
Maupertuis on attraction as an inherent property of matter

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11.1 Introduction

I begin with a caveat. This paper examines Maupertuis from the very particular perspective of two issues that come together in his *Discours*: (1) The history of regularity-based defenses of Newtonian gravity, that is, the tradition, originating in Newton himself and prominent in the early eighteenth century, of defending the law of gravity as a mere regularity, not requiring any account of underlying causes.¹ Maupertuis, in the *Discours*, is one of the most influential exemplars of this tradition, but he also steps firmly beyond it, as will be detailed in what follows. (2) Lockean Newtonianism, that is, the uses of Locke's thought, especially his skepticism about knowledge of real essences, as a resource for the defense of Newton. Such Lockean themes are prominent too in the *Discours*.² In this paper I examine the *Discours* from both of these perspectives, hoping to illuminate both the text itself and a delicate episode in the history of philosophy of science.

First, however, I examine an important point of comparison: Willem Jacob Van 'sGravesande's 1720 text, *Physices elementa mathematica, experimentis confirmata*. I should, therefore, say a bit about the special importance of these two texts in the context of the defense of Newton. Newton appeared to require defense because Newtonian gravity was widely perceived to face a problem:³ it

1 Of course, the question of Newton's considered view of the status and source of gravity is a tortured one, and even the seemingly simpler question of his position in the *Principia* is subtle, as has been emphasized recently in the work of Stein, Smith, and Janiak (among others). There is no doubt, however, that Newton's own words inspired a regularity defense. Notably, Newton states that he treats forces, including attraction, mathematically, not physically (Newton 1999, pp. 408, 589), suggests that this leaves questions about the causes of attraction open (589), and disavows hypotheses about the cause of gravity (943, this in the General Scholium, where he is responding to criticism).

2 In "Locke's Newtonianism and Lockean Newtonianism" (Downing 1997) I discuss some of this same material towards the end of better articulating Locke's complex attitude towards the natural philosophy of his day.

3 Indeed, it was perceived to face multiple related problems.

could not be straightforwardly linked to an acceptable metaphysics, for treating attraction as a genuine physical quality violated standard doctrines about the passivity of body. One prominent strategy for defending Newton took its initial cue from the Newton of the *Principia*, who eschewed speculation as to the cause of gravity, and thus apparently treated gravity as a manifest effect and avoided linking his dynamics to metaphysics.⁴

This defense of Newton, however, left many readers unsatisfied. Firstly, since many passages in the *Principia* seem to describe gravity as an attractive force, intrinsic to bodies, allowing them to affect distant bodies, it is natural to take such talk literally, lacking any developed alternative interpretation.⁵ Furthermore, as Cotes pointed out to Newton himself in correspondence, Newton's application of his third law to gravitational attraction between distant bodies (Book III, prop. V, corr. 1) appears to require that bodies be able to act directly on one another at a distance.⁶ Secondly, Newton's evasive tactics raise pointedly the question of whether scientific explanation can be had in the absence of causal explanation. Both these issues were, of course, highlighted by Newton's critics, who argued, in effect, that Newton was attributing gravity to bodies as an (unintelligible) intrinsic attractive power, or he was proposing a perpetual miracle, or he was offering up a radically incomplete theory.⁷

A number of early Newtonians, saw that a way out of this impasse might be provided by the following basic strategy: Treat physics and metaphysics as separate domains, the former concerned with regularities among the phenomena, the latter with underlying causes. Reconceive scientific explanation accordingly: if an occurrence can be deduced from a more general principle or system of principles, it has been given a scientific explanation. This strategy begins

4 Again, there are many issues of Newton interpretation lurking here. One question is whether Newton is consistent in this position, even within the *Principia* (the General Scholium, for example, seems to verge on speculation about the cause of gravity). A further question is what it is to treat gravity as a manifest effect. Stein and Janiak have in effect argued that this doesn't rule out some modest ontology: that for Newton gravity is a natural power of bodies (Stein 2002), that gravity is itself a cause, though one not yet physically characterized (Janiak 2008).

5 See (Heilbron 1982, p. 40) and McMullin (1978, p. 116).

6 See Newton (1850/1969, p. 153). Newton's reply apparently neglects the problem raised by Cotes, and simply asserts that universal gravitation is proven from the phenomena. For more discussion, see Koyré (1968, pp. 273–283), Janiak (2008, pp. 168–174).

7 Leibniz, Newton's most philosophically distinguished critic, in effect assumes that Newton must be giving some sort of causal account and thus makes the first two criticisms (Leibniz's letter to Hartsoeker, published 1711, in Newton 2004, pp. 111–112). He implicitly holds that without a causal account, it is not a genuine piece of physics. This last charge can be found explicitly in the early anonymous review of the *Principia* in the *Journal des Sçavans*, wherein the author complains that Newton writes as a geometer, not a physicist, and thus supplies a mere mechanics, but not, as yet, a physics (Cohen 1971, pp. 156–157). Versions of all three charges can be found in Fontenelle's much later *Théorie des Tourbillons Cartésiens* (1752).

from Newton's remarks in the *Principia*, but isolates this tendency, develops it, strengthens it, and makes it explicit. Two enormously influential examples of this strategy were Willem Jacob Van 'sGravesande's 1720 text, the *Elementa*, and Pierre Louis Moreau de Maupertuis's 1732 tract, *Discours sur les différentes figures des astres*.

