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ESSAY REVIEW

Method and Metaphysics: Essay Review of Katherine Brading's *Émilie Du Châtelet and the Foundations of Physical Science*

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Katherine Brading, *Émilie Du Châtelet and the Foundations of Physical Science*. New York: Routledge (2019), 132 pp., $66.39 (hardcover).

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Émilie Du Châtelet was one of the great natural philosophers of the eighteenth century. She tackled many topics, including free will, scriptural interpretation, politics, and happiness—the latter in a lovely essay called the *Discourse on Happiness*, which you should read tonight. But Du Châtelet's primary philosophical interest was physics, and her work includes essays on optics and the nature of fire, the first and still-standard French translation of Newton's *Principia*, and significant contributions to the *Éléments de la philosophie de Newton*, which was authored by her longtime collaborator and companion, Voltaire. Du Châtelet's masterpiece, however, is her 1740 *Institutions de Physique* (IP), usually translated *Foundations of Physics*. She presents it as a textbook on physics dedicated to her son, but it is also a penetrating and innovative treatise on natural philosophy, focused especially on physics and its foundations but touching on metaphysics, method, epistemology, and divinity. Widely read and influential in its time, it went through multiple editions in multiple languages; it was discussed and cited by the likes of Kant, Bernoulli, and Wolff; and parts of it served as authoritative entries in Diderot and D'Alembert's *Encyclopédie*, including its most famous chapter, on hypotheses.

Katherine Brading is one of the great natural philosophers of our own century, and like Du Châtelet, her primary philosophical interest is in physics—its foundations, development, and methods. Brading's work, too, draws upon empirical science and on the history and philosophy of physics. In the last ten years or so, Brading has built a community of students and collaborators around the *Foundations*, resulting in the completion of its English translation and an explosion of interest in the philosophy it contains. In doing so, she has exemplified what it means to be not just a philosopher and scholar but also a collaborator and mentor.

Émilie du Châtelet and the Foundations of Physical Science is Brading's introduction to the philosophy of the *Foundations*, and at an easily enjoyed 106 pages, it is a most stimulating entrée into Du Châtelet's philosophy of physics. Brading brings to the *Foundations* an unparalleled knowledge of eighteenth-century physics, a deep interest in the structure and motivations internal to Du Châtelet's project, and a great sensitivity, cultivated by long investment, to the philosophical issues raised by Newtonian and post-Newtonian physics. The depth of that investment is evident from the first sentence of the book:

> as I pondered the philosophical problems left unsolved in the wake of Newton's *Principia*, I picked up the [*Foundations*]. There, I found a text that addressed exactly the questions I was interested in (1).

In other words, for Brading, this is (philosophically) personal. And that is what makes this book so great. The proximity between the questions that animate Brading and those that animate the *Foundations* allow her to inhabit Du Châtelet's project in a way that, in my opinion, characterizes the most interesting and engaging history of philosophy.

Brading offers her book as a corrective to what she describes as the "Received View" of the *Foundations*, according to which it is a "marriage between Leibnizian metaphysics and Newtonian science" motivated by Du Châtelet's belief that physics was "dangerously incomplete" without a metaphysical foundation (8, citing Barber (2006[1967]). We are now five years out from this book's publication, and I think it is fair to say that this view is no longer received, thanks in large part to Brading's work. Even before that, the interpretive landscape was more subtle than this label would suggest, and Brading generously cites the virtues as well as the vices of extant interpretations, providing ample and helpful pointers to that work, especially in footnotes. But the attitude behind the Received View is real, and, Brading argues, it leads to a variety of interpretive ills.

For one, it suggests that Du Châtelet is "passive with respect to the philosophical content of her book" (9). But while Du Châtelet draws on a wide variety of philosophical sources, not least Leibniz and Newton, that is because, as Du Châtelet puts it, "physics is an immense building that surpasses the powers of a single man" (IP §XI). Du Châtelet selects, transforms, and critically adapts her sources, arriving not only at a "highly perceptive review of the state of natural philosophy in 1740 and the key problems therein" (11) but also "new philosophical positions on a wide variety of issues and at a new overall philosophical system" (16). This, I think, is incontrovertible. The *Foundations* is an ingenious work of natural philosophy aimed at conveying what Du Châtelet takes to be the best account of physics and its foundations of her day; the result is her own synthesis and contains many original elements, as is evident from its reception by her contemporaries and successors. That she draws on existing work sets her apart from any other natural philosopher only inasmuch as she owns it.

