008.

[7] «Il estime beaucoup le livre de Galilée imprimé à Leyden, qui temoigne qu l'auteur a un admirable esprit; mais cela n'empesche pas qu'il ne voye aussi qu'il y a plusiers erreurs et faussetez, qui proviennent pour la pluspart de ce qu'il n'est pas si bien fondé dans les Metaphysiques, comme il est exacte et judicieux observateur des phenomes physiques. Mais les erreurs de tels gens, comme Galilée et Monsieur des Cartes (provenants de quelque manquement aux principes qui ne sont pas parfaitement bien penetrez) sont plus à estimer et plus ingenieuse que touts les volumes des philosophes modernes vulgaires, qui se croyent bien subtils et profonds quand ils bastissent et *texunt* des toiles de araignees sur des termes qu'ils n'entendent point et qui, en effet, ne signifient rien», MERSENNE, *Correspondance* (cit. n. 5), IX, p. 122.

philosophers in the orbit of Mersenne were ambivalent about Galileo's *Discorsi*, and not afraid to reprimand him for what they saw as his errors. Digby was clearly very influenced by his friend's negative judgments, and we can see evidence both of the admiration for Galileo's achievements, and criticism of his lack of philosophical grounding in Digby's *Two Treatises*. Digby indicates his approval of White's *De mundo* early in the *Two Treatises*: at the end of the first chapter he invites his reader to consult White's work in order to be «further instructed» about the nature of place. «Vnto which booke», he says,

> I shall from time to time (according as I shall haue occasion) referre my Reader [...] being confident that his Metaphysicall demonstrations there, are as firme, as any Mathematicall ones (for Metaphysicall demonstrations haue in themselues as much firmenesse, certainty and euidency as they) and so will appeare as euident, as they, vnto whosoeuer shall vnderstand them throughly, and shall frame right conceptions of them [...].[8]

Later in the work Digby goes so far as to say that his own philosophy is merely an addendum to White's: «what I haue, and shall sett downe in all this discourse, is but a few sparkes kindled by me att his greate fire».[9] Clearly one of the «sparkes», was his criticisms of Galileo's theories of motion.

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[8] DIGBY *Two Treatises*, (cit. n. 2), I. 7, p. 7.

[9] DIGBY, *Two Treatises*, (cit. n. 2), XVII. 1, p. 144. In his dedicatory poem to Digby, appended to the 1645 London imprint of the *Two Treatises*, John Sergeant also testifies to White's influence: «... this you did by th'guidance of *his* light, | Who was your *Plato*, you his *Stagyrite*; | (Saue that his Doctrine's such, you could invent, | In *Truth*'s behalf, no reason to dissent.) Even * That Great Soul, which fathoms th'*Universe*, | Doth, to the center, *Natures* entrails pierce». DIGBY, *Two Treatises*: *In the one of which, The Nature of Bodies; In the*

Before we look at the criticisms of Galileo, however, we need to look at the positive side of Digby's reception of Galileo. Rather than being an outright refutation, Digby's treatise actually accepts and makes use of some of Galileo's key concepts. Digby certainly doesn't stint in his praises of Galileo's achievements, and echoes those of Hobbes a decade later, who had praised Galileo as «the first that opened to us the gate of Natural Philosophy Vniversal, which is the knowledge of the Nature of *Motion*.»[10] In chapter III of the *Two Treatises*, on rarity and density, Digby refers to «the greate Galileus; vnto whose excellent witt and admirable industry, the world is beholding, not onely for his wonderfull discoueries made in the heauens, but also for his accurate and learned declaring of those very thinges that lye vnder our feete».[11] In chapter IX («Of Locall Motion in common») Digby refers to Galileo as the philosopher «vnto whom we owe the greatest part of what is knowne concerning motion».[12]

Digby's praise of Galileo is not insincere, for he accepts unquestioningly some of the primary claims that Galileo makes about the motion of bodies. Like Gassendi and Hobbes, Digby, for example, asserts the odd number rule as an unquestioned verity. Thus, in chapter IX. 9, we read: «Galileus (that miracle of our age, and whose witt was able to discouer whatsoeuer he had a mind to employ it about) hath told vs that naturall motion, encreaseth in the proportion of the odde numbers».[13]

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other, the Nature of Mans Soule is looked into; In way of Discovery of the Immortality of Reasonable Soules London, John Williams 1645, sig. *3^{v}. The asterisked marginal gloss reads: «Mr *Thomas White*».

[10] THOMAS HOBBES, *Of Body*, London, R. & W. Leybourn and Andrew Crooke, 1656, sig. A1^{v}; THOMAS HOBBES, *Elementorum Philosophiae sectio prima De corpore*, London, Andrew Crook, 1655, sig. A2^{v}.

[11] DIGBY, *Two Treatises* (cit. n. 2), III. 4, p. 18.

[12] DIGBY *Two Treatises* (cit. n. 2), IX. 6, p. 69.

[13] DIGBY *Two Treatises* (cit. n. 2), IX. 9, p. 70. For Gassendi's unquestioning acceptance in his *De motu impresso*, see PALMERINO *Introduction* (cit. n. 2), p. 6, and her article in the volume. Cf. GALLUZZI, *Gassendi*

In section 12 of the same chapter, he argues that when motion decelerates it must also do so «in the proportion of the odde numbers» because «it must follow the lawes that are common to all motions [...].»[14]

Digby also adheres to Galileo's claims about the increase of the speed of a moving object from rest. So in chapter IX. 6, we read, «nothing recedeth from quiet or rest, and attaineth a great degree of celerity, but it must passe through all the degrees of celerity that are below the obtain'd degree.»[15] On the following page he reiterates the point, stating that between the «vtmost periode» of an agent's power and rest «or any inferiour degree of velocity, there may be designed infinite intermediate degrees, proportionable to the infinite diuisibility of time, and space [...]».[16] The increase of motion in time «is in a determinate proportion», which «Galileus .. teacheth vs how to find out; and to discouer what degree of celerity any mooueable that is moued by nature, hath in any determinate part of the space it moueth in».[17]

Criticism of Galileo's theory of motion in the Two Treatises

Thus far Digby's reception of Galileo's seems quite positive, and he is happy to accept its principal tenets. Given Digby's theory of motion, however, it is not entirely clear how he

and l'Affaire Galilée (cit. n. 1), p. 241. On Hobbes's acceptance of Galileo's laws of motion in the *Anti-White*, see LEIJENHORST, *Hobbes and the Galilean Law of Free Fall* (cit. n. 3), p. 170.

[14] DIGBY *Two Treatises* (cit. n. 2), IX. 12, p. 75.

[15] DIGBY *Two Treatises* (cit. n. 2), IX. 6, p. 67.

[16] DIGBY *Two Treatises* (cit. n. 2), IX. 6, p. 68.

[17] DIGBY *Two Treatises* (cit. n. 2), IX. 6, p. 69.

thought the mechanical explanations he offered might be consistent with Galileo's theories, and despite his enthusiastic endorsement of the odd number law, there is reason to believe that Digby did not fully understand Galileo's arguments. Digby rejected two important Galilean concepts: his claim that the weight of a body is not responsible for the speed of its fall, and his account of violent motion in terms of impressed force. Both of these objections are connected in that he saw them as contradicting the principles of causation which, in his view, governed the course of nature.