'sGravesande's book appeared in two different English translations in 1720, immediately following its first publication in Latin.⁸ It was widely disseminated and treated as an authoritative exposition of Newtonian physics and Newtonian methodology.⁹ It was, in particular, a strong influence on Maupertuis, whose *Discours* famously marked an official introduction of Newtonian gravity into the Cartesian bastion of the Académie Royale des Sciences in Paris.¹⁰ Moreover aspects of their approach to the defense of Newton can be found, to one extent or another, in a wide range of Newtonians, including Pemberton, Keill, Maclaurin, Voltaire, and d'Alembert. Further, I will show that the views put forward by 'sGravesande and Maupertuis in this context are of significant philosophical interest in their own right. Although the fact that early Newtonianism contains a "positivistic" streak has often been remarked upon,¹¹ not enough has been done by way of philosophical analysis of the relevant texts: 'sGravesande's *Elements* and Maupertuis's *Discours* are the most philosophically rich examples of this tendency and repay serious study. Indeed, Maupertuis's *Discours* contains the best developed defense of attractionism per se of any published work in the period. Moreover, as I will argue below, the philosophy of science presented in it is complex and points beyond the more straightforwardly positivistic line carried over from 'sGravesande.

11.2 'sGravesande

The Dutch natural philosopher 'sGravesande's Newtonian credentials were impeccable, having been cemented by a 1714 trip to England, which resulted in his election to the Royal Society and personal acquaintance with Newton. After returning to Holland and taking up a professorship at Leiden, where he himself was educated, he turned to the composition of the *Elementa*, subtitled (in translation) "An Introduction to Sir Isaac Newton's Philosophy."

8 I quote from Desagulier's 1721 (second edition) translation below. The other translation is credited to Keill.

9 See Heilbron (1982, p. 45), Thackray (1970, p. 102), Ruestow (1973, pp. 113–139). A. Rupert Hall has called it the most influential book of its kind, at least before 1750 (Hall 1970, p. 510). On 'sGravesande's importance more generally, see Cassirer (1951, pp. 60–64).

10 As briefly discussed below, aspects of Newton's work were already influential in France.

11 E.g. Heilbron (1982), Hankins (1970, p. 3).

11.2.1 *Defense of the necessary priority of laws*

The preface to ‘sGravesande’s *Elementa* is in no way an explicitly polemical work. Nothing about its measured tones suggests a response to controversy, or even an acknowledgment of controversy. Nevertheless, this introduction to the introduction to Sir Isaac Newton’s philosophy clearly functions as, and was intended to function as, a defense of Newton. Although ‘attraction’ occurs not at all in the preface, and gravity is only mentioned once, the preface contains, as we will see, the ingredients of a powerful and influential defense of attractionism, and, more generally, significant developments in philosophy of science.

The preface begins by articulating two recurring themes: (1) The subject matter of physics is the laws that God has prescribed to the Universe. (2) An epistemic modesty becomes us in questions of natural philosophy, for “What has led most People in Errors, is an immoderate Desire of Knowledge, and the Shame of confessing our Ignorance,” but “there is a learned Ignorance that is the Fruit of Knowledge, and which is much preferable to an ignorant learning” (*Elements*, I, p. viii). These two themes are quickly joined, however, as ‘sGravesande attempts to justify his claim that the natural philosophers must seek empirical laws, rather than pursuing a more Cartesian method. This justification is based on an account of our limited epistemic situation:

What Substances are, is one of the things hidden from us, We know, for instance, some of the Properties of Matter; but we are absolutely ignorant, what Subject they are inherent in.

Who dares affirm that there are not in Body many other Properties, which we have no Notions of? And who ever could certainly know, that, besides the Properties of Body which flow from the Essence of Matter, there are not others depending upon the free Power of GOD, and that extended and solid Substance (for thus we define Body) is endowed with some Properties without which it could exist. We are not, I own, to affirm or deny any Thing concerning what we do not know. But this Rule is not followed by those who reason in Physical Matters, as if they had a compleat Knowledge of whatever belongs to Body, and who do not scruple to affirm, that the few Properties of Body which they are acquainted with, constitute the very Essence of Body.

(*Elements* I, p. xi)

Our knowledge of some properties of bodies does not amount to knowledge of the essence of body. Moreover, even if we did know the essences of bodies, we could not rule out that bodies had other, inessential, qualities, bestowed upon them by God.¹²

¹² A direct appeal to superaddition is also found in Keill (1809, p. 419) (originally published in 1708), where the topic is a short range attractive force distinct from gravitational attraction.

These reflections sound, of course, thoroughly Lockean. They begin from the undeniably Lockean point that we are ignorant of the real essences of things, including the essence of body in general. Interestingly, they proceed in a way that suggests two common misreadings of Locke. First, 'sGravesande suggests that God might superadd to bodies qualities which do not flow from their essence. Although many, including Leibniz, have understood Locke to have suggested as much in his correspondence with Stillingfleet, in my view he was a consistent essentialist; his talk of superaddition is not meant to suggest that God might attach to bodies qualities that do not derive from their actual real constitution.¹³ The problem, as we will see later, lies in 'sGravesande's failure to cleanly distinguish between nominal and real essence. Further, the paragraphs that follow suggest that 'sGravesande has conflated essences with logical subjects, in a way that could easily be inspired by a reading (or misreading) of 2.23 of Locke's *Essay*:¹⁴

What do they mean by saying that the Properties of Substance constitute the very Substance?

*Can those Things subsist when joyn'd together that cannot subsist separately?
Can Extension, Impenetrability, Motion, &c. be conceived without a Subject
to which they belong? And have we any Notion of that Subject?*

(*Elements* I, p. xi)

Nevertheless, we can see here a reasonably effective, if rather basic, argument against a Cartesian-style strict mechanism. 'sGravesande assumes that we have no insight, no intellectual intuition, into the natures of things. Given this, there cannot be any grounds for a demand that all the properties we observe bodies to have be reducible to a mechanistic short list of preferred, supposedly essential, qualities.