Another problem that Brading has with the Received View is that it does not yield the most interesting and successful reading of the *Foundations*. It depicts a disjointed amalgam of (Leibnizian) metaphysics and (Newtonian) physics and invites us to evaluate the *Foundations* in terms of the accuracy of those presentations and its

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success at providing a metaphysical foundation for physics. If we consider instead what Du Châtelet was in fact trying to achieve, we find a coherent work, full of "philosophical richness," "significance for the history of philosophy" (2), and insight into serious and unresolved problems in the foundations of physics. This *Foundations*, as Brading puts it elsewhere, should be "required reading for philosophers of physics" (Brading 2023:519).

Du Châtelet's true aim in the *Foundations*, according to Brading, has two related aspects: a "central metaphysical problem" that concerns "how it is that bodies act upon one another" and a "central epistemological problem" that concerns "the appropriate method by which to address this problem of bodily action" (2). Accordingly, "the key to reading Du Châtelet's book as a work of philosophy" is

> to approach it in three steps, beginning with the problem of method for natural philosophy, and moving form there to her account of matter, body, and force, and finally to her application of these resources in tackling key problems in the physics of bodies (8).

Brading's book has three main chapters, corresponding to these three steps. Both Brading's argument, and Du Châtelet's, begin with method.

Brading's central claim concerning method is that the foundations for physics that Du Châtelet seeks should be understood as methodological and not metaphysical. We will return to this point, but the methodological significance of the *Foundations* is indubitable, as Brading brings out, and two of Du Châtelet's methodological innovations are worth emphasizing.

First, as Brading puts it, Du Châtelet endorses a "two-pronged" method. On Prong Number One, we've got experience and experiment, which is the only thing that can teach us about the "physical characteristics of things" (IP §IX). On Prong Number Two, we've got certain self-evident "principles of our knowledge" upon which we must rely to properly reason about what we observe.

Second, against Newtonians like Musschenbroek who declared that "hypotheses are to be utterly banished from Physicks" (cited on 28), Du Châtelet argues that hypotheses are indispensable to make progress in physics because we cannot deduce certain knowledge of causes from first principles. But hypotheses "become the poison of philosophy when they are made to pass for truth" (IP §X), so Du Châtelet proposes stringent and detailed criteria for evaluating them. In brief, they must be properly constrained by the principles of our knowledge, on one side, and the facts that we discover from experiments, on the other. With the combination of these, Brading very plausibly claims, Du Châtelet became "the first to articulate a detailed hypothetico-deductive" method for physics (27).

Du Châtelet's articulation of this method begins with the very first chapter of the *Foundations*, entitled "Of the Principles of Our Knowledge." There, she establishes that the first such principles are the Principle of Contradiction (PC) and the Principle of Sufficient Reason (PSR). So, you can understand the temptation to read this chapter as a bit of Leibnizian metaphysics. But Du Châtelet's versions of these principles, her arguments for them, and the use to which she puts them are unique to her, and very interesting.

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Most significantly for our purposes, Du Châtelet justifies these principles almost entirely in terms of their indispensability for our reasoning. The PC is the "first axiom" of our knowledge and "the foundation of all certainty" because if one denied it "there would no longer be any truth, even in numbers, and every thing could be, or not be, according to the fantasy of each person" (IP §4). As she hints here, the PC ensures certainty at least in part because it does not permit disagreement—unlike, Du Châtelet argues, Descartes's reliance on his own imagination in the guise of clear and distinct ideas. While two people might disagree about whether some claim is certain or some idea is clear and distinct, we cannot (do not? should not?) disagree about what deductively follows from what. The status of the PC as the first axiom of our knowledge is related to this fact about our reasoning.

While the PC suffices to establish necessary truths, it tell us nothing about contingent truths, which concern not what is possible but what in fact is. For that, we need the Principle of Sufficient Reason (PSR). Du Châtelet's argument for the PSR also relies on its indispensability for our reasoning and the universality of its acceptance: "All men naturally follow it," she writes, and "if we tried to deny this great principle, we would fall into strange contradictions" (IP §8). We would have no justification for believing that a thing or state of affairs remains the same from one moment to the next, we would (as a result) not be able to compare and hence measure things, and we would not know that the universe was produced by a supreme wisdom.

