

SYMPOSIA PAPER

Toward a new phase of Du Châtelet scholarship: From *Institutions de Physique* (1740) to *Institutions Physiques* (1742)

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Abstract

There is a mysterious twofold change in Du Châtelet's position on Newtonian attraction: from acceptance thereof as an explanatory principle in *Essai sur l'optique* (ca. 1738–39), to rejection in the 1740 *Institutions*, and returning to acceptance again in her *Commentary* (1756) to Newton's *Principia*. In this article, I suggest that we turn to the 1742 *Institutions* for answers. There, Du Châtelet introduces physical explanation and maintains that we can appeal to certain physical qualities (such as attraction) for explanatory force. Using this case study, I argue that the scholarship will benefit greatly from turning to the 1742 edition going forward.

1. Introduction

Scholars have made impressive progress in interpreting Du Châtelet's *magnum opus*, *Institutions de Physique* (1740) (e.g., Brading 2019; Janik 1982; Stan 2018; Lascano 2021; Detlefsen 2013).

Nevertheless, there is almost no interest in its second edition (published in 1742 under the somewhat modified title *Institutions Physiques*). Some chose to sidestep the later edition owing to the “mostly minor changes” made by the philosopher (Janik 1982, 98). Most chose to restrict their treatment to the first edition without explaining explicitly their favoring the first over the second. The goal of this article is to challenge the standard practice of using the first edition as the preferred text for interpreting Du Châtelet, arguing that, to better understand her views, we henceforth ought to attend to the second edition. To this end, this article is split into three sections. First, I select the case of Newtonian attraction to show that neglecting the 1742 edition risks creating unnecessary interpretive issues. Second, I turn to the 1742 *Institutions*. There, Du Châtelet develops new theoretical resources that would allow her to admit attraction as an explanatory principle in physical theorizing. Finally, I suggest that to best proceed with the business of recovering Du Châtelet in the

history of philosophy of physics, we should rely on the 1742 edition of her *Institutions* as the primary text going forward. Three further considerations, two historical and one methodological, are offered to strengthen my case.

2. Du Châtelet on attraction: An unresolved mystery

Du Châtelet's *Essai sur l'optique* has a complicated history.¹ Following extensive work on the manuscript, Bryce Gessell produced a full transcription and English translation of the text, making it available for scholarly use. Moreover, he situated this text historically and philosophically with respect to Du Châtelet's later works, including the *Institutions* (1740) and one of the philosopher's lesser-studied pieces, namely her *Commentary* (1756) to Newton's *Principia*.²

One of Gessell's key findings pertains to Du Châtelet's changing attitudes toward Newtonianism from the *Essai* to the *Institutions*: "the *Essai* and the *Institutions* approach Newtonian philosophy with conflicting attitudes (Gessell 2019, 861)." To support this claim, Gessell focuses on Du Châtelet's position regarding Newtonian attraction and observes that in the *Essai* and the *Institutions* the philosopher would apparently offer two different answers to the question, "is attraction a legitimate cause that explains phenomena?" As Gessell (*ibid.*, 873) succinctly remarks, "The *Essai* only succeeds by taking attraction as a legitimate cause. The *Institutions* makes that impossible. Instead, she argues that attraction can't be a cause, for we do not know the sufficient reasons behind it (§395–6)."

This shift in attitude is borne out by substantial textual evidence.³ In the *Essai*, Du Châtelet provides an explanation for refraction in terms of attraction exerted on light by the denser medium through which it travels. Consider Figure 1.

In this diagram, FF represents the surface that separates separating two medium types, whereby the medium below FF is denser than that above it. CD represents the observed path of light. The explanandum is that the angle of refraction of light (δ) is smaller than the angle of incidence (β). What explanation does Du Châtelet offer for this phenomenon? In the *Essai*, Du Châtelet asserts that light deviates from its original path upon entering the denser medium because the denser medium exerts an attractive force on it, thereby accelerating light's vertical speed and "pulling" it toward the normal. Hence her conclusion, "The combination of the attractive force from the media light is passing through is therefore the cause which accelerates or slows its motion in those different media" (*Essai*, 20). For Du Châtelet in the *Essai*, in other words, attraction can indeed serve as a legitimate cause of phenomena—in this case, refraction.