'sGravesande's further goal, however, is to defend the general irreducibility of laws in natural philosophy:

*It is past doubt, for instance, That a Body once mov'd continues in Motion:
that Reaction is always equal and contrary to Action. And several other such
Laws concerning Body have been discovered: which can no way be deduced*

¹³ See Downing (2007).

¹⁴ Michael Ayers has argued convincingly that Locke did not think of "substance" as an entity distinct from all properties, i.e. as an in principle unknowable logical subject. However, 'sGravesande was certainly not the last to read Locke in this way. (See Ayers 1977, especially p. 78.)

Of course, I don't mean to suggest that 'sGravesande was particularly interested in Locke interpretation. Nevertheless, it is worth examining how Lockean doctrines appear, sometimes altered or distorted, in many Newtonians. For an interesting discussion of a variety of ways in which 'sGravesande is influenced by and responds to Locke, see Schuurman (2004, pp. 129–155).

from those Properties that are said to constitute Body; and since those Laws always hold good and upon all Occasions, they are to be look'd upon as general Laws of Nature. But then we are at a loss to know, whether they flow from the Essence of Matter, or whether they are deducible from Properties, given by GOD to the Bodies, the World consists of; but no way essential to Body; or whether finally those Effects, which pass for Laws of Nature depend upon external causes, which even our Ideas cannot attain to.

(Elements I, p. xii)

Not even the most basic laws of motion, including the inertial law that a body in motion continues in motion unless opposed by some force, can be deduced from the qualities some deem to be essential to bodies. The aim and end of science, then, can only be the articulation of such laws:

It appears then sufficiently, what is the End of Physics, from what Laws of Nature the Phenomena are to be deduc'd, and wherefore when we are once come to the general Laws, we cannot penetrate any further into the Knowledge of Causes.

(Elements I, p. xiii)¹⁵

We should pause, at this point, to note some possible objections, not from the perspective of a Cartesian who would defend the real use of the intellect in identifying essences, but from the perspective of an influential set of early Newtonians: Whiston, Bentley, and Clarke. 'sGravesande's position that we can make no claims about the essence of body brings him into fundamental disagreement with this trio. They unanimously maintained that we *can* draw conclusions about the nature of body from experience. Furthermore, they would have rejected 'sGravesande's claim that the law of motion according to which every body in motion remains in motion cannot be shown to follow from the essence of body. On the contrary, Whiston and Clarke both held that this law flows directly from the passive nature of matter – as a passive

15 It is interesting to contrast Maclaurin (1748/1968) here, who is similarly empiricist and anti-metaphysical (for example, attributing to Newton the view that "metaphysical considerations . . . had often misled philosophers, and had seldom been of real use in their enquiries" [p. 8]) but who nevertheless would dissent from this last statement. Like 'sGravesande, Maclaurin defends Newton as not having attempted to give the cause of gravity, but suggests that "the tracing the chain of causes is the most noble pursuit of philosophy; but we meet with no cause but what is, itself, to be considered as an effect, and are able to number but few links of the chain" (p. 17). Thus, science aims at tracing the chain of causes, although at any point in time, we will have to stop somewhere. Maclaurin treats the ether as one speculative hypothesis about the cause of gravity, and implies that further progress on this issue is not ruled out.

D'Alembert, by contrast, positions himself much more closely to 'sGravesande (as well as to Berkeley) by treating mechanics as "the science of effects, rather than the science of causes" (D'Alembert 1743/1967, p. xxiii; see also Hankins 1970, p. 153).

entity it has this one negative power.¹⁶ More importantly, in their view, from our observations of the passivity of matter, we can conclude that attraction *could not* flow from its essence. Given that attraction cannot simply be due to bodies as they are in themselves, it must be due to God. However, if it is asked how God could bestow such a quality upon bodies, all three of these authors conclude that he must do so by a continual activity.¹⁷ Thus, Clarke, Bentley, and Whiston conclude not with metaphysical agnosticism but with a particular metaphysical account of attraction as God's action. 'sGravesande's failure to convincingly address the issue – Why can we not draw conclusions about essences from experience?– leaves him vulnerable to attack from this quarter. Maupertuis's case, as we will see, is somewhat different, both because his discussion of essence is more nuanced and because he does not attempt to close off connections between physics and metaphysics.

11.3 Maupertuis

Pierre Louis Moreau de Maupertuis was a member of the Académie Royale des Sciences in Paris from the age of 25. His most celebrated early work, the *Discours sur les différentes figures des astres*, was, like 'sGravesande's *Elementa*, written not long after an influential trip to England. Although historians such as Thackray (1970, pp. 83–101) and Guerlac (1981, pp. 41–73)¹⁸ have made clear that many aspects of Newton's thought were widely discussed, even accepted and transformed, among French natural philosophers quite soon after their initial publication, Maupertuis's discourse is still a remarkable historical document, for it represents the first public defense of attractionism in the Paris Academy, where Cartesian ideology still dominated. It thus represents a crucial stage in the early career of Newtonianism in the Cartesian stronghold of France.¹⁹

16 Clarke (1738, II, p. 697), Whiston (1696/1978, p. 6). Interestingly, 'sGravesande sounds much more like Clarke or Whiston in his later commentary on the first law of motion:

We see that Bodies by their Nature are inactive and incapable of moving themselves; wherefore unless they be moved by some extrinsical Agent, they must necessarily remain for ever at rest.