In her introduction to *The Reception of the Galilean Science of Motion in Seventeenth-Century Europe*, Carla Rita Palmerino identified a number of reasons for the failure of Galileo's laws of motion to gain immediate approval. One was the perceived mismatch between mathematical mechanics and the natural philosophy of the time. Descartes she notes, saw the law of fall as «an abstract mathematical formula which did not offer, nor could be reconciled with a physical explanation of gravity». Secondly, many of his readers were not convinced by his mathematical reasoning: «With the infinitesimal calculus still to be invented», Palmerino says, «Galileo's way of conceiving the overall speed of a falling body as the sum of an infinite number of degrees of speed appeared to most contemporaries unacceptable». Thirdly, there were concerns about Galileo's religious orthodoxy, and some saw a direct connection between his new laws of motion and the Copernicanism of the *Dialogo*.[18]

Digby, I think makes an interesting test case for these claims. In his case, there is no rejection of the infinite degrees of speed hypothesis, and despite being under the influence of his friend White, whose *De mundo* is a sustained attack on the cosmology of Galileo's

[18] PALMERINO, *Introduction* (cit. n. 2), pp. 1-2. On the association between the laws of motion and Copernicanism, and Gassendi's role in establishing this connection, see GALLUZZI, *Gassendi and l'Affaire Galilée* (cit. n. 1), pp. 241-2.

Dialogo, his criticisms in the *Two Treatises* do not make any connections between Galileo's laws of motion and his Copernicanism. We should, perhaps, note that while Digby was formulating the outline of his work in early 1640, he had not yet seen Gassendi's *De motu impresso*, which makes this link explicit. In chapter IX.9, where Digby offers a mathematical proof for the odd-number rule using the example of an increasing isoceles triangle, Digby sees it as similar to one that he had seen in Gassendi's *De motu*:

> Which proposition is very ingeniously sett downe by the learned Monsieur Gassendi in his first Epistle *de motu impresso a motore translato*, to the same purpose for which we bring it. Though we do not here make vse of his scheme and way of demonstration; because we had fallen vpon this before his booke came abroad: and therefore we onely note his to direct the Reader vnto it who peraduenture may like his better then ours, Howbeit we do not conceiue that he hath in his discourse there, arriued to the true reason of the effect we search into: as may appeare by what we haue already deliuered.[19]

Digby's claim not to have seen Gassendi's work seems likely to have been true, and his work bears no trace of Gassendi's identification of Galileo's laws of motion and the Copernican hypothesis, that struck other readers so forcibly. Digby's grudging comments on Gassendi's work which he seems to have read after having composed his own is significant, and relates to the first reason which Palmerino identifies for Galileo's lack of success: the mismatch between natural philosophy and mathematical mechanics. Gassendi's «discourse» he says, has failed to arrive at the «true reason of the effect we search into».[20] Like Gassendi, and

[19] DIGBY *Two Treatises* (cit. n. 2), IX. 9, p. 72.

[20] Ibid.

others in the Mersenne circle, Digby was happy with Galileo's assertion of the laws of motion, but what he was searching for was a causal explanation of the law – the «true reason of the effect».[21] This seems to be behind Digby's criticism of Galileo.

The Causes of Natural and Violent Motion

It is telling that in chapter IX, where Digby praises Galileo for his ability to calculate the degree of celerity a body has in a determinate part of the space, he immediately qualifies this praise: «Hauing settled these *conditions* of motion; we shall do well in the next place to enquire after the *causes* of it: as well in the body moued, as also in the mouer that occasioneth the motion».[22] Having established that local motion is «nothing in substance but diuision: we may determine that those causes which contribute to diuision, or resist it, are the causes which make, or resist locall motion», and these causes are the twin pillars of Digby's philosophy, rarity and density.[23] It is clear from this that Digby considered Galileo's natural philosophy to be incomplete, as it does not consider the causes of motion, only offers an account of their observable effects.

In chapter XII, «Of violent motion», for example, Digby notes that Galileo «relisheth not» the Aristotelian claim that the only cause of the continued motion of a projectile is the

[21] On the search for causal explanations for Galileo's laws of motion in the Mersenne circle see PALMERINO, *Introduction* (cit. n. 3), p. 6: «Hobbes was in close contact with Gassendi and other members of the Mersenne circle who all tried to find a mechanical explanation of free fall that could be squared with Galileo's odd number law.»

[22] DIGBY *Two Treatises* (cit. n. 2), IX. 7, p. 69 (our emphasis).

[23] Ibid.

air. Digby notes Galileo's objections to this theory: that the rarity of the air is «not apt to conserue motion», that air «hath no power ouer» heavy objects, and air acts on objects with the «broadest superficies» and so «an arrow would flye faster broadwayes then longwayes, if this were true».[24] Digby refutes each of these objections in turn, but what is interesting is his insistence on finding a corporeal cause for the continued motion. «[E]uery effect must haue a proportionable cause from whence it immediately floweth», Digby says, and «a body must haue an other body to thrust it on, as long as it mooueth». He proposes therefore to «examine what bodies do touch a moueable whilest it is in motion: as the onely meanes to find an issue out of this difficulty». What he objects to is Galileo's solution of impressed force which he identifies with an Aristotelian quality: «to haue recourse vnto a quality or impressed force, for deliuerance out of this straight», he argues, «is a shift that will not serue the turne in this way of discourse we vse. In this Philosophy, no knott admitteth such a solution.»[25]

It seems important to grasp what «way of discourse», what kind of «Philosophy» Digby is referring to here. Galileo's discourse is unacceptable to Digby because it appeals to what Digby saw as an inhering quality rather than a moving body itself. In his natural philosophy all effects must have extrinsic bodily causes. What makes Digby's account of natural and violent motion definitively un-Aristotelian is its essentially *corpuscularian* and mechanical nature. Digby had this corpuscularian conception as early as March 1640, when he wrote another letter to Mersenne which gives a concise summary of his views on the causes of motion:

[24] DIGBY *Two Treatises* (cit. n. 2), XII. 1, p. 100. See GALILEO GALILEI, *Dialogue Concerning the Two Chief World Systems*, tr. STILLMAN DRAKE, 2nd edn, Berkeley and Los Angeles, University of California Press, 1967, 152-3; OG, VII, pp. 178-9.

[25] DIGBY *Two Treatises* (cit. n. 2), XII. 1, p. 101.