¹ See Gessell (2019), especially 862–63, for a helpful account about the history of composition of the *Essai*. The quoted text is from the edition edited by Gessell, Janiak, and Nagel, which is available online at <http://projectvox.org/du-chatelet-1706-1749/texts/essai-sur-loptique>.

² See Smith (2022) for a systematic analysis of Du Châtelet's achievements and shortcomings in the *Commentary*.

³ Du Châtelet writes that "a cause is good only insofar as it satisfies the principle of sufficient reason" (1740, 27). See Brading (2019, 93–94) for a discussion of Du Châtelet's rejection of Newtonian attraction as a cause of gravitational phenomena because it doesn't satisfy the Principle of Sufficient Reason.

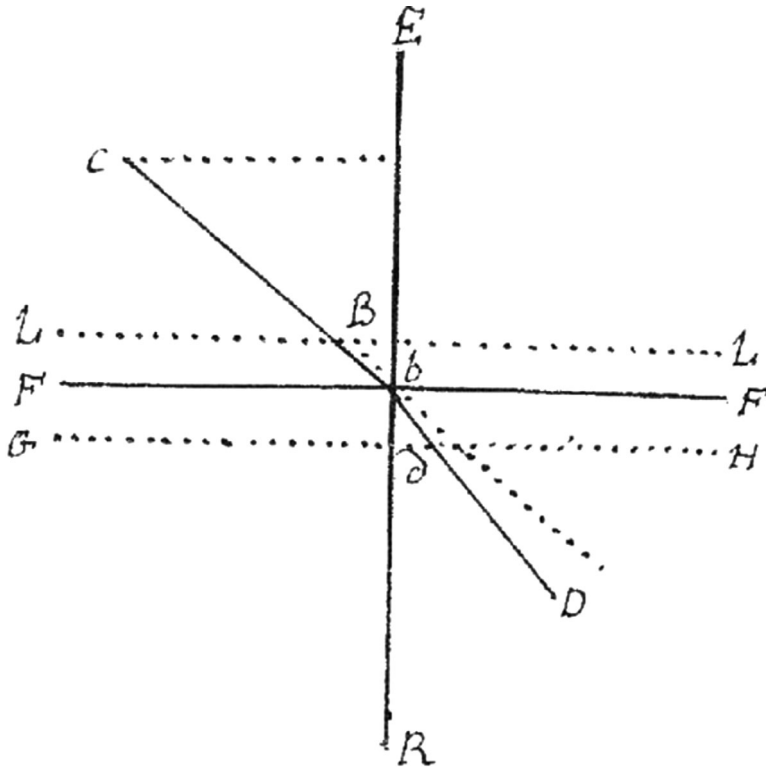


Figure 1. From “Chapter 2: On Transparent Bodies and Cause of Transparency,” *Essai*.

Gessell notes that the philosopher’s attitude toward attraction in the *Institutions*, particularly regarding whether it can serve as a legitimate cause in physical theorizing, has shifted.

Characteristically, Du Châtelet addresses gravitational phenomena—a case in which Newtonian attraction appears to function tremendously successfully as an explanation—and argues that even in this case, attraction should *not* be admitted as a cause. As Gessell astutely observes, this shift is attributable to the philosopher’s commitment to mechanical philosophy, a commitment that is absent in the *Essai* and that requires her to admit “mechanical cause” only as actual causes in physics.⁴ More specifically, according to Du Châtelet, to provide a causal explanation for a phenomenon is to explain it mechanically, whereby the causal explanation can appeal only to “the size, shape, situation and motion of matter” (§146). Even in cases in which attraction can be accurately measured, Du Châtelet insists that physicists “would still need to examine whether or not some subtle matter is the cause of this Phenomenon” (§399). The Du Châtelet that emerges from the *Institutions* is a typical mechanical

⁴ The literature on Du Châtelet’s views on causes and explanation in physics abounds. For further discussion, see Brading (2019, 38–39) and Wells (2021).

philosopher who rejects action-at-a-distance forces and insists that only contact action can be explanatory.