(*Elements* 1: 49)

17 See Clarke (1738, II, p. 601), Whiston (1696/1978, p. 218), Bentley (1838/1996, III, p. 168). I thus disagree with John Henry's (1994a) contention that Bentley proposes (and Newton accepts) an account of gravitational attraction as a superadded quality. Unfortunately, I cannot provide a full discussion of Henry's interesting case here.

18 And more recently J. B. Shank 2004.

19 See Beeson (1992), Brunet (1931), Thackray (1970, p. 96). It should be noted that the views Maupertuis expresses so ably in this early work are not necessarily representative of those he held later in his career. In particular, although Maupertuis retains a Lockean skepticism about knowledge of the essence of body, his views about the relation of physics and metaphysics clearly evolve from those suggested in the *Discours*. For example, when it came to his principle of least action, Maupertuis seemed willing to allow that metaphysical

Maupertuis's discourse is also notable for its philosophical content: it contains one of the best developed defenses of attractionism of the period. The second chapter of Maupertuis's discourse is devoted to a "discussion métaphysique sur l'attraction," in which Maupertuis seeks to identify and defuse sources of resistance to Newton's theory of gravity. Thus, unlike 'sGravesande, Maupertuis specifically acknowledges the existence of a dispute "which divides the greatest philosophers" (*Discours*, p. 10).²⁰ He strategically underplays, however, his own role as a polemicist in that dispute, claiming that he will not "pronounce" on the question but only "compare the ideas" of the two (*Discours*, p. 10).

11.3.1 First facts vs. causal explanations

As Maupertuis depicts it, the central dispute between Cartesians and Newtonians concerns the question of whether gravity ought to be regarded as the effect of circulating vortices of matter, or whether it may be treated "as if it were an inherent property of bodies" "without looking for its cause" (*Discours*, p. 10). Maupertuis's initial defense of the Newtonian position emphasizes this last proviso, stating that Newton himself officially treats universal attraction or gravitation as a fact, not a cause, leaving open the possibility of a deeper causal explanation in terms of subtle matter, perhaps even a fully mechanistic one (*Discours*, p. 12).²¹ This in itself, of course, as we have already seen, is not an original point; indeed, the observation that Newton did not claim to have settled the causes of gravity was a sort of Newtonian piety, found, e.g., in the writings of Keill (1758, p. 4), Desaguliers (1734, pp. 6, 21), Maclaurin (1748/1968, p. 10), and Voltaire (1741, p. 186).²²

This strategy, however, motivates the following question: Does a theory which fails to provide an acceptable causal explanation of the phenomena it discusses count as an acceptable piece of natural philosophy? In returning a positive answer to the question, Maupertuis follows 'sGravesande, but Maupertuis's handling of the question is more direct and is specifically focused on the question of gravity. Whatever gravity may be, he argues, it is always a "first fact," from which one can depart in order to explain the other facts which depend on it (*Discours*, p. 12). "Every regular effect, though its cause be unknown, may be the object of the Mathematicians" (*Discours*, p. 12), and the

argument might have direct implications for natural philosophy. This presumably reflects the increasing Leibnizian influence on his later thought.

20 Translations of Maupertuis's text are my own. All references to the *Discours* are to the original 1732 edition, unless otherwise noted.

21 As Janiak's work reminds us, Maupertuis's interpretation of Newton, while hardly idiosyncratic, may not be entirely correct. The claim that the *Principia* does not aim to settle the causes of gravitational attraction does not entail that gravitational attraction may not itself be regarded as a cause.

22 Also, it is mouthed by Whiston, Bentley, and Clarke.

resulting theory is indeed explanatory: it explains the phenomena which can be deduced from it:

Galileo, without knowing the cause of the gravitation of bodies towards the earth, did not fail to give us a very beautiful and very sure theory on this gravity and to explain the phenomena which depend on it.

(*Discours*, p. 12)

Maupertuis is thus making the methodological point that universal attraction may be taken as a first principle for physics, whether or not it is metaphysically primary, that is, whether or not gravitational attraction can be causally reduced to some more fundamental properties of bodies. Maupertuis buttresses this position by arguing that ultimate causal explanations elude us in any case, so it would be a mistake to insist on them when it comes to gravity: “I do not believe that it is permitted to us to ascend to first causes, nor to comprehend how bodies act upon one another” (*Discours*, p. 13). He concludes this part of his case for Newtonian gravity by suggesting that the search for the cause of this force might be left “to more sublime Philosophers” (*Discours*, p. 13), implying that it is not a task for natural philosophers.

Again, the suggestion that the pursuit of physics can be divorced from metaphysical questions about underlying causes, coupled with and supported by an agnosticism about ultimate causes, is highly reminiscent of ‘sGravesande. What is most interestingly different about Maupertuis is that, unlike his Dutch colleague, he is drawn back into the question of the causes of gravity, albeit framed in terms of possibility rather than actuality.