> In my philosophy, I banish gravity ... as internal accidents of a body which operate on it, and cause (for example) movement towards the centre. All body in itself is indifferent to all movement, and that which causes it from one side or another is an external agent. Now that which causes the downward movement of solid and dense bodies is a perpetual impulse from the perpetual blows of small corpuscules, which always descend in the air in order to make place for the smaller corpuscules which perpetually rise because of the light which draws them up and subtilises them. These blows, although small, being continual and almost infinite, on an indifferent subject, make it move; and when the movement is *in actu* it increases continually in the proportion of the solidity and density of the moving body and of the divisibility of the medium [...].[26]

Digby is opposed to the Aristotelian idea that bodies have an «intrinsecall inclination» towards «any determinate part or place of the vniuerse», (earthy bodies downwards towards the centre of the earth, or fire upwards towards the sphere of fire) because this kind of appetite seems to him to be more fitting for animate creatures rather than natural bodies.[27] In Digby's view a body «can not mooue vnlesse it be mooued by some extrinsecall Agent».[28] In place of the Aristotelian idea of things seeking their proper place in the universe, in chapter X, «Of Gravity and Levity», Digby sets out a complex corpuscular system based on the continual emission of corporeal light atoms from the sun onto the surface of the earth. The atoms of light strike the surface of the earth and are reflected upwards through the air,

[26] KENELM DIGBY to MARIN MERSENNE, 15 March 1640, in MERSENNE, *Correspondance* (cit. n. 5), letter 839, IX, pp. 203-7: 205-6.

[27] DIGBY *Two Treatises* (cit. n. 2), IX. 8, p. 70.

[28] Ibid.

bringing with them atoms of earth. At a certain height the atoms compounded of light and earth part company, and the denser atoms—congregating with other earthy atoms and so becoming more bulky—descend. As they do so they strike any body which is in their path, and that is why bodies fall in natural motion. As all motion involves the impulsion or percussion of particles, Digby consciously blurs the distinction between natural and violent motion, which distinction, he says, «will vanish to nothing» if closely considered.[29] The activity of these rebounding atoms of light, thus creates a double stream of atoms which Digby asserts will ascend and descend in perpendicular lines. If the downward propensity of larger bodies is caused by descending earth atoms, it might be asked what causes the earth atoms to descend in the first place. Digby here has two slightly inconsistent answers: one, is because the earth atoms moved downward to take up the space left by the ascending atoms «[so] that there may be no vacuity in nature».[30] *Horror vacui*, of course, is not impulsion by an extrinsic agent, but precisely the kind of intentional activity, or appetite which Digby seeks to avoid. The other answer is that density is what makes bodies apt to descend because dense bodies are «more powerfull»[31] and are thus more apt to divide the medium, and because density (along with bulk and celerity is one of the three «conditions» which Digby assigns to «efficacious» (i.e., percussive) motion.[32]

[29] DIGBY *Two Treatises* (cit. n. 2), X. 1, p. 76. See, ibid., «For seeing we haue said that no body hath a naturall intrinsecall inclination vnto any place, to which it is able to moue it selfe; we must needes conclude that the motion of euery body followeth the percussion, of extrinsecall Agents.»

[30] DIGBY *Two Treatises* (cit. n. 2), X. 3, p. 77.

[31] DIGBY *Two Treatises* (cit. n. 2), X. 4, p. 79.

[32] DIGBY *Two Treatises* (cit. n. 2), VIII. 6, p. 60: «three thinges do concurre to make a percussion great. The bignesse, the density and the celerity of the body mooued.». Cf. IX. 7, p. 69, where Digby changes «celerity» to «sharpenesse».

In Digby's system—as we saw from his letter to Mersenne—there is no such thing as gravity and levity as such. As he says in the *Two Treatises*,

> Out of this discourse, we may conclude that there is no such thing among bodies, as positiue grauity or leuity : but that their course vpwardes or downewardes happeneth vnto them by the order of nature, which by outward causes giueth them an impulse one of these wayes: without which, they would rest quietly wheresoeuer they are, as being of themselues indifferent to any motion.[33]

Despite this indifference of bodies, Digby still asserts that the density of bodies is directly related to the velocity of their motion (presumably because density makes a body more prone to be impelled as there are more parts in relation to their bulk for the descending atoms to strike. Considering the variety of densities of natural bodies, it was, Digby thought «irrationall to conceiue, that all bodies should descend att the same rate, and keepe equall pace with one an other». If there are two bodies, and one is denser than the other, «that which is so, will cutt the ayre more powerfully, and will descend faster then the other».[34] The difference in weight also affected velocity, and a falling body weighing one pound and one scruple would fall faster than a body weighing a pound, although the «difference of velocity

[33] DIGBY *Two Treatises* (cit. n. 2), X. 6, p. 81. Galileo, too stressed, that a body at equilibrium is «indifferente al moto … e non ha per se stesso inclination di muoersi verso alcuna parte.» GALILEO GALILEI, *Discorsi e Dimostrationi Matematiche, Intorno à due nuoue scienze, Attenti alla Mecanica, & i Mouimenti Locali*, Bologna, 1655, p. 132 [sig. [R4] recto]. This passage was revised by Galileo and inserted by Viviani into the 1655 edition. See GALILEO GALILEI, *Two New Sciences Including centres of Gravity & Force of Percussion*, trans. Stillman Drake, Madison: University of Wisconsin Press, 1974, p. 171 n. 26.

[34] DIGBY *Two Treatises* (cit. n. 2), X. 7, pp. 81-2.

in descending [will] be hardly perceptible».[35] Regardless of the difficulty in perceiving the difference of these speeds, Digby here clearly departs from Galileo's insistence that weight is not a factor in the speed of falling bodies. Those philosophers who wish to determine the proportion of the velocities of various bodies, Digby claims, would need to examine all the conditions of a moving body which he has outlined, although he declines to give details of this procedure on the grounds that he is only interested in a «suruay of nature, but in grosse». His «chiefe drift» he says was:

> to open the way for the discouering how bodies that of themselues haue no propension vnto any determinate place; do neuertheless mooue constantly and perpetually one way; the dense ones descending, and the rare ones ascending: not by any intrinsecall quality that worketh vpon them; but by the oeconomy of nature, that hath sett on foote due and plaine causes to produce knowne effects.[36]

This appeal to the «oeconomy» of nature, or the *cursus naturae*—requiring an investigation of both causes and effects—immediately precedes an attack on some of Galileo's claims in the first dialogue of the *Discorsi*:

> Here we must craue patience of the great soule of Galileo (whose admirable learning all posterity must reuerence) whiles we reprehend in him, that which we can not terme lesse then absurd: and yet, he not onely maintaineth it in seuerall places, but also professeth [...] to make it more cleare then day. His position is, that more or lesse grauity contributeth nothing att all to the faster or slower descending of a naturall

[35] DIGBY *Two Treatises* (cit. n. 2), X. 8, p. 83.

[36] DIGBY *Two Treatises* (cit. n. 2), X. 8, p. 83.

> body: but that all the effect it giueth vnto a body, is to make it descend or not descend in such a medium.[37]

This Digby, argues, «is against the first and most knowne principle that is in bodies: to witt, that more doth more; and lesse doth lesse; for he alloweth, that grauity causeth a body to descend; and yet will not allow, that more grauity causeth it to descend more».[38] Against this he places a series of everyday observations: that a heavy weight on a scale will travel faster than a light one; that more weight hung on a «iacke» will make a spit turn faster, and so on. Having appealed to common experience, he attacks Galileo's experiment with the pendulum in which he claims a light weight was observed to swing «almost as fast as the heavier». Digby denies that the experience proves the point which Galileo is trying to make:

> we must aske him; whether experience or reason taught him, that the slower going of the lighter pendant, proceeded onely from the medium, and not from want of grauity? And when he shall haue answered (as he needes must) that experience doth not shew this; then we must importune him for a good reason: but I do not find that he bringeth any att all.[39]

Digby then turns to a philosophical objection to Galileo's observations about gravity's overcoming the resistance of a medium, which (in Digby's view) involves a logical

[37] DIGBY *Two Treatises* (cit. n. 2), X. 9, p. 83-4.