Given her new commitment to mechanical philosophy in the *Institutions*, one might reasonably expect Du Châtelet to disown the former explanation that she ascribed to refraction in the *Essai*, which appeals to body–light attraction as the cause of light’s deviated path. However, as Gessell points out, this is contrary to what emerges from Du Châtelet’s final work, the *Commentary*. In the *Commentary*, Du Châtelet appears to experience a second change of heart regarding attraction when she attempts to explain light’s refraction:

The advantage of the principle of attraction is to not need any supposition; rather, [it requires] only the knowledge of phenomena, and the more observations and experiments are exact, the easier it is to apply the attractive principle to explaining them. (Du Châtelet 1756, 184)

According to Gessell’s reading, in this passage, Du Châtelet appears to have forsaken her former commitment to mechanical philosophy to affirm body–light attraction once again as the cause of refraction. Moreover, on no occasion in the *Commentary* does Du Châtelet broach the need to seek mechanical explanations for phenomena. In view of this second volte-face, one might reasonably wonder what occurred in the intervening period between the *Institutions* and the *Commentary* that might elucidate the philosopher’s commitment to mechanical philosophy.

To address this question, Gessell proposes two hypotheses. First, he suggests that the change may have reflected some new development on Du Châtelet’s part after the 1740 *Institutions* that allowed her to admit attraction as “a causal notion,” where “attraction considered by itself requires no ‘supposition’” (Gessell 2019, 875). Unable to identify any appropriate texts in support of this hypothesis, however, Gessell criticizes the philosopher’s failure to supply adequate grounds to justify her approval of attraction: “[S]he gives no additional justification or comment on the causal power of attraction” (ibid., 876). Gessell goes on to suggest that the change may be attributable to Du Châtelet’s intensified appreciation for “Newton’s method” upon working on her translation and commentary on Newton’s *Principia* (ibid., 875–76). Unfortunately, however, Gessell provides no textual support for this hypothesis either.

In the absence of substantial textual evidence for Gessell’s hypotheses, the reason for Du Châtelet’s second change of heart remains a mystery. As the next section shall demonstrate, Gessell is correct in speculating that this change is attributable to a new development on Du Châtelet’s part; however, he overlooks the possibility that this new development occurs in the second edition of the *Institutions*, published in 1742, which substantially and significantly revises its 1740 predecessor.

3. Solving the mystery: A two-part explanation

In this section, I offer a two-part explanation for Du Châtelet’s mysterious second change of heart for which Gessell (2019) identifies but fails to account. The first part of this solution recalls the context in which the passage on refraction in the *Commentary* occurs. The second part addresses a broader question about

Du Châtelet's commitment to mechanical philosophy, with the aim of demonstrating that, despite her explicit commitment to mechanical explanations for phenomena in the 1740 *Institutions*, she is willing to admit nonmechanical explanations into her physical theorizing in the 1742 edition, which has received lamentably little scholarly attention to date.

3.1 A closer examination of the context

Gessell interprets Du Châtelet's assertion that attraction "is not to need any supposition" to mean that attraction, for Du Châtelet, requires no mechanical explanation for its ability to serve as a causal notion. However, closer inspection of the context suggests a different interpretation.