11.3.2 Attraction as intrinsic quality, real vs. nominal essences, and primary qualities

As we have seen, Maupertuis’s first defense of Newtonianism invokes agnosticism about causes. Nevertheless, his next step is to address the question of whether a causal account which makes gravity the effect of an inherent attractive power in matter can be ruled out a priori as a “*Monstre métaphysique*” (*Discours*, p. 13). A first question to ask here is why Maupertuis felt compelled to address this question. If regularities may be taken as first principles, why is any further defense of attraction required? Maupertuis’s willingness to answer this challenge at length suggests that he believes that if we are in a position to rule out a priori the possibility of an inherent property of attraction in matter, the Newtonian is in trouble. The difficulty is two-fold: (1) If the question of the existence of intrinsic attractive powers can be definitely settled, then progress can evidently be made on this relatively metaphysical front, which suggests that neglecting it may not be a legitimate strategy. (2) If the question is settled in the negative, then the insistence that some other explanation (whether Cartesian impact or God’s action) must be available and ought to be sought

looks correspondingly compelling. This Newtonian predicament is neatly flagged by Maupertuis in his subtle first characterization of Newtonianism: the Newtonians treat gravity *as if it were an inherent property*. For example, the rather frequent Newtonian protest that, for all they knew, gravity might be produced by impulse,²³ was pretty clearly disingenuous: for a mechanical model which worked by simple impact would make gravity proportional to surface area,²⁴ and, while ether hypotheses were floated to explain gravity, the ether invoked was typically elastic, i.e. characterized by interparticulate attractive and/or repulsive forces.²⁵ Maupertuis seeks to *legitimate* the “as if” of attractionism by arguing that the possibility that attraction is an inherent property²⁶ of bodies cannot be eliminated.²⁷

We would be in a position to definitively rule out or affirm attraction, Maupertuis asserts, were our epistemic situation quite different from our actual one:

23 An example is provided by Maupertuis, although he seems to attribute the claim to Newton, rather than endorsing it himself:

Newton . . . often stated . . . that it might even be that this tendency was caused by some subtle matter emitted by bodies, and was the effect of a veritable impulsions.

(Discours, p. 12)

24 Newton made this point against the Cartesians in the General Scholium (Newton 1999, p. 943). It is echoed, for example, in Voltaire (1738/1967, p. 201), and Maclaurin (1748/1968, p. 387).

25 This was certainly the case with the ether of Newton’s 1717 Queries to the *Opticks*. See McGuire (1977, p. 117) and Heimann and McGuire (1971, p. 242).

26 Maupertuis uses the terminology of inherent property, “propriété inhérente.” I understand this as meaning the same as “intrinsic”; thus, the question at issue is whether attraction can be regarded as if it were a property seated in each body. The contrast would be an extrinsic quality, externally imposed, e.g. by an aether or by God’s continuous action. If attraction were intrinsic, this still leaves open the question of whether or not it is primordial, that is, an ultimate quality irreducible to more fundamental qualities (which is one thing that might be meant by calling attraction an essential quality). It also leaves open the question of whether or not we would call something matter/body only if it possessed attraction (which, following Boyle and Locke, is another thing that might be meant by calling attraction an essential quality). Newton famously disavows the claim that gravity is essential to matter (1999, p. 796). Maupertuis does not pronounce on this question here, though as we will see below he allows that for all we know gravity could be a primordial quality.

Eric Schliesser (2010b) has argued that Newton himself, in his (posthumously published) *Treatise of the System of the World*, treats gravity as an interaction, thus something relational, but an interaction partially grounded in an intrinsic property of all matter. Maupertuis does not specifically consider this position, but I suspect he would include it under his broad “as if” characterization, since it holds that gravity derives from an intrinsic property of all matter.

27 ‘s Gravesande in effect does this as well by arguing that there is no reason to demand reducibility to mechanist qualities, but the argument is considerably less systematic and satisfying.

If we had complete ideas of bodies, such that we well understood what they are in themselves, and what their properties are to them, how and in what number they reside in them; we would not be at a loss to decide whether attraction is a property of matter. But we are very far from having such ideas; we only know bodies by a few properties, without knowing at all the subject in which these properties are united.

(*Discours*, pp. 13–14)

The counterfactual situation described by Maupertuis here is one in which we would know the real essences of bodies – that which they are in themselves and that which gives them their properties. This is clearly another version of the same Lockean point about our ignorance of real essences that we saw above in ‘sGravesande’s “Preface.”²⁸ Maupertuis’s version is more thoroughly Lockean, however.²⁹ For one thing, Maupertuis explicitly includes a version of Locke’s doctrine of nominal essences, noting that our actual situation is one in which we know not the real but only the nominal essences of bodies; that is, we know what co-existent observable properties we take to be characteristic of such and such a body (e.g. Rover) or such and such a type of body (e.g. gold):

We perceive some different collections of these properties, and that suffices for us to designate the ideas of such or such particular body.

(*Discours*, p. 14)

Furthermore, while ‘sGravesande’s grounds for asserting the unknowability of real essences seem to center on the uncharacterizability of the logical subject, Maupertuis’s argument, as we will see, is quite different. Indeed, his initial way of putting the point, in terms of our inability to understand how a thing’s observable properties hang together, bears a striking resemblance to some of Locke’s formulations in the earlier drafts of the *Essay*:

Hence it comes to passe that we have noe Ideas nor notion of the essence of matter, but it lies wholly in the darke. Because when we talke of or thinke on those things which we call material substances as man horse stone the Idea we have of either of them is but the complication or collection of those particular simple Ideas of sensible qualitys which we use to find united in the thing cald horse or stone . . . which because we cannot apprehend how they should subsist alone or one in an other we suppose they subsist & are united in some fit & common subject . . .

(Locke 1990, pp. 129–130)

28 A similar point is made by Voltaire (1738/1967, p. 182): “we know nothing at all of what Matter is; we know only some few of its Properties.”

29 Maupertuis’s admiration for Locke’s *Essay* was later made explicit in his 1743 address to the Académie française. He there describes Locke as having shown that “grammar” (what Locke calls the “doctrine of signs” at 4.21.4, which includes both words and ideas) lies at the foundation of the other sciences (Maupertuis 1756, III, p. 264), a belief that fuels his own *Réflexions philosophiques* (1740).

