

DISCUSSION

Force and the Nature of Body in *Discourse on Metaphysics* §§17-18¹

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According to Robert Sleigh Jr., “The opening remarks of DM.18 make it clear that Leibniz took the results of DM.17 as either establishing, or at least going a long way toward establishing, that force is not identifiable with any mode characterizable terms of size, shape, and motion.”² Sleigh finds this puzzling and suggests that other commentators have generally been insufficiently perplexed by the bearing that the DM.17 has on the metaphysical issue. He notes that §17 of the *Discourse* is a presentation of “the argument of the *Brevis demonstratio* to the effect that Descartes erred in measuring force in terms of mass and velocity, rather than in terms of mass and the square of velocity,”³ and observes that, given this, it is initially plausible to think that Leibniz ought to have concluded the very opposite, for “if force were measurable in terms of mass and the square of velocity⁴—then force would be characterizable in terms of size (mass) and motion.”⁵

In this brief paper, I want to examine the solution that Sleigh offers to his puzzle, and present an alternative way of understanding the relationship between these two sections of the *Discourse*. More precisely, after considering Sleigh’s interpretation and raising some difficulties, I shall try to dissolve his worries by ascribing a rather different, and somewhat deflated role to DM.17 in Leibniz’s case for the DM.18 claim that “force is something different from size, shape, and motion.”⁶

In order to try to understand how the argument of DM.17 could do the job that he has assigned to it, Sleigh moves beyond the confines of the *Discourse* itself, and appeals to a letter that was written to Pierre Bayle in 1687. In this letter Leibniz presents a version of the *Brief Demonstration*,⁷ and then continues:

I will add a remark which is of consequence for metaphysics, I have shown that force should not be estimated by the composition of speed and size, but by the future effect. Nevertheless it seems that force or power is something real here and now, and the future effect is not. From which it follows that it will be necessary to admit something different from size and speed in body, unless we want to refuse all power to act to bodies. (G.III.48)

Sleigh interprets this passage as follows: The motive force of a given body at t should be measured by determining the amount of work that it could do by a certain time t' under appropriate conditions. Corresponding to this dispositional property

of the body at time t , there will be an occurrent property which realizes it, i.e., the motive force.⁸

This much is relatively clear from Leibniz's own words. The interesting question is how it leads us to the final conclusion that there must be something over and above size and speed in bodies, if we are to preserve their active power. Here Sleigh suggests that if we look for an occurrent property of body among extension and its modes, "the only plausible candidate is what Leibniz called impetus in the *Specimen dynamicum*, that is the composition of mass (size) and velocity (speed) at a given instant."⁹ But, he adds, this is precisely the measure that has been ruled out by the argument in §17 of the *Discourse*. For here Leibniz purports to show that there is a situation in which force is conserved but the product of mass (size) and speed (velocity) isn't. And while it is true that Leibniz is prepared to measure force by the product of the mass and the square of velocity, Sleigh does not regard this as a plausible candidate since "no one who utilized the machinery of a substance-mode ontology in [this] time period would have viewed the abstract composite entity consisting of a body's mass at t and the *square* of its velocity at t as a mode of anything." Thus, he concludes, on Leibniz's behalf, "there is no property identifiable with a mode characterizable in terms of size, shape, and motion, that yields the right results [...] So motive force is not a [...] mode of extension."¹⁰

Sleigh's reading of Leibniz's argument can be summarized as follows: According to Leibniz, the motive force of a body must be some occurrent property which grounds a disposition to produce work, the amount of which must be conserved in the universe as a whole over time. The only modification of extension that could serve this function is the product of size (mass) and speed (velocity). But, from the *Brief Demonstration*, we know that this quantity is not always conserved. Therefore, force is not a modification of extension, and we need to identify some other property if we are to maintain that bodies have a motive force.

While Sleigh's attempt to reconstruct Leibniz's reasoning has some prima facie plausibility, a closer examination of the way that he utilizes the information contained therein reveals several difficulties. One worry stems from the fact that Sleigh tries to explain the strategy of DM.17 and 18 by looking outside the *Discourse*. This would be fine if there were no alternative explanation to be found in the *Discourse* itself. But it is not clear that this is the case. I shall argue below that we can understand Leibniz's motivation for the views expressed in DM.18 and their relation to the argument of DM.17 solely on the basis of these sections and earlier parts of the same work. And with the argument understood this way, we shall be in a position to solve Sleigh's initial puzzle—albeit in a somewhat different way.