[38] DIGBY *Two Treatises* (cit. n. 2), X. 9, p. 84.

[39] Ibid. Galileo's discussion of the pendulum appears in GALILEO GALILEI, *Discorsi e Dimostrazioni matematiche, intorno à due nuoue scienze*, Leiden, Elsevier, 1638, pp. 84-6; GALILEO, *Two New Sciences* (cit. n. 33), pp. 87-8; OG, VIII, pp. 128-9.

contradiction. As gravity overcomes the resistance of a medium in some proportion, he argues, «it followeth that the proportions betweene the grauity and the medium, may be multiplyed without end». Here he imputes to Galileo a definition which he does not articulate, viz., that «his manner of putting the force of gravity» is that «the grauity of a body do make it goe att a certaine rate in imaginary space.»[40] As Digby had argued earlier in his treatise that the concept of imaginary space was «an ayery entity, an vnconceiuable moode» which could only ground «a ruinous Philosophy», this is clearly not a definition he would approve of.[41]

If a body is travelling a determinate rate in imaginary space (i.e., if a body is moving at its «intrinsic and natural» or «absolute» speed in a void space),[42] he says,

> then there may be giuen such a proportion of a[nother] heauy body to the medium, as it shall goe in such a medium att the same rate; and neuerthelesse, there will be an infinite difference, betwixt the resistance of the medium compared to that body, and the resistance of the imaginary space compared to that other body which he supposeth to be mooued in it at the same rate: which no man will sticke att confessing to be very absurd.[43]

[40] DIGBY *Two Treatises* (cit. n. 2), X. 9, p. 84.

[41] DIGBY *Two Treatises* (cit. n. 2), V. 2, p. 33.

[42] GALILEO, *Discorsi* (cit. n. 39), pp. 76-7; GALILEO, *Two New Sciences* (cit. n. 33), p. 79; OG, VIII, p. 120.

[43] DIGBY *Two Treatises* (cit. n. 2), X. 9, pp. 84-5.

Galileo, of course never defines «the force of gravity» (or heaviness) as that which makes a moving body «goe att a certaine rate in imaginary space».[44] It seems that Digby might be reformulating Galileo's ideas about motion in a void. The term 'imaginary space' (*spatium imaginarium*) was sometimes used by late scholastics to describe extra-or intra-cosmic void space.[45] As Digby himself is an anti-vacuist, and because (as Galileo himself concedes) no space without a resistant medium actually exists in nature,[46] the space through which Galileo's bodies move must be imaginary. In the *Discorsi*, Galileo argues that falling bodies of different weights are resisted differently by the media through which they travel, hindering their motions to differing degrees. If these resistant media (e.g., air) «could be entirely removed» then the speeds of falling bodies «would be equalized». Galileo suggests that

> If we then assume the principle that in a medium no resistance exists at all to speed of motion, whether because it is a void or for any other reason, so that the speeds of all moveables would be equal, we can very consistently assign the ratios of speeds of like and unlike moveables, in the same and in different filled (and therefore resistant) mediums.[47]

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[44] When Galileo does define heaviness it is as natural tendency downwards towards the centre of the earth. See GALILEO, *Discorsi* (cit. n. 39), p. 75; GALILEO, *Two New Sciences* (cit. n. 33), p. 77; OG, VIII, p. 118. Cf. the definition of heaviness in GALILEO, *Le meccaniche* in GALILEO GALILEI, *On Motion and On Mechanics: Comprising De Motu (ca. 1590) … and Le Meccaniche (ca. 1600)*, trans. I. E. Drabkin and Stillman Drake, Madison, University of Wisconsin Press, 1960, p. 151.

[45] See CEES LEIJENHORST *Jesuit Conceptions of* Spatium Imaginarium *and Thomas Hobbes's Doctrine of Space*, «Early Science and Medicine», 1 (1996), pp. 355-380: 369.

[46] GALILEO, *Discorsi* (cit. n. 39), p. 73; GALILEO, *Two New Sciences* (cit. n. 33), p. 77; OG, VIII, 117.

[47] GALILEO, *Discorsi* (cit. n. 39), p. 76; GALILEO, *Two New Sciences* (cit. n. 33), p. 78; OG, VIII, 119. Cf. GALILEO, Discorsi (cit. n. 39), p. 73; GALILEO, *Two New Sciences* (cit. n. 33), p. 76; OG, VIII, 117. «We are

However, even if we assume that Digby's formulation refers to motion in a void, his objection seems difficult to comprehend as he speaks about the «resistance of the imaginary space». According to Galileo, however, «no such action [resistance of the medium] occurs in the void».[48] It seems possible, however, that he is assuming that the resistance in that space would be zero (although he doesn't state this), and therefore the difference between a body travelling in a void and a body travelling in a given medium at the 'same rate' are infinitely different (i.e., the difference between zero resistance and an increasing resistance which passes through all the infinite intermediate degrees of resistance. Although it is rather tortuous, this is probably the logical paradox he had in mind.

After he has attacked Galileo's notion of impressed force in chapter XII, Digby acknowledges Galileo's authority, but also parts company with him, aligning him with those modern scholastics who invoke inherent qualities when explaining natural phenomena. «Thus farre, with due respect, and with acknowledging remembrance of the many admirable mysteries of nature which that great man hath taught the world», Digby says,

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trying to investigate what would happen to moveables very diverse in weight, in a medium quite devoid of resistance, so that the whole difference of speed existing between these moveables would have to be referred to inequality of weight alone. Hence just one space entirely void of air – and of every other body, however thin and yielding – would be suitable for showing us sensibly that which we seek. Since we lack such a space, let us [instead] observe what happens in the thinnest and least resistant mediums, comparing this with what happens in others less thin and more resistant. […] despite extreme difference in weight, their diversity of speed in the most tenuous medium of all (though not void) is found to be very small and almost unobservable, then it seems to me that we may believe, by a highly probable guess, that in the void all speeds would be entirely equal.»

[48] GALILEO, *Two New Sciences* (cit. n. 33), p. 78; OG, VIII, 119.

> we haue taken liberty to dispute against him: because this difficulty seemeth to haue driuen him against his Genius, to beleeue that in such motions there must be allowed a quality imprinted into the mooued body to cause them : which our whole scope both in this and in all other occasions where like qualities are vrged, is to prooue superfluous and *ill grounded in nature*; and to be but meere termes to confound and leaue in the darke whosoeuer is forced to fly vnto them.[49]

The grounds of nature in Digby must follows mechanical laws: in his prefatory letter to his son, also called Kenelm, he asserted that the only aim of his treatise of bodies was to «shew what may be effected by corporeall agents».[50] Galileo's *Discorsi* failed in his view by lapsing into incorporeal explanations. Digby also told his son that «a complete braue man» ought to know how to avail himself of different kinds of knowledge:

> [He] must know how to serue himselfe when he pleaseth, and that it is needfull to him, of the Diuines high contemplations, of the Metaphysitians subtile speculations, of the naturall Philosophers minute obseruations, of the Mathematicians nice demonstrations; and of whatsoeuer else of particular professions, may conduce to his end; though without making any of them his professed businesse.[51]

[49] DIGBY *Two Treatises* (cit. n. 2), XII. 7, p. 105 (our emphasis).