So Brading's invitation to read this seminal chapter, and the PC and the PSR, in methodological terms makes a great deal of sense. And Brading fortifies her case with some contextual considerations. She argues that Du Châtelet most closely modeled the *Foundations* on English and Latin Newtonian textbooks by Keill, Musschenbroek, 's Gravesande, and Pemberton (6), and points out that the first chapter of each concerns the proper method for physics. Three of those four first chapters contain Newton's rules of reasoning; meanwhile, the first chapter of the initial manuscript version of the *Foundations* contained at least one of Newton's rules. Those rules are gone from the second edition, and Brading concludes from this that what replaces them should be understood as Du Châtelet's alternative method.

That method, moreover, is "directed toward securing knowledge of causes" (7)—specifically, knowledge of how there might be genuine causal interaction between bodies. This is a component of what Brading has named "the problem of bodies," which her past work argues is the central challenge of eighteenth-century physics. This challenge was to satisfactorily ground physics in an account of the "nature, properties, and behaviors of bodies, including their actions on one another" (16), and Brading argues that Du Châtelet "rightly saw" that previous attempts to meet this challenge did not succeed (16–17).

Among the reasons for this, Brading tells us, is that at Du Châtelet's time, despite the importance of induction to the Newtonian method, the defense of it in Newtonian texts was "weak" (35). For example, 's Gravesande characterizes the inference from the fact that "I have used such and such Food for several Years" to the conclusion that I may "take it to-day without any Fear" (as cited on 35) as a case of reasoning by analogy. So, when Du Châtelet writes that without the PSR, I cannot know that a thing or state of affairs does not spontaneously change from one moment to the next, it makes sense to read this, with Brading, as an attempt to legitimate induction.

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The question then is: How does this justification of induction gets us to "an account of bodies as true causal agents in the world" (54)? If we adopt the PSR simply because we must to reason inductively, how does this justify what sounds like a pretty substantive conclusion about the world out there, namely, that bodies are genuine causes?

We can put a finer point on this question by considering Brading's attitude toward the metaphysics of the *Foundations*. In no way does Brading deny that the *Foundations* contains metaphysics. She only claims, very carefully, that the PSR is not *first and foremost* a metaphysical principle, that providing a metaphysical foundation for physics is not Du Châtelet's *primary* objective (22), that Du Châtelet's *principal* concern is finding a methodology for physics (31), and that the incompleteness of Newtonian physics is not metaphysical *in the first instance* (12). Some of this is polemics: Brading is deemphasizing the metaphysics to counteract the dominance of the Received View. But a big reason that she wants to do that is that she does not think that providing a metaphysical foundation for physics is an interesting project, and she does not think that the *Foundations* succeeds in doing it. This is borne out by her evaluation of the more metaphysics-laden parts of the *Foundations*, which she describes as a "metaphysically extravagant" "price" that Du Châtelet pays to achieve her goal of providing an account of bodily causation (55), established by an argument that, in contrast to the rest of her writing, "seems rushed and lacking in clarity" (56).

Now, one can give good reasons for deeming something interesting and successful, and Brading certainly does. But interest and success also depend upon your perspective. In a really great unpublished reply to L. A. Paul (which you should read tomorrow night), Brading articulates her own view of the relationship between physics and metaphysics. Informed both by the history of philosophy and science as well as the actual results and practices of physicists, it is what I would call a natural philosophical approach, on which the search for natural causes is a unified one that involves tools sometimes claimed by scientists or metaphysicians. As she makes clear there, Brading has no truck with the notion that metaphysics has a monopoly on conceptual or foundational questions, which may be pursued prior to any scientific (read especially: empirically informed) theorizing. For example, "there is no independent concept of causation to be studied by metaphysicians in isolation from the details of scientific theories" (2016: 3). This helps us to understand Brading's claim that according to Du Châtelet, "a secure basis [for physics] requires the introduction of metaphysics, but the motivation is not primarily that of providing a 'metaphysical foundation' for physics" (12). Brading is not averse to metaphysics, but to the idea that a priori speculative system building must precede physical (empirical) inquiry.

This is no criticism of Brading's interpretation. Quite the contrary. There is a reason Brading found a kindred spirit when she picked up the *Foundations*; to inhabit a philosopher is not to lose one's own philosophical personality. It is Brading's perspective and voice alongside her attention to Du Châtelet and her scholarship that make her work so wonderful. This is not to take sides in any debates about methodology in the history of philosophy, only to add a point that is sometimes left out of those debates, which is that learning from a historical philosopher always entails two philosophical perspectives. And learning from a philosopher learning from a philosopher, like we get to do with Brading's book, involves three.