But before I consider this alternative approach, I want to raise a couple of further worries that count against Sleigh's account of the strategy that Leibniz adopts. The first concerns the characterization of Leibniz's employment of the *Brief Demonstration* in DM.17. As we have seen, Sleigh suggests that this argument shows that Descartes should have measured force in terms of mass and the square of velocity, rather than in terms of mass and velocity. But if we turn to the section itself, things appear somewhat different. Leibniz advertises this section as one in which he will show that God conserves the same force in the universe, but not the same quantity of motion.¹¹ However, it soon becomes clear that this is not his primary concern. Immediately after presenting the *Brief Demonstration*, he concludes "Hence there is a great difference between quantity of motion and force *which was what needed to be proved*."¹² Leibniz's real aim was to show that Cartesian quantity of motion (i.e., mass x velocity) should not be identified with force.¹³

Leibniz continues by offering an alternative measure of force. But this provides cold comfort for Sleigh's reading. For rather than offering the product of mass and the square of velocity, Leibniz suggests "the quantity of the effect that it [the force] can produce, for example, by the height to which a heavy body of a certain size and kind can be raised."¹⁴ It is true that Leibniz recognized that the product of mass and the square of the velocity of a moving body could serve as a measure of its motive force as early as 1678.¹⁵ But there is no evidence that it is intended to play any direct part in the argument of the *Discourse*.¹⁶

The second worry concerns Sleigh's interpretation of the Bayle letter. Here it seems that Sleigh's reading implies that force *could* have been an occurrent property of body understandable in terms of extension and its modifications. He leaves open the possibility that, had the numbers come out differently, Cartesian quantity of motion, or impetus, would have been an appropriate measure of force, and there would have been no outstanding problem regarding its metaphysical status. Thus, Sleigh's reading appears to present Leibniz as one who reaches the metaphysical conclusion largely on empirical grounds.¹⁷ This conflicts with the interpretation of DM.17 and 18 that I shall set forth below. But there are other reasons to think that we should be a little more cautious in following Sleigh's claim that the metaphysical thesis of DM.18 depends upon the physical result of DM.17. In a letter written to Johann Bernoulli on precisely this issue in July 1698, Leibniz says:

It is no more necessary to appeal to some higher thing when we set up our conservation of power than when the Cartesians set up their conservation of the product of mass and velocity; for neither can be derived from extension and impenetrability alone; and it would not be very philosophical to follow

Descartes and revert to the bare will of God. Whatever measure we adopt for quantifying the power that is conserved, it follows from the fact the force or action is not lost that there is something in body, other than extension and impenetrability. (GM.III.521)

Admittedly this letter postdates the *Discourse* by over a decade, and we must be cautious in assuming that Leibniz's views on this issue had remained static during the intervening period. Nonetheless, the claim here is simple, and in direct conflict with Sleigh's reading: Unless one is prepared to ascribe all power to God, as he claims the Cartesians do, then, *whatever* measure one adopted for the power, or force, that is conserved, there must be something in bodies over and above extension and its modes.

But as well as providing evidence against Sleigh's reading, this passage suggests something even more surprising, namely, that at least by this time in his career, Leibniz did not take the *Brief Demonstration* as relevant, in any direct sense, to the conclusions that he wished to draw regarding the relation between nature of force and nature of body. For Leibniz appears to claim that, even if Cartesian quantity of motion had proved to be an adequate measure of force, something would still have been required beyond extension and its modes in order to account for the nature of this force.

This is the very opposite of the assumption that drove Sleigh's reading of the relation between DM.17 and 18, and, for the remainder of this paper, I want to argue that there are reasons to believe that the Bernoulli letter presents the views that Leibniz held at the time of writing the *Discourse*.

Let us begin by returning to DM.18. Leibniz heads this section as follows:

18. The distinction between force and quantity of motion is important, among other reasons, for judging that one must have recourse to metaphysical considerations distinct from extension in order to explain the phenomena of bodies. (AG.51)

Given this heading, one might expect the result of DM.17 to figure significantly in what follows. However, closer examination shows that this is not the case. When Leibniz turns to the relevant issue in the body of the section, he states quite baldly, and without any reference to DM.17:

Now this force is something different from size, figure, and motion, and one can therefore judge that not everything that conceived in body consists solely in extension and its modifications as our moderns have persuaded themselves. (ibid.)