[50] DIGBY *Two Treatises* (cit. n. 2), sig. a4r. Cf. also the *Preface*, where he claims all operations of nature can be explained by «an exact disposition, and ordering ... of quantitatiue and corporeall partes», and inveighs against the use of «qualities occult, specificall, or incomprehensible»; DIGBY *Two Treatises* (cit. n. 2), *Preface*, sigs. õ[6]^{r}, ũ1^{r}.

[51] Ibid.

This is consistent with Digby's ambivalence toward Galileo in the *Two Treatises*: he praises him for having elucidated mechanics, and is broadly favourable towards his mathematical approach to motion, but he does not shrink from making objections to the law of motion on the basis of his own «minute obseruations» in natural philosophy which places motion in the context of the mechanical causes and effects which in his view constituted the «oeconomy of nature».

The Parisian Manuscript of the Two Treatises

Our understanding of the genesis of Digby's *Two Treatises*, and its philosophical objections to Galileo's natural philosophy are enhanced when we consider the extant manuscript sources. A holograph manuscript version of Sir Kenelm Digby's *Two Treatises* of 1644 has long been known to reside in the Bibliothèque Sainte-Geneviève in Paris. Its existence was first announced to the English-speaking world in *Notes & Queries* in 1862, and a short description subsequently appeared in the library's manuscript catalogue in 1896.[52] While students of Digby have occasionally referenced the existence of the manuscript, we do not believe that any have taken the trouble to consult it. Digby's biographer, R.T. Petersson, for instance, mentions the *Notes & Queries* article, speculates that the manuscript might still be in the Bibliothèque Sainte-Geneviève, but says no more about it.[53] Neither Digby's bibliographer, Davida Rubin, nor the recent editor of the *Two Treatises*, Paul S. MacDonald,

[52] JOHN G. FOTHERINGHAM, *MSS of Sir Kenelm Digby*, «Notes & Queries», 3rd series, II (1862), 45; CH. KOHLER, *Catalogue des Manuscrits de la Bibliothèque Sainte-Geneviève*, 2 vols., Paris, 1893-96, II, p. 673.

[53] R. T. PETERSSON, *Sir Kenelm Digby: The Ornament of England 1603-1665*, London, Cape, 1956, p. 341, n. 116.

make any reference to the manuscript.[54] This is unfortunate because the manuscript is a holograph and is therefore of considerable value as a witness to the composition of Digby's most substantial work. It is also of interest for students of the English reception of Galileo, revealing the impact of the Parisian context—and the impact especially of Mersenne's Galilean researches—on the penultimate stage of Digby's work.

Let us begin with some remarks on the physical composition of the manuscript. The text is bound in two large folio volumes measuring around 343 x 221 mm.[55] Each volume is bound matching calf, with gold double-ruled covers and spines with six raised bands yielding seven panels, each of which is elaborately tooled in gold, with the central device of a pot of flowers, save for the second down, which contains the title «THE | IMMORTAL. OF | MANS SOVLE |», and the third, which contains the volume number: e.g. «.TOM. | .I.», «.TOM. | .II.». The binding does not display any of the characteristic arms or cyphers with which Digby's bindings are often adorned.[56] But it seems likely that Digby was responsible for it. Who else would have made the decision to entitle the work, on one of the embossed panels of the spine of each volume, «THE | IMMORTAL. OF | MANS SOVLE |»? As we have noted above, this was the title—*Traitté de l'Immortalité de l'ame*—by which Digby referred to the work as early as 1640.[57] And although the phrase *the Immortality of*

[54] DAVIDA RUBIN (COMP.), *Sir Kenelm Digby F.R.S. (1603-1665: A Bibliography Based on the Collection of K. Garth Huston, SR., M.D.*, San Francisco, Jeffery Norman, 1991; KENELM DIGBY, *Two Treatises: Of Bodies and of Man's Soul*, ed. PAUL S. MACDONALD, n.p., Gresham Press, 2013.

[55] Paris, Bibliothèque Sainte-Geneviève, MS 3392 and MS 3393.

[56] On Digby's bindings, see PETERSSON, *Sir Kenelm Digby* (cit. n. 53), pp. 241-2; RUBIN, *Sir Kenelm Digby*, (cit. n. 54), pp. 75-94.

[57] MERSENNE, *Correspondance*, (cit. n. 5), IX, pp. 120, 207.

Reasonable Soules remains the end point of the long title of the printed work, posterity has tended to call the work by its opening formula: *Two Treatises*.

The first volume, MS 3392, which contains the first of the two treatises—that concerning bodies—currently consists of [viii] + 438 leaves, measuring between 325-330 x 213 mm. The construction of the volume is fairly straightforward. It is quired throughout in gatherings of eight leaves, almost all of which are clearly comprised of four bifolia, with four of the leaves displaying watermarks.[58] Digby has numbered these, and added catchwords at the foot of the final verso to prevent mis-binding. Into these quires Digby has inserted, at several points, additional sheets, consisting of one or more bifolia. The quired sheets are on two stocks of paper, the first («A») covers an unnumbered gathering of initial blanks fos. [i-viii]. This paper stock displays the watermark of a posthorn subscribed by the monogram TV (with a simple four leaved flower dividing the letters; it measures 68 x 23 mm. The main body of the quired manuscript comprises a second paper stock («B»), showing the watermark of a posthorn, subscribed PH, measuring 52 x 35 mm. It is similar to Gaudriault, no. 396, which appears in a French manuscript of 1644.[59] Two bifolia, containing a variant version of the same design (measuring 84 x 55 mm.) appear as fos. 155-8.

The main body of the text begins with two preliminary gatherings, signed by Digby A-B, covering folios 1-16. These contain the title page and dedicatory epistle. That they are later additions is suggested by their cleanliness, which contrasts strikingly with the dirty, inky appearance of the first folio of sig. 1 (fo. 17r), which had evidently served for some time as a

[58] The exceptions are sig. B, which only displays three watermarks, and some confusion in the sequence at the end of sig. 79, which seems to have only 6 leaves (5 of which show watermarks) and appears to be followed by a gathering of 6 leaves, only one of which (fo. 211) shows a watermark.

[59] RAYMOND GAUDRIAULT, *Filigranes et autre caractéristiques des papier fabriqués en Frnaceaux XVII^e^ et XVIII^e^ siècles*, Paris, CNRS Editions and J. Telford, 1995.

wrapper. The main text begins, with the Preface, on folio 17r, and runs up to folio 438 through sigs. 1-50 (sig. 40 appears twice, due to a quiring error, as 40.1 and 40.2). The text on folio 438v ends abruptly, and following folio 438 is a stub. There are evidently some leaves missing here. Kohler suggests five or six, but from the extent of the missing text and the continuation of the quiring in MS 3393 it is clear that twenty-six leaves are in fact wanting: two from the last extant quire (sig. 50; fos. 439-40) and three whole quires of eight leaves each which should have followed it (sigs. 51-53; fos. 441-64).