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In that spirit, I think that is also possible to read the *Foundations* as interesting philosophy through a more metaphysical frame, if you are into that sort of thing. Alongside Brading's book, you might take a look at Detlefsen and Janiak's Stanford Encyclopedia article on Du Châtelet, which sees the *Foundations* as more closely modeled on Descartes's *Principles*, and thus attributes more significance to its move from the principles of our knowledge to what seem to be foundational metaphysical claims. And alongside Brading's arguments against half the Received View—that the *Foundations* is half Leibnizian metaphysics—it is worth a look at Marius Stan's takedown of the other half, that the *Foundations* is half Newtonian physics (2022). There and in his treatment of Du Châtelet on substance (2018), Stan emphasizes the influence of Christian Wolff on Du Châtelet, arguing that she is a metaphysical realist. And I would be remiss not to mention that Du Châtelet seems to get pretty excited about speculative metaphysics. In the preface to the *Foundations*, she describes metaphysics as the "summit of the edifice" of our knowledge (IP XI), and in a letter to Frederick the Great, gamely cited by Brading, she describes the *Institutions* as a book of metaphysics and tells him that she is "persuaded that physics cannot proceed without metaphysics, on which it is founded" (24). In response, Brading writes that she does not dispute the importance of metaphysics to the *Foundations*, only wishes to urge "a broader conception of Du Châtelet's foundational project." What she does dispute, I think, is that this "founding" involves a commitment to the notion that foundations are the sole realm of a priori metaphysics.

Let us return to Du Châtelet's search for an account of genuine bodily causation. To do that, we need a brief account of the fundamentals of Du Châtelean bodies and forces, which Brading treats in Chapter 3, the second step of her interpretive approach to the *Institutions*.

Du Châtelet argues that the only true substances are unextended "simple beings," each of which has an internal state that distinguishes it from the others, and a principle of action that brings about and makes intelligible the changes in that internal state (IP §126). She calls those internal states "experiences" and writes that our own souls provide examples of such states (IP §128). Du Châtelet describes the simple beings as very deeply linked, connected, interdetermined, and, related, every one with every other, so much so that "the state of [one] being given," it is in principle possible "to determine the past state, present, and future of all the universe" (IP §130–31). This is, as Brading writes, a "remarkable statement of a very strong form of determinism, predating Laplace's famous 1814 statement of determinism by 64 years" (60).

Brading concludes, further, that Du Châtelet's simple beings "stand in deterministic causal relations" to one another. I am not totally convinced, however, that these relationships between simple beings are causal. To go further, we need to know what Du Châtelet thinks is a cause.

First off, it is essential to a cause that it serve as the principle of actuality or existence of a thing (IP §34, §50). But a "good" cause must also contain "the sufficient reason for this thing, that is to say, what makes it possible for an intelligent being to understand why this thing exists" (IP §9, see also §10, §50). The Scholastic vegetative soul is not a good cause: while a cause of plant generation and growth "is indeed advanced," Du Châtelet writes, it is "not admissible" (IP §10,50). Is the vegetative soul "bad" and "inadmissible" because it is not a cause? Or is it a cause that is bad for some

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other reason; namely, that it doesn't advance our understanding? (For a defense of the former option, see Amijee [2024]; for the latter, see Wells [2021].)

Du Châtelet does not explicitly call the connections between simple beings "causes." And she tells us that the chain of actualization and intelligibility for each state of each being traces back to God's wise choice of the most harmonious world, which sounds a great deal like preestablished harmony. If you emphasize the intelligibility part of causation, the relationships between the simple beings might sound close enough to causes, given that they represent an in-principle intelligible order among beings. However, if you emphasize the actualization condition of Du Châtelean causes, they do not—the state of one simple being does not, it seems, bring about the actualization of the state of another.