What we are missing, according to Locke, and what requires us to employ the obscure idea of substance in general, is access to real essences that would show us why particular sets of observable properties accompany each other as they do. In order to properly characterize *Maupertuis's* argument, however, we will need to examine its development in some detail.

Maupertuis begins by introducing a notion of primary or primordial property. Having accumulated sufficient experience of bodies to collect properties into nominal essences usable for distinguishing particular bodies or types of bodies, our next step, as human knowers, is as follows:

We advance one step further, we distinguish these properties into different orders. We see that while some vary in different bodies, some others are always the same; and from that we regard the latter as primordial properties and as the grounds of the others.

(*Discours*, p. 14)

The *universality* of extension and impenetrability, Maupertuis continues, leads us to put them in the order or category of primordial properties, and thus to regard them as intrinsic and irreducible qualities. He then distinguishes other properties which are less universal, belonging to bodies only when they are in a certain state, e.g. the property of moving other bodies at impact, which is found in all bodies in motion. Maupertuis argues, however, that these experience-based distinctions that we make among properties do not allow us to *exclude* any properties from bodies, other than those which are actually contradictory to universal properties:

We are right to exclude from a subject only the properties contradictory to those which we know are found in it: mobility being found in matter, we can say that immobility is not; matter being impenetrable, is not penetrable.

(*Discours*, p. 16)

At this point, however, we can pose the challenge to Maupertuis that we posed, on behalf of Clarke, Bentley, and Whiston, to 'sGravesande: Why can we not draw conclusions about essences from this uniform experience? Here we reach the core of Maupertuis's argument. He argues that, without an understanding of how the primordial properties stick together, so to speak, we cannot require that all other properties obviously reduce to them:

But again, was the collection of these properties necessary? And do all the general properties of bodies reduce to them? It seems to me that it would be to reason badly to wish to reduce them all to them.

(*Discours*, p. 15)

If we saw necessary connections among the known properties of body, e.g. if we apprehended that a body cannot be extended without being impenetrable,

we might have some grounds to suppose that we had grasped the real essence of body. This too, I think, is a genuinely Lockean thought: part of what appeals to Locke about mechanist natural philosophy is that the primary qualities it posits seem to be internally connected to one another. Maupertuis contends, however, that while this sort of understanding is not ruled out as a matter of logic, we clearly do not have it:

But is there some necessary connection between these properties? Could extension not exist without impenetrability? Should I foresee through the property of extension which other properties accompany it? That is what I do not in any way see.

(*Discours*, pp. 14–15)³⁰

Lacking this, we must be more modest in our claims:

It would be foolish to wish to assign to bodies properties other than those which experience has taught us are found in them; but it would perhaps be more foolish to wish, with a small number of properties scarcely known, to pronounce dogmatically the exclusion of all others; as if we had the measure of the capacity of the subjects, when we are acquainted with them only by this small number of properties.

(*Discours*, pp. 15–16)

Thus, we cannot suppose that we have a knowledge of the real essence of body which would allow us to proclaim that attraction is excluded from the nature of bodies.

Maupertuis's next step in his defense of attraction is to consider whether the notion of attraction as an intrinsic property of bodies is somehow incoherent or "less conceivable" than the properties commonly acknowledged to belong to bodies. He addresses this question by comparing the strict mechanist notion of impulse with its Newtonian competitor, attractive force:

Common people are not at all astonished when they see one body in motion communicate this motion to others; because they are accustomed to seeing this phenomenon, they are prevented from perceiving the marvelousness of it; but Philosophers . . . take care not to suppose that impulsive force is

³⁰ It is interesting that Maupertuis does not attempt to argue in the other direction, that impenetrability can exist without extension; thus he has not provided an effective argument that there are no necessary connections to be found here at all. It seems that he has in his sights especially the Cartesian claim that the essence of body is extension and all further properties follow from extension. Descartes of course maintained in his correspondence with More that extension does entail impenetrability (Descartes 1985–1991, III, pp. 362, 372).

more conceivable than attractive. What is this impulsive force? How does it reside in bodies? Who would have been able to divine that it resided in them before having seen bodies collide?

(*Discours*, pp. 16–17)

Maupertuis acknowledges the naturalness of mechanism and mechanist explanations, but maintains that this consideration ultimately ought to carry little weight. He argues that impulse is no more intelligible than attraction; experience has made the phenomenon of impulse familiar, but philosophers find that impulsive force is no more conceivable than attractive. Here Maupertuis again expands on a point made by Locke, namely, that impulse itself is not ultimately intelligible, for we cannot comprehend the communication of motion at impact.³¹ This led Locke to include the communication of motion, along with cohesion and the production of sensation, on the list of phenomena which we cannot explain except by appealing to God's omnipotence.³² Maupertuis concludes that impulse and attraction are on the same footing.³³ In doing so, he was followed by Voltaire, in his influential popularization of the Newtonian system, *Éléments de la philosophie de Newton*.³⁴

One possible response to the perceived problems with impulse, of course, is the occasionalist one put forward by Malebranche. Maupertuis, however, considers and neatly rejects this tactic, if it is employed for anti-attractionist ends:

31 Locke, of course, was not the first to discuss this problem. Malebranche, for example, uses it as one basis from which to argue for occasionalism.

32 See *Essay* 4.3.29:

the coherence and continuity of the parts of Matter; the production of Sensation in us of Colours and Sounds, *etc.* by impulse and motion; nay, the original Rules and Communication of Motion being such, wherein we can discover no natural connexion with any *Ideas* we have, we cannot but ascribe them to the arbitrary Will and good Pleasure of the Wise Architect.