While the volume lacks some leaves at the end, a number of additional leaves have been inserted throughout in order to incorporate additions to the text. These appear on a thinner, smaller paper stock («C»), leaves of which have been folded to create bifolia. They display the small watermark of an eagle in a plain shield, measuring 47 x 23 mm.[60] The leaves themselves measure 294 x 205 mm., and constitute folios 123-4, 133-6, 161-2, 242-3, 247-8, 256 and 258 (which are conjugate), and 436-7.

A second volume, MS 3393, contains the second of the two treatises—that concerning soul. It begins with three unsigned quires of eight leaves (fos. [i-xxiv]), on the same paper stock («B») found in the body of the first volume. The main text begins, again on paper stock «B», with sig. 54 at folio 1. It runs without interruption (save for four blank leaves at sigs. 69-72 at the division between the two parts of the text) or insertion to sig. 79, the text ending on folio 206^{v}. A further 118 unsigned and blank leaves follow. With the exception of the final gathering, which is on paper «B» (the watermark is visible on fos. 319, 321, 323-4) these leaves, beginning at folio 211, are on paper stock «A». They seem, following folio 213, to be gathered in eights—though there are occasional confusions in the identification of gatherings by means of watermarks, suggesting some inconsistencies in the size of gatherings.

[60] Similar to GAUDRIAULT, *Filigranes*, (cit. n. 53), no. 23, but with a straight-sided shield.

The text is written throughout in a fair version of Digby's distinctive script. That the quires were written sequentially and corrected *currente calamo* is clear from a correction to the catchword at the end of sig. 45, the foot of folio 398^{v}. The earliest version of the text here ends «them it like» and the catchword reads «wise». Digby has, however, reconsidered the passage, deleting «like» and replacing the catchword with «leaueth also», which is how the text continues at the top of folio 399^{r}.

The text is written throughout in a fair version of Digby's distinctive script. It shows no other hands at work. The dating of the Dedicatory Epistle to 31 August 1644 provides us with a *terminus ad quem* for the manuscript. Despite its appearing first, the leaves containing it were clearly a late addition to the manuscript—as we noted above, they are not part of the quiring sequence of the main body of the text, and are in a much cleaner state than the opening leaves of the main body. Indeed, as we noted, the extremely dirty, inky state of the opening leaf of the main body (p. 1; fo. 17) shows that it had served for some time as a wrapper, prior to the addition of the prefatory leaves. The Dedicatory Epistle represented a late addition to a text that was already penned.

When was that text most likely written? Biographical evidence might incline one to push the date back to 1640. Digby told Mersenne in mid-February 1640 he was a mere month away from completing the work; and then, three weeks later, that he would be finished as soon as he could find fifteen free days.[61] Digby was a quick writer: immediately upon learning about Thomas Browne's *Religio Medici* he sent out for a copy, read it, and sat up all night filling «a sheete or two of paper» with reflections on it—these *Observations* run to some 124 printed octavo pages.[62] But such claims of progress are professions of hope, of

[61] MERSENNE, *Correspondance* (cit. n. 5), IX, p. 120; IX, p. 207 (5/15 March 1639/40).

[62] PETERSSON, *Sir Kenelm Digby* (cit. n. 47), p. 169. Petersson doubts the veracity of the claim; but we see no reason to do so. Digby addresses his *Observations* to the Earl of Dorset, who, he claims, recommended the work

wishful thinking, rather than accurate reports—the equivalent of the modern scholar's overambitious research grant proposal. And the years immediately following February 1640 were not ones which afforded Digby very much by way of leisure for study, as he took a lead role in mustering support for the Queen as relations between crown and parliament collapsed.[63]

The likelihood is that Digby did not find the leisure he needed to work further on the *Two Treatises* until he came under house arrest in Winchester House, Southwark, between October 1642 and July 1643.[64] Such a suggestion squares with his description of the state of the text of in December 1642, as a «first draught» of «a totall Survey of the whole science of *Bodyes*», running to «neere two hundred sheets of paper».[65] In other words, the first draught is under half the length of the Parisian manuscript. It squares also with the dependence of much of the base-text of the Parisian manuscript on Thomas White's *De mundo* of 1642, a copy of which Digby had acquired by the end of the year.[66]

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to him in a letter of 19 December 1642; this letter Digby claims to have received «yesternight», prior to dating his *Observations* to the night of the 22 or the morning of 23 December; KENELM DIGBY, *Observations vpon* «*Religio Medici*», London, F. L. for Lawrence Chapman and Daniel Frere, 1644, pp. 1-5, 121-2. It is inherently unlikely that in addressing his *Observations* to Dorset, Digby would distort the timing.

[63] PETERSSON, *Sir Kenelm Digby* (cit. n. 53), pp. 151-9.

[64] PETERSSON, *Sir Kenelm Digby* (cit. n. 53), pp. 161-3.

[65] DIGBY, *Observations* (cit. n. 62), p. 10.

[66] Digby refers to White's *De mundo* as having been recently published at Paris in his *Observations* (cit. n. 56), pp. 25-6. White's work appears to have been printed in the early autumn; Mersenne began circulating copies at the beginning of October: see MERSENNE, *Correspondance* (cit. n. 5), XI, pp. 288, 290, 299. As noted above (see nn. 8-9), Digby acknowledges his frequent use of White's work in the *Two Treatises*. See, for instance, DIGBY, *Two Treatises* (cit. n. 2), pp. 353, 378. The important point for the purposes of dating the manuscript is that Digby's references to White are part of the base-text and not additions to or insertions into it.

We presume that Digby took this working draft with him to Paris on his release and, once there, made the fair copy now in the Bibliothèque Sainte-Geneviève. This he then circulated, or at the very least discussed, with Mersenne and other members of his circle in Paris—Mersenne's centrality in the printed text has already been noted above. While the employment of French paper does not necessarily mean that the manuscript was written in France, it certainly supports such a supposition.[67]

In his catalogue entry, Kohler suggests that the manuscript might have served as printer's copy for the Paris edition of 1644. While it might at some point have been intended for the printer, it cannot have been used in the printing of the 1644 edition because it differs in its fundamental structure and also in a number of other substantive ways from the printed edition. The inky marks and smudges in the main text are not those of the printer, but those of Digby himself, as he emended and tinkered with the copy, and perhaps sent it into circulation.

The text contained in MSS 3392 and 3393 differs in several significant respects from that published in 1644. The most striking change is the greater sophistication of the structuring apparatus in the printed text, which sees the introduction of many additional chapter divisions, and the insertion of numbered sections within chapters, each accompanied by descriptive marginal glosses. In the manuscript version, the first treatise, *Of Bodies*, comprises a mere ten chapters; while the printed version of the text is largely the same, it is divided into thirty-eight chapters, with the frequent provision of new or expanded chapter headings. The relationship between the two may be roughly tabulated as follows:

MS	*1644 edition*
Epistle Dedicatory	Epistle Dedicatory

[67] See also PETERSSON, *Sir Kenelm Digby* (cit. n. 53), p. 180.