Brading's case for reading these relationships as causal rests on her account of the goal of the *Foundations*—specifically, on the role that these relationships must play in establishing causal foundations for physics. But if the goal is to establish that *bodies* are genuine causes, we still have a ways to go. That is because body, according to Du Châtelet, is a mere phenomenon that results from our confused representation of many simple beings. We "necessarily" represent many simple beings as spatially extended because, having no access to the internal realities that distinguish them from one another, we can represent them as distinct only by representing them one outside of the other. (§§52,77,133,134). There is "nothing substantial" in bodies beyond the simple beings, and the "original reasons for all that happens in bodies" are ultimately caused by these simple beings (§134). This makes it hard to see how bodies, as opposed to simple beings, can be genuine causes.

And yet, Brading's case that that Du Châtelet was motivated to provide an account of bodies as causes is convincing. After despairing in the manuscript version of the *Foundations* that the action of one body on another and the nature of force are "mysteries . . . concealed from us mortals" (67–68), Du Châtelet concludes that physics cannot do without an account of bodily force. It is this conviction that leads Du Châtelet to make force part of the essence of matter. Brading describes Du Châtelet's argument for this as "a bit of a leap," but proposes that we "interpret [force] modestly," as whatever ensures the distinctness of a body from others and its ability to change. Ultimately, Du Châtelet defines (bodily) force as "the principle that contains the sufficient reason for the actuality of any action" (IP §126), clearly connecting the nature of bodies, and the causes of their actions, with the (methodological) PSR.

On this telling, the argument from the PSR to bodily causes does not really need to pass through the metaphysically extravagant monadology, even if that does play a supporting role. And maybe this is exactly the point. After all, Du Châtelet admits that we can deduce very little of true causes from the first principles of our knowledge. This is why we must content ourselves with empirical methods, which at least allow us to "crawl from probability to probability" (§55).

But then I wonder in what sense the connections between the simple beings and the connections between bodies both count as causes, and whether and how they are related, and whether one or another is more "genuine." I wonder exactly how, as Du Châtelet triumphantly announces,

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> from the Metaphysical union of the Elements among themselves flows the Mechanical union of the Bodies that we see; for all mechanics that falls under our senses derives in the end, and in going back to the first source, from superior and Metaphysical principles. (§188)

I think Brading would reply by identifying the "metaphysical elements" not as simple beings but as the conceptual, a priori presuppositions required for us to have knowledge of causes. This sounds a bit Kantian, and indeed Brading argues that Du Châtelet's project is one that has been attributed to the precritical Kant: that of trying to resolve the metaphysical and physical perspectives to provide physics with an intelligible framework. Understood that way, the projects of physics and metaphysics are entwined and complementary; neither can proceed without the other. This—and Brading's book more generally—brings out Du Châtelet's pioneering place among eighteenth-century philosophers who were carefully thinking about how it is possible that what makes the world intelligible for us reflects how things in fact are. For context, the *Foundations* was published one year after the first two chapters of Hume's *Treatise* and about a decade before Kant's earliest writings. Like theirs, Du Châtelet's project is enormously ambitious, and raises some familiar questions, like whether, which, and in what sense certain elements of her system lean toward realism or idealism, and how exactly to think about the epistemic normativity of our forms of reasoning. And Brading and Du Châtelet remind us of how deeply these other projects, so central to development of philosophy more generally, were inspired by emerging science.

Brading goes on in the final chapter of her book to show how Du Châtelet applies her new conception of body, and her methodology, to problems in physics. I have run out of space to do justice to this chapter, but it is masterful, considering in detail Du Châtelet's treatment of Newtonian attraction and gravitation, her contribution to debates over the *vis viva*, and her evaluation of mechanism. Especially worthy of note is a likely less familiar topic: the physics of collisions. Along with her co-author Marius Stan, Brading has done groundbreaking and authoritative work on the philosophical mechanics of the eighteenth century, describing Du Châtelet as having "the most promising attempt at an integrated, causal-explanatory account of collisions from the first half of the 18th-century" and yet one that is "riddled with problems" (15). Here, Brading discusses both these successes and failures.

To close, let us return to Du Châtelet's metaphor, that of the great edifice that is physics. Newton was surely after a similar sentiment when he wrote that he saw as far as he did only by standing on the shoulders of giants. But I like Du Châtelet's metaphor better. I like the idea that we are constructing something, together, as much as we are propping each other up to survey the landscape. And building involves a great number of different and valuable tasks, one of which is going down to inspect and refurbish the foundations, both philosophical and historical. I am grateful to Brading for her work, alongside others, in bringing Du Châtelet back to us, her philosophical insight, and her spirit of community. We are lucky that Du Châtelet and Brading are on the construction crew.

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