33 Indeed, one might wonder why Locke never explicitly draws this same conclusion. Nevertheless, I believe that this was in the end Locke's view. The only privilege ultimately assigned to impulse over attraction is its peculiar naturalness, i.e., the fact that it coheres (via the all-important notion of solidity, which itself has dynamic implications in Locke's view) with the commonsense conception of body that we derive from ordinary experience.

34 See Voltaire (1738/1967, p. 85)

We ought to suppose, that we know no more of the Cause of Impulsion, than we do of that of Attraction. We even have not a greater idea of the one than the other of these Powers; for no-body can conceive why a Body has Power by them to move another from its Place.

Right below this remark, Voltaire recommends "Mr. *Maupertuis's* Metaphysical Discussion upon Attraction."

But perhaps someone will say that bodies do not have impulsive force at all. A body does not impress movement on the body that it strikes; it is God himself who moves the struck body, or who has established some laws for the communication of motions . . . If bodies in motion do not have the property of moving others; if when a body strikes another, the latter is only moved because God moves it, and has established some laws for this distribution of motion; by what right could one affirm that God could not wish to establish parallel laws for attraction [la Tendance]? As soon as it is necessary to appeal to an all-powerful agent whom only a contradiction stops, one must say that the establishment of parallel laws includes some contradiction: but that is what one will not be able to say; and so is it more difficult for God to make two distant bodies tend or move towards each other, than to wait to move them until one body has been struck by another?

(*Discours*, pp. 17–18)

While Maupertuis shows little sympathy for this sort of appeal to God's action,³⁵ he rightly observes that the attractionist has no difficulty telling the same story.³⁶

The last anti-attractionist argument considered by Maupertuis is billed by him as the most substantive (“le plus solide”) that can be made against attraction (*Discours*, pp. 18–19). This argument seeks to show that gravity is less intelligible than contact action by establishing that we see the necessity of some sort of contact action, since it logically follows from motion and impenetrability, two established properties of bodies, whereas we do not see the necessity of gravity. As Maupertuis puts it, if bodies are impenetrable, and one body moves against another, it cannot continue to move without penetrating it, therefore God *must* establish some law of impact (*Discours*, p. 18). However, it is not clear that God must establish a law of attraction. To this Maupertuis responds:

But if gravity were a property of the first order; if it were attached to matter, independently of the other properties; we would not see that its establishment was necessary, because it would not owe its establishment to the combination of other properties.

(*Discours*, p. 20)

Maupertuis's basic point is that the fact that attraction is not evidently necessary in the way that contact action arguably is, i.e. logically derivable from

³⁵ Despite Maupertuis's clear distancing of himself from the occasionalist element of Malebranche's system, J. B. Shank (2008, p. 287) has argued that the *Discours* invokes a Malebranchian skepticism about human understanding.

³⁶ This point has its parallel in Berkeley, for whom impulsive forces are no less problematic than attractive, while ideas can obey laws of attraction as easily as laws of impact.

uncontroversial properties of bodies (impenetrability and motion), does not count against its being a primordial property/property of the first order.³⁷

This passage is crucial to understanding Maupertuis's conception of a primordial property. What it demonstrates is that the primordial properties are not simply the universally experienced ones; i.e. the concept of a primordial property is not the concept of a universally experienced property. If it were, there would be no open question as to whether gravity is a primordial property or not: if it is universally experienced, it is, if not, not. Rather, the primordial properties are properties that are genuinely basic to body, i.e. irreducible to other properties. Gravity, Maupertuis suggests, may for all we know be one such property. In the above cited passages (*Discours*, p. 14) where universality is invoked, Maupertuis's point is to explain how it is that we come to take certain properties as primordial: we suppose that the properties we universally experience in body are its basic and irreducible properties. While it seems that Maupertuis regards this as an acceptable working assumption, it is clear from the example of gravity that he does not suppose that it settles the question.

Here again, Maupertuis's thought tracks Locke's with remarkable subtlety. Like Maupertuis's, Locke's prose suggests, at some points, that he is conflating epistemic and metaphysical versions of the primary/secondary quality distinction. However, both make an implicit distinction between the two. Both hold, moreover, that our epistemic version of the distinction, that is, our common-sense view about what the metaphysically primary qualities of bodies really are, is determined by uniformities in experience. Both agree, however, that these uniformities do not suffice to definitively identify the metaphysically primary qualities. What our universal experience gives us is the nominal essence of matter itself. The real essence of matter might in fact be quite different.

This gives us more than one possible metaphysical status for attraction. It might be a primary quality, part of the (otherwise unknown) real essence of matter. It might flow as a *consequence* from the unknown real essence of matter. Maupertuis's prose here suggests further that, unlike Locke, he would

37 In making this point he follows Cotes, who in his preface to the second edition of the *Principia* (1713) addressed the opponents of attraction as follows:

For either they will say that gravity is not a property of all bodies – which cannot be maintained – or they will assert that gravity is preternatural on the grounds that it does not arise from other affections of bodies and thus not from mechanical causes. Certainly there are primary affections of bodies, and since they are primary, they do not depend on others. Therefore let them consider whether or not all these are equally preternatural, and so equally to be rejected, and let them consider what philosophy will then be like.