Preface	Preface
I	I-II
II	III
III	IV
IV	V-VIII
V	IX-XIII
VI	XIV-XVI
VII	XVII-XXII
VIII	XXIII-XXVI
IX	XXVII-XXXV
X	XXXVI-XXXVIII
[Conclusion]	Conclusion

The manuscript version of the second treatise, *Of Mans Soule*, includes the same number of chapters as the printed version, with the same chapter headings. It differs by being subdivided into two «Parts». The second begins after chapter IV and is introduced by a Preface, the bulk of which reappears in the printed text in the general Preface to the entire treatise. This reorganization may be roughly tabulated as follows:

MS	*1644 edition*
	Preface
Part 1. I-IV	I-IV
Part 2. Preface	
I-VI	V-XII
Conclusion	Conclusion

In addition to this restructuring, the manuscript also underwent a number of substantive local alterations. Most of these affect the first part of the work, that concerning bodies; the second part—that concerning souls—remains largely unaltered.

Of changes to the first part, aside from a few deletions of short passages and many instances of local rephrasing, the most significant take the form of additions. And those additions affect several topics in particular: rarity and density, light, magnetism, and above all, motion, both natural and violent. The additions to the discussion on motion lead to a considerable elaboration of the arguments advanced in the original manuscript text. Some feel for the extent of these changes can be gleaned from the titles of the five chapters of the printed text into which the material of a single chapter in the manuscript has been redisposed:

MS

Chap. V: «Of locall motion in Common. Both naturall, and forced.»

1644 edition

Chap. IX: «Of locall Motion in common.»

Chap. X: «Of Grauity and Leuity; and of Locall Motion, commonly termed Naturall.»

Chap. XI: «An answere to objections against the causes of naturall motion, auowed in the former chapter; and a refutation of the contrary opinion.»

Chap. XII: «Of Violent Motion.»

Chap. XIII: «Of three sortes of violent motion, Reflexion, Vndulation, and Refraction.»

While this might suggest a massive expansion of the text, it represents more a reorganization. Most of the additions take the form of fresh examples, or fresh arguments or counter-arguments to existing propositions. Some are careted and squeezed into upper, lower, left and right margins; others are so extensive as to require additional sheets of paper to be interleaved. The most extensive additions in this area of the text are the summary account of Digby's corpuscular theory of gravity, explained from first principles in what would become chapter X. 5—an addition which requires the insertion of a closely written bifolium.[68] Linked to this is the long, inserted criticism of Galileo's account of gravity at what becomes X.9, about which we have written above: this is careted into the margins of two pages in the manuscript.[69] Connected to it also is the supporting series of points defending against possible counter-arguments to Digby's theory inserted, on four additional leaves, into the text as a series of paragraphs that become chapter XI.4-10, and account for 8.5 of the chapter's 14 printed pages.[70] This is a substantial amount of fresh material; but additions of this scope are not typical. Most are on a smaller scale.

Of other additions to the discussion of motion in chapter V of the manuscript, most, in one way or another, involve critical responses to Galileo's theories of motion: either directly, or indirectly, by further buttressing of Digby's alternative theories, as we have just seen in Digby's expanded defence of his treatment of gravity, along with his critique of Galileo's account. Every one of the critical remarks about Galileo quoted or referenced above is an addition to the manuscript. But this is not to say that the first version of the manuscript was uncritical of Galileo's theories of motion. Digby's objections to Galileo's arguments against the possibility that the medium is responsible for projectile motion is attacked in several

[68] DIGBY, MS 3922 (cit. n. 55), fos. 123-4; DIGBY, *Two Treatises* (cit. n. 2), pp. 79-81.

[69] DIGBY, MS 3922 (cit. n. 55), fos. 128^{r-v}; DIGBY, *Two Treatises* (cit. n. 2), pp. 83-5.

[70] DIGBY, MS 3922 (cit. n. 55), fos. 133^{r}-136^{v}; DIGBY, *Two Treatises* (cit. n. 2), pp. 89-97.

passages in the base text (XII. 4-7 in the printed work).[71] What the additions introduce are buttressing arguments: either further arguments for Digby's own positions—such as his account of gravity—or new information from other sources: sources which either provide alternative explanations to, or more often experimental evidence for them. And the ultimate source of this new experimental information in all cases either is, or is likely to be, Mersenne.

In chapter XII, for example, Digby considers the problem of violent motion. Here he takes issue with Galileo's arguments that in such cases momentum is impressed on the projectile. Digby adheres to Aristotle's principle that a patient can be moved only by continuous contact with an agent.[72] This he takes to be the medium—specifically the air and the «atoms» contained therein—which (in order to prevent a vacuum—somewhat at odds with Digby's anti-scholasticism) jostle to fill in behind the arrow, creating a disturbance which contributes to the continuation of the projectile's motion.[73] Digby then raises the question of how the air has enough strength to continue a violent motion, and dismisses Galileo's objections to the theory that the medium is the course of continued motion by appeal to an example offered by Galileo himself: that of air as a potential source of violent motion (XII. 4).[74] He cites the example, from the *Two New Sciences*, that one can set a heavy pendulum in motion by blowing on it.[75] The resulting motion will, in the case of a projectile like an arrow, be determined either by the impulse of the bow-spring, or the beatings of the air, or by a combination of both. For the calculation of the proportions involved in that

[71] DIGBY, MS 3922 (cit. n. 55), fos. 142^{v}-147^{r}; DIGBY, *Two Treatises* (cit. n. 2), pp. 102-5.

[72] DIGBY, *Two Treatises* (cit. n. 2), XII. 2, pp. 100-1.

[73] DIGBY, *Two Treatises* (cit. n. 2), XII. 2-3, pp. 101-2.

[74] DIGBY, *Two Treatises* (cit. n. 2), XII. 4, pp. 102-3.

[75] GALILEI, *Discorsi* (cit. n. 39), p. 98; OG, VIII, p. 116.

compounded projectile motion, Digby refers to Galileo's calculations in the fourth day of *Two New Sciences*.

But there is a significant change between the manuscript and printed versions of this part of the article. In the first manuscript version, Digby presents Galileo's explication of the proportions involved in projectile motion as authoritative:

> Which proportions, are so diuinely expressed by Galileus in his fourth dialogue of motion, that one should be too blame to seeke that doctrine any where else, or not be appayed wth. what he hath deliuered vs of it.[76]

But the assumption of uniform motion along a horizontal is at odds with Digby's theory of the medium as the source of motion and it is clear that new information, furnished by Mersenne, had come to Digby after he had completed the fair copy of his text. Digby thus deletes his paean to Galileo's account of the proportions of projectile motion, and replaces it with a curt dismissal of the explanation offered in day four, and with it Galileo's entire analysis of motion:

> Which proportions, Galileus in his 4.th Dialogue of motion, hath attempted to explicate very ingeniously: But hauing missed in one of his suppositions; to witt, that forced motion vpon an horizontall line, is throughout vniforme; his great Labours therein have taken litle effect towardes aduancing the knowledge of nature, as he pretended. for his conclusions succeede not in experience, as Mersenius assureth vs after uery exact tryals; nor can they in their reasons be fitted to nature.[77]

[76] DIGBY, MS 3922 (cit. n. 55), fo. 143^{r-v}.