At this point in the *Commentary*, Du Châtelet is surveying the status of a long-standing debate between Descartes and Fermat over the physics behind Snell's Law ("the sine of incidence and that of refraction are always in constant proportion") before introducing her preferred theory. According to Du Châtelet, both Descartes and Fermat "considered light as a body of sensible magnitude, and upon which media act the same way as they would on other bodies" (1756, 185).

However, this supposition poses a thorny difficulty: If light behaves in the same way as a material body, it ought to decelerate on entering a denser medium, and the angle of refraction ought to be greater than that of incidence, which is contrary to experience. To resolve this difficulty, Du Châtelet reports, Descartes and Fermat each propose a hypothesis, and it is here that their disagreement arises:

In order to reconcile [laws of mechanics] with experience, which he could not evade, Descartes claimed that the denser the media, the more they open up an easy passage for light. But instead of giving a reason to explain the phenomenon, doing so only casts more doubt on it.

Finding Descartes' physical explanation impossible to accept, Fermat preferred to resort to metaphysics and to final causes. He therefore entrenched himself in saying that it is agreeable to the wisdom of the author of nature to cause light to go from one point to another by the path of the shortest time, as it does not go by the shortest path which is the straight line. (Du Châtelet 1756, 186)

Du Châtelet's wording establishes that she is not in favor of either proposal. She dismisses Descartes's view for its lack of grounding: If one already supposes that light behaves similarly to material bodies, it appears arbitrary to also posit that a denser medium would simply open up an easier passage for light while exerting greater resistance on material bodies. She also strongly disapproves of Fermat's resort to God's design to explain a natural phenomenon. Immediately following her diagnosis of why both hypotheses founder, Du Châtelet introduces a third hypothesis⁵:

⁵ Du Châtelet knew and read Pierre Coste's French translation of Newton's *Opticks*, which was based on its second English edition. For more on Newton's views on refraction, see Shapiro (2002) and Hall (1993).

It is easy to see how attraction gives an end to this difficulty; because this principle shows that the progressive movement of light is not only less retarded in the denser medium, as Descartes would have it, but that light is accelerated by the attraction of the denser medium when it penetrates it. (Du Châtelet 1756, 186; emphasis added)

Here, Du Châtelet designates the attraction hypothesis as the victor that will put an end to the Descartes–Fermat debate because, unlike its competitors, the attraction hypothesis explains *why* light accelerates (i.e., using the attractive force acting on it vertically) on entering into a denser medium.

We are now in a better position to reassess what Du Châtelet means by the statement that “[t]he advantage of the principle of attraction is to not need any supposition (1756, 188).” At this point in the text, Du Châtelet is comparing three competing hypotheses concerning refraction— Descartes’s, Fermat’s, and Newton’s— and finding that Newton’s is gaining the upper hand. Her reason for preferring the Newtonian hypothesis over the other two is that it “[does] not need any supposition (ibid.).” By this, she means that it does not rest on an arbitrary assumption about denser media, as Descartes had argued, nor does it appeal to “metaphysics and final causes,” as Fermat had suggested. In other words, the “supposition” in question refers to Descartes’s and Fermat’s respective hypotheses about refraction, which she deems to be lacking. This remark should not be regarded as implying that attraction requires no mechanical explanation.

3.2 A new passage in 1742: Physical explanation versus mechanical explanation

The explanation offered in section 3.1 constitutes only a partial solution to the mystery that Gessell identifies. The question of *why*, in the *Commentary*, Du Châtelet appears so ready to accept attraction as the cause of refraction, rather than insisting that we must seek its mechanical cause, as she repeatedly does in the 1740 *Institutions*, remains unresolved. Indeed, Du Châtelet’s complete lack of interest in mechanical cause in the *Commentary* contrasts sharply with the philosopher’s persistent adherence to it in the 1740 *Institutions*. To resolve the mystery that Gessell identifies, therefore, we must probe the issue further.