(Newton 1999, p. 392)

not foreclose the anti-essentialist hypothesis that the irreducible properties of bodies in fact do not come united into internally connected categorical properties, i.e. real essences, and, thus, that attraction might be basic without being connected to such a real essence. Here, one might suggest that Maupertuis expresses a more Lockean view than Locke himself does. I've argued elsewhere that Locke never questions the essentialist metaphysics that he takes to be our natural metaphysics, required for the world to be in principle intelligible to us.³⁸ However, given that he held that our natural physics, Boylean mechanism, had in fact been defeated by experience, he should have regarded this metaphysical assumption as itself defeasible. Interestingly, when Maupertuis returns briefly to this issue again in a later edition of the *Discours*, in the concluding chapter, he hews slightly closer to Lockean essentialism, suggesting that "apparently" "if attraction has a place in Nature" "to the eyes of someone who understood the whole essence of bodies, attraction would be a necessary consequence of that essence." In our current epistemic situation, however, we can do nothing but refer to the will of God, who has somehow spread out ("répandre") attraction in matter (Maupertuis 1756, 1: 161).³⁹

11.3.3 Implications of Maupertuis's defense of attractionism

We have seen that Maupertuis's sophisticated defense of Newtonian gravity/attraction trades on the following thoroughly Lockean points: (1) A general knowledge of the natural world based on a grasp of ultimate causes eludes us; natural philosophy must therefore settle for experience-based regularities. (2) We know the nominal essences of bodies, but not their real essences; i.e. there are regularly recurring observable properties through which we identify bodies, but we don't comprehend the causal nexus of those properties. (3) Impulse itself is not fully intelligible, for the communication of motion at impact is inexplicable by us, given our corporeal concepts. However, in Maupertuis's hand they are mobilized towards a new end, the defense of attractionism.

But what, in the end, are the implications of that account? In particular, how well does Maupertuis's defense of the possibility of attraction as an intrinsic quality fit with the apparent metaphysical agnosticism of his opening remarks? It is worth remembering that Maupertuis had in fact billed this chapter as a sort of metaphysical interlude by titling it as he did. Nevertheless, he concludes by emphasizing that he does not claim to have provided a metaphysics of attraction and that he wishes to consider *questions de fait*:

38 Downing (2008, pp. 115–116), Downing (2007, pp. 378–380). Some amendment to this thesis might be required to take full account of *Essay* 4.10.18.

39 On the history of the *Discours* and the differences among its editions, see Terrall 2002, especially p. 76. This new final chapter dates from 1752.

All which we have just said does not prove that there is attraction in Nature; I do not have any further ambition to prove it. I only set out to examine whether attraction, even when one considers it as an inherent property of matter, was metaphysically impossible. If it were so, the most urgent phenomena of nature could not make it be received; but if it does not contain any impossibility or contradiction, one can examine freely whether the phenomena prove it or not. Attraction is no more, so to speak, than a question of fact; it is to the System of the Universe that one must look in order to find whether it is a principle which really has a place in Nature, to what extent it is necessary in order to explain the phenomena, or finally whether it is uselessly introduced to explain facts which are well explained without it.

(*Discours*, p. 21)

Maupertuis's position is cautiously stated, but nevertheless a view can be discerned here which is in some tension with his apparently forthright initial endorsement of 'sGravesande's law-based model of the aims of science.⁴⁰

Maupertuis's concluding remarks suggest that what he takes himself to have established with his "discussion métaphysique" is the following: (1) Abstract philosophical arguments *are* relevant to the question of the *possibility* of attraction as an inherent quality. (2) The balance of argumentation favors the position that such qualities *are* possible. (3) Given this, the question of the actual existence of attraction as an inherent quality must be settled by experience. This implies, then, that experience is in principle *capable* of settling this question. That is, we might determine (with probability, if not certainty) that the true cause of gravity is the intrinsic attractive powers of bodies.⁴¹ Of course, Maupertuis might still wave off questions of ultimate causes and manners of action as pertaining to "more sublime philosophers," and he can still retain his previous claims that reduction to regularity *suffices* for satisfactory explanation. Nevertheless, it seems that Maupertuis would not in the end endorse 'sGravesande's claim that "when we are once come to the general Laws, we *cannot* penetrate any further into the Knowledge of Causes" (*Elements* 1: xiii, my emphasis). Although Maupertuis is careful to end by framing the question of the existence of attractive powers as a mere question of fact, the fact in question seems no

40 A somewhat similar tension might be seen in Voltaire, who on the one hand calls attraction merely a "constant phenomenon," and on the other a property with which every atom of matter in the Universe is invested, and perhaps a primary cause or first principle (Voltaire 1738/1967, pp. 85, 236, 239). In the end, however, Voltaire is in this work closer to 'sGravesande than Maupertuis, for his notion of first principle is crucially vague, he uses 'property' loosely, and he states forthrightly that "this Attraction, is not, nor can be, the simple Power of one Body to draw another to itself" (Voltaire 1738/1967, p. 237).

41 His view thus recalls Cotes's in the preface to the *Principia*, but it is less radical. Cotes not only suggests that gravity is a primary property of bodies but implies that it is an essential one: "we should not conceive of any bodies that are not heavy" (Newton 1999, p. 391).

longer to be one of the “first facts” invoked in his initial defense, i.e. a mere regularity, but to be a fact about the nature of bodies. The *Discours*, in the end, veers closer to a genuine dynamicism or realism about attraction than at first appears.⁴² And, while it maintains that physics can *function* separately from metaphysics, it suggests that each may still have implications for the other.^{43,44}

42 This aspect of the *Discours* is commonly neglected; e.g. it seems to be missed by Hankins (1970, pp. 159–160).

43 A line that is in some respects similar had been taken by Pemberton (1728), who defends the finding of intermediate causes as a legitimate natural philosophical activity (p. 12) and notes that “it is not easy to determine, what properties of Bodies are essentially inherent in the matter, out of which they are made, and what depend upon their frame and composition” (p. 19). Nevertheless, he clearly takes this latter issue as a genuine question for natural philosophy, if a difficult one which we may not be able to resolve.

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