[77] DIGBY, MS 3922 (cit. n. 55), fo. 143^{r}; DIGBY, *Two Treatises* (cit. n. 2), p. 103.

Mersenne's experiments allow Digby to attack Galileo's assumption that motion on the horizontal is uniform («aequabile»), and to undermine his entire thesis about the possibility of violent motion being impressed, as opposed to being determined by the medium.[78] It seems likely that these «uery exact tryals» refer to the tables in the *Ballistica* (1644) in which Mersenne corrects some of Galileo's tables from *Two New Sciences*.[79]

Questions of intellectual ownership, attribution, and priority inform some of the additions relating to Mersenne and members of his circle. We discussed above Digby's comment that he hasn't employed Gassendi's geometrical method for calculating acceleration because had already thought of the same procedure prior to the publication of *De motu impresso* (1642); that rider is in fact a careted addition to the manuscript.[80] Such claims to priority are familiar moves, frequently encountered among Mersenne's satellites. A page later, having introduced a problem aimed at calculating the force of percussion, he carets in the clarification that it was Mersenne who had proposed this this problem to him: «This Probleme was proposed to me by that worthy religious man, Father Mersenius: who is not content w.th aduancing learning by his owne industry and labours; but besides, is alwayes (out of his generous affection to verity) inciting others to contribute to the publike stocke of it».[81]

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[78] GALILEO, *Discorsi* (cit. n. 39), p. 236; OG, VIII, p. 236. See also GALILEO, *Discorsi* (cit. n. 39), p. 245, «equabile»; OG, VIII, p. 276.

[79] MARIN MERSENNE, *Ballistica et Acontismologia*, in *Cogitata physico mathematica in quibus tam naturæ quam artis effectus admirandi certissimis demonstrationibus explicantur*, Paris, Antoine Bertier, 1644, pp. 93-4, 103-10 (Props. XVII [Monitum], XXX-XXXI). On Mersenne's use of tables to test and correct Galileo's theories, see BERTOLONI MELI, *The Role of Numerical Tables in Galileo and Mersenne*, «Perspectives in Science», 12 (2004), pp. 164-90: 176-84.

[80] DIGBY, MS 3922 (cit. n. 55), fo. 115^{v}; DIGBY, *Two Treatises* (cit. n. 2), IX. 9, p. 72.

[81] DIGBY, MS 3922 (cit. n. 55), fo. 117^{r}; DIGBY, *Two Treatises* (cit. n. 2), IX. 11, p. 74.

And as an earnest of that contribution, Digby's insertion goes on to describe another problem which Mersenne had put to him: «to witt, Why there is required a weight of water in double Geometricall proportion, to make a pipe runne twice as fast as it did, <or to haue twice as much water runne out in the same time>?».[82] Digby offers a causal explanation for the phenomenon, buttressing it by reference to one of Galileo's pendulum experiments from *Two New Sciences*.[83] He concludes by emphasizing that where Mersenne has merely found something by experience, he has offered a reason for it. Having said that, however, he generously refers the reader to Mersenne's forthcoming publication of the problem: «j doubt not but when he shall sett out the treatise, w.[ch] he hath made of this subiect; the reader will haue better satisfaction».[84] Mersenne had been sharing his experiments on and raising questions about the flow of water with members of his circle for several years; some of his conclusions eventually appeared in his *Hydraulica*, Prop. II.[85]

This distinction between mere experiments or experiences and causal explanations is one that we have noted above. It is prominent in another of Digby's late insertions. Having offered his theory that «No motion can encrease for euer, without coming to a periode», and that there comes a point at which the increase in velocity reaches a maximum: «the pitch att

[82] DIGBY, MS 3922 (cit. n. 55), fo. 117[r]; DIGBY, *Two Treatises* (cit. n. 2), IX. 11, p. 74.

[83] GALILEO, *Discorsi* (cit. n. 39), pp. 95-6; OG, VIII, pp. 139-40; DIGBY, MS 3922 (cit. n. 55), fo. 117[r]; DIGBY, *Two Treatises* (cit. n. 2), IX. 11, p. 74.

[84] DIGBY, MS 3922 (cit. n. 55), fo. 117[r]; DIGBY, *Two Treatises* (cit. n. 2), IX. 11, p. 74.

[85] MERSENNE, *Correspondance* (cit. n. 5), XII, pp. 67-8, 104, 112-13; VIII, pp. 186-8, 212-14, 300, 307-8; MERSENNE, *Nouvelles Observations Physiques et Mathematiques*, [Paris], [1638?], pp. 4-5; this work was appended to MERSENNE, *Harmonie Universelle*, Paris, Sebastien Cramoisy, 1636 (see the facsimile edition of Mersenne's own copy, with authorial annotations, intro. François Lesure, 3 vols., Paris, CNRS, 1965); MERSENNE, *Hydraulica*, in *Cogitata Physico-Mathematica* (cit. n. 79), pp. 47-50. We are most grateful to Professor Carla Rita Palmerino for advice on this topic.

w.ch distance weights being lett fall, would giue the greatest stroakes and make greatest impressions», Digby inserts a paragraph referencing the claims of Galileo and Mersenne to have experimental proof of the truth of this rule.[86] This Digby rejects on the grounds that the increase in velocity must come to a point, prior to reaching maximum, at which the increase is imperceptible to our senses («vndiscernible by sense»). Instead, he suggests that it can be demonstrated on purely mathematical grounds, by which he «concludeth plainely that it is impossible».

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Our essay has, we hope, brought out something of the impact on his *magnum opus*, the *Two Treatises*, of Digby's arrival in Paris in the latter part of 1643. His renewed contacts with the Mersenne circle had a significant effect on the disposition and content of the text, as he revised it in reaction to data received from Mersenne, either by responding to philosophical shortcomings in the work of his experimentalist friends and allies, or by deploying their experiments in support of his causal explanations. There is much work to be done. It remains to set this account in a wider context. A more extensive investigation of Digby's late emendations to the text of the *Two Treatises* would demonstrate the extent of his debts to Galileo and Mersenne, and perhaps bring to attention other kinds of influence on the text. Another area for investigation is the question of the proximity between Digby's work on the text with that of his friend and associate Thomas Hobbes, who was also in Paris at this time, wrapping up his animadversions on Thomas White's *De mundo*—in an important sense the departure-point for Digby's work—and starting to sketch out the early chapters of his *De corpore*. Because *De corpore* was published in London, a decade later, we don't necessarily

[86] DIGBY, MS 3922 (cit. n. 55), fo. 117r; DIGBY, *Two Treatises* (cit. n. 2), IX. 10, p. 73. For the experiments referred to by Digby see GALILEO, *Discorsi* (cit. n. 39), pp. 93-4; GALILEO, *Two New Sciences* (cit. n. 33), pp. 94-5; OG, VIII, p. 137.

think of it alongside Digby's *Two Treatises*. And yet clearer understanding of the late stages of composition of the *Two Treatises* and of Digby's connections with Hobbes at this time may yet illuminate the social and intellectual context—that of the analysis and critique of Galileo's theories of motion within the Mersenne circle—within which Hobbes developed and first set out the physics and metaphysics that lies at the foundation of his great philosophical system.