The passage that is key to the problem in question lies in the 1742 edition, in which Du Châtelet made numerous revisions over the first. These revisions often take the form of significant addition, clarification, expansion, and restructuring of argumentation.⁶ The passage to which we shall presently turn is a new addition that portrays a more nuanced position on mechanical philosophy than that which she espoused in 1740.

In the 1742 edition, Du Châtelet introduces a new category of explanation— *physical explanation*—and defines it in terms that contrast with those used in mechanical explanation. She writes,

⁶ Revisions can be found in virtually all chapters. In Chapter 9 (“On the Divisibility of Matter and the Fashion in which Sensible Bodies Are Composed”) alone, §172–74, §179–80, and §182 are significantly rewritten.

When one explains a phenomenon by the figure, size, situation, and so on, of parts of matter, one gives it a mechanical explanation, but when one employs physical qualities to explain it, such as elasticity and heat, without seeking the mechanical cause of these qualities, the explanation one gives to this phenomenon is a physical explanation. (Du Châtelet 1742, §203)

Here, Du Châtelet distinguishes between mechanical explanation and physical explanation on the basis of the kind of explanans each invokes. A mechanical explanation is one in which the explanans are “the figure, size, situation, and so on, of parts of matter” or that which she elsewhere calls “mechanical principles,” and a physical explanation is one in which the explanans are “physical qualities” or “physical principles” (§201). Du Châtelet intends *physical qualities* to be understood broadly: Not only does she cite a wide variety of these qualities as examples,⁷ she also maintains that physical qualities include “all the qualities whose mechanical reasons have yet to be found” (*ibid.*). The question that we must now ask is whether light-body attraction is a physical quality according to Du Châtelet’s definition.

I believe that the answer to the preceding question is affirmative. This attraction satisfies the aforementioned requirement that its mechanical reasons have yet to be found. Of course, one might find this requirement too permissive: There exist numerous qualities whose mechanical reasons have yet to be found (e.g., dormitive virtue), and yet we tend *not* to think that they are all explanatory. Has Du Châtelet imposed any additional restrictions onto what counts as explanatory physical qualities to avoid the simplistic interpretation according to which a physical quality is just any feature of a given body that has yet to be explained mechanically?

To answer this question, let us examine an example from the text and extract two further characteristics that render physical qualities explanatory. Du Châtelet writes,

Physical principles often suffice for the explanation of a phenomenon, even though their mechanical cause is not known: thus, for example, the elasticity of the air explains very well the rise of water in pumps, although we have not yet discovered the mechanical principle of this elasticity, and even if we knew this principle, we would not use it to show how water rises in a pump, because it is enough to explain insofar as one is assured by experience that air is elastic. Hence, the mechanical cause of elasticity is a new question, which is not necessary to explain the effect of pumps, and consequently one must not inquire into. (Du Châtelet 1742, §181)

From this quotation, we may extract two criteria that render a physical quality explanatory. First, it must provide an answer to the research question. In the preceding example, in which Du Châtelet is likely considering experimentation with water using Boyle’s air pump, the research question being posed is a *why*-question: “Why does the water rise in the pump?” The answer to this question rests on a relevant physical quality of the air—elasticity—by virtue of which it pushes the water outside the pump to cause the water inside to rise. In appealing to the elasticity of air, one can relate a causal narrative of the occurrence that agrees with the observed phenomenon.

⁷ See (1742, §223), for instance, where Du Châtelet elasticity, heat, cohesion, softness, fluidity, gravity, electricity, and magnetism as examples of physical qualities.

Second, for a physical quality to be explanatory, it must be empirically trackable: as Du Châtelet observes, “it [elasticity] suffices to explain it [water’s rising in the pump] as we are assured by *experience* that air is elastic” (emphasis added). In other words, the understanding that air is elastic—that is, that a volume of air can expand when subject to reduced pressure and contract when subject to increased pressure—was not only an empirically established characteristic of the air: this elasticity was also known to be quantitatively related to altitude and pressure (using mercury heights) by the late seventeenth century.⁸

Let us now test light-body attraction to determine whether it may be counted as an explanatory physical quality. It satisfies the first criterion easily: This attraction has not yet been reduced mechanically. It also satisfies the second criterion by providing an answer to the question of why light changes its path upon entering a denser medium that agrees with the observed phenomenon. The causal narrative relates that when light approaches the denser medium, the medium exerts an attractive force on light and thereby increases its vertical speed, causing its path to deviate toward the normal, just as observed. The third criterion, which concerns empirical trackability, is satisfied as well. In the *Commentary*, Du Châtelet endorsed Alexis Clairaut’s theory of refraction, according to which one can relate the attractive force with two measurable quantities: the angle of incidence and the angle of refraction.⁹ In hindsight, we know that Clairaut is mistaken—light doesn’t accelerate, but rather decelerates, upon entering a denser medium. However, it remains that for Du Châtelet, he provides a viable physical explanation for the phenomenon.¹⁰

Hence, the explanation of refraction in terms of light-body attraction amounts to the provision of a physical explanation for the phenomenon for Du Châtelet in the *Commentary*. It specifies a physical quality as an intermediate cause without denying that this quality is subject to mechanical explanation at a deeper level.¹¹ Thus, the mystery that Gessell observed is resolved: Du Châtelet did not undergo a second change of heart in relation to attraction in the *Commentary*; rather, she developed a more sophisticated perspective on explanation in 1742 that allowed her to admit attraction as a causal notion to explain refraction in the *Commentary* while retaining her belief that this attraction may someday be explained mechanically.

4. Turning to the second edition for a change

In the previous section, I showed that key to solving Gessell’s puzzle is the consideration of a significant yet neglected text that was published between the 1740 *Institutions* and the *Commentary*—the 1742 *Institutions*, which the philosopher explicitly

⁸ A classic account of the evolution of Boyle’s conception of elasticity and related experimental attempts to measure it is Webster (1965), see esp. 484–89. Du Châtelet demonstrates a familiarity with Boyle’s work. As Detlefsen (2013) noted, her chapter on hypotheses “captures many aspects of Robert Boyle’s account of good and excellent hypotheses.”

⁹ See Du Châtelet (1756, 189–92), where she lays out Clairaut’s solution to the problem concerning light’s trajectory and three corollaries, relating the attractive force to the distance to the surface as well as the angles.

¹⁰ Additional evidence is that Du Châtelet characterizes Descartes’ account, which is a rival of Clairaut’s, as a “physical explanation” (1756, 186).

¹¹ Du Châtelet retains her commitment to mechanical philosophy as the ultimate goal of physical theorizing in the 1742 edition. See Du Châtelet (1742, §399).

states on the front page is a “new edition, corrected and augmented considerably by the author.” However, the broader purpose of this essay is not to solve a local interpretive issue; rather, I would like this case study to motivate a new scholarly practice: That is, we should henceforth use the 1742 *Institutions* as the standard text of reference when interpreting Du Châtelet. This new practice would help us to avoid problems such as that identified by Gessell and allow us to interpret the philosopher’s work in light of her more considered views.

Nevertheless, one might object that a solitary case study is inadequate to leverage a global shift in Du Châtelet scholarship. The extent of the revisions in the 1742 edition remains an open question, one that would require a line-by-line comparative study of the two editions to resolve. In the interim, one might argue that we should continue to use the 1740 edition to interpret Du Châtelet because (1) the philosopher’s claimed substantial changes might constitute an exaggeration and (2) the majority of existing literature is founded on the first edition. As such, it would not be amiss to fully explore it first before turning to its successor.

To such an argument, I would respond that the present study is indeed limited in one sense—that is, it rests on a single passage that is a new addition in the 1742 edition to resolve a puzzle recently raised in the literature. Given that this passage touches on issues that are of central importance for Du Châtelet (i.e., explanation and mechanism), one might expect that it can help us to obtain a better understanding of several other interpretive problems in the literature.

Unfortunately, there is insufficient scope here to examine the full range of implications. Moreover, even if such an examination might be undertaken, the objection nonetheless stands: We cannot alter a long-standing scholarly practice on the grounds of a handful of interpretive insights afforded by a single passage. Therefore, rather than advancing more arguments pertaining to interpretation proper, I shall offer three further considerations to strengthen my case: two historical and one methodological.

First, abundant evidence from Du Châtelet’s correspondence demonstrates that she still actively solicited opinions regarding the 1740 edition after its publication and made numerous changes accordingly.¹² However, she does not appear to have done so for the 1742 edition. This suggests that the author was not entirely satisfied with the first edition. Indeed, as Janik (1982) helpfully recounts, Du Châtelet’s tutor Samuel König had mounted an accusation of plagiarism against her on the eve of the first edition’s publication in late 1739, and she even considered withdrawing the manuscript from print altogether. Another interesting but often overlooked difference between the two editions is that the later version exhibits a greater degree of editorial care than the earlier version: For instance, it includes 230 items in the section entitled “Table of Materials,” while the first only has 80. It is highly likely, therefore, that the 1740 edition was rushed by the complicated circumstances that the author was negotiating at the time; as such, it is likely that it does not represent her most considered views.

¹² See Du Châtelet (2018): *La Correspondance d’Émilie Du Châtelet*, esp. letters 339 (to Maupertuis), 343 (from Clairaut), 358 (to Johann II Bernoulli), 360 (from Clairaut) and 362 (from Clairaut), all written in 1741.

Second, the 1742 edition was translated into German and Italian, and so it historically enjoyed a wider circulation than the earlier edition. When Kant engaged with Du Châtelet in his first publication, the *Thoughts on the True Estimation of Living Forces* (1746–49), for example, he was referencing the 1742 edition, given that his focus is on Du Châtelet's dispute over *vis viva* with Jean-Jacques Dortous de Mairan, and this dispute was fully presented only in the 1742 edition.¹³ Therefore, to accurately assess the reception of Du Châtelet by her contemporaries and successors, the 1742 edition is a more reliable source.

Finally, on the question of how we might best approach neglected figures in the philosophy of physics, a subfield of philosophy in which women have historically been particularly underrepresented, I believe that text choice is of the utmost importance. As scholars working in the 2020s, we find ourselves in a favorable time during that exists an unprecedented consensus in the academy that we ought to restore voices from philosophy's history that have been unduly forgotten. However, while this consensus is widespread today, its permanence is by no means guaranteed. We now have an opportunity to restore Du Châtelet to her rightful place in the history of the philosophy of physics by prioritizing the more considered version of her *magnum opus*. Du Châtelet has already suffered sufficient unfair representation in centuries past; we should now make amends by affording her the best representation possible.

5. Conclusion

I have revisited an interpretive problem raised by Gessell (2019) and provided a solution to it by drawing on the 1742 *Institutions*. Using this case study, I urged scholars to turn to the 1742 *Institutions* as the primary text for interpreting Du Châtelet's mature philosophy of physics going forward. This is not to deny the importance of the 1740 edition, however: For those interested in learning about the intellectual development of Du Châtelet in the early 1740s, for instance, the former edition is of exceptional relevance. Rather, my point is that instead of continuing to rely on the 1740 edition, the scholarship will benefit greatly from turning to the 1742 edition for the following reasons: (1) we would avoid unnecessary interpretive problems and puzzles, such as the one raised by Gessell (*ibid.*); (2) we would avail ourselves of a more philosophically robust text for analysis and critical engagement; and (3) we would gain a more accurate picture of Du Châtelet's intellectual development and connections among her works from different periods.

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¹³ For more on Du Châtelet and Kant's responses to this dispute, see Lu-Adler (2018).

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