Clearly, this amounts to little more than a statement of the conclusion that Leibniz

is trying to establish, and, at this stage, it is tempting to follow Sleigh and look outside the *Discourse* for help. However, there is another passage which offers assistance from slightly earlier in the same section:

For if we consider only what motion contains precisely and formally, that is, change of place, motion is not something entirely real [...] But the force or the proximate cause of these changes is something more real. (ibid.)

This passage does not provide us with all we need for a coherent argument to the thesis of DM.18. However the view that Leibniz expresses here is suggestive, namely that force must be different from motion, because it lacks the requisite degree of reality. Why force should be treated as more real than motion is not entirely clear from what Leibniz says here. But the fact that it is the *cause* of motion appears to be significant.¹⁸ Nor does Leibniz explain why it is that motion cannot be said to be properly real in either §17 or §18. However, if we go back to DM.12 we find the following:

It is even possible to demonstrate that the notions of size, shape, and motion are not as distinct as is imagined, and that they contain something imaginary and relative to our perception, as do (though to a greater extent) color, heat and other similar qualities, qualities about which one can doubt whether they are truly found in the nature of things outside ourselves. (AG.44)

Here Leibniz extends his claim that motion is not entirely real to include the other modes of extension, shape and size. And, although we are not provided with Leibniz's demonstration,¹⁹ this passage makes it clear that he thinks of the perceptual relativity of the modes of extension as that which deprives them of absolute reality. More importantly, this passage provides us with the necessary information that we need to reconstruct Leibniz's argument for the claim that one must have recourse to something beyond extension and its modes to explain the phenomena of bodies. I suggest that it is something like the following:

- (1) Force, or the cause of motion, is required to explain motion. (from DM.18)
- (2) Force is more real than size shape and motion, and so something beyond extension and its modes.(from DM.18 & DM.12)
- (3) Therefore, something beyond extension and its modes is required to explain the phenomena of body.

I have not explained in any detail *why* Leibniz is committed to the premises of this argument. However, that is not my aim in here. All I wish to claim is that (1)-(3) provide us with a reasonable interpretation of Leibniz's main argument in DM.18, an argument to the conclusion that "one must have recourse to metaphysical considerations distinct from extension in order to explain the phenomena of

bodies.”²⁰ I think that it occurs more or less explicitly in that section, for the case of motion, and is easily reconstructed for the other modes when a previous section of the *Discourse* is brought into view.

If this interpretation is correct, it has a number of surprising consequences. Firstly, the argument as it appears in DM.18 is in no way *dependent* on the *Brief Demonstration* of DM.17. And secondly, and perhaps more importantly, it suggests, just as the letter to Bernoulli did, that no measure of force in terms of the modifications of extension could ever have provided Leibniz with a characterization of the nature of force. So, *pace* Sleigh, even if the *Brief Demonstration* had not provided empirical evidence that force and quantity of motion are distinct, there would still have been an outstanding issue regarding the nature of force and its relation to Cartesian extended substance.

Clearly, then, the question arises as to whether there is any connection at all between the two sections of the *Discourse* with which we began. Let us reconsider Leibniz’s remarks from the heading to §18. I think the answer is still ‘yes’ but not in the way that Sleigh appeared to want. Leibniz’s choice of language in the heading is significant. Notice he does not say that the distinction between force and quantity of motion *entails* the need for metaphysical principles beyond extension. Rather, it is important for *judging* that this is the case. It seems to me that there is a background assumption at work here which can make this more intelligible, namely, Leibniz’s belief that the relation between two notions was not sufficiently understood by his contemporaries.

In §17 of the *Discourse*, Leibniz notes that “Descartes and many other able mathematicians have believed that the quantity of motion, that is the speed multiplied by the size of the moving body, coincides exactly with the moving force,”²¹ and, even more explicitly, in the *Brief Demonstration*: “Descartes [...] held *motive force* and *quantity of motion* to be equivalent.”²² What the *Brief Demonstration* argument provides is empirical evidence that there is a distinction between these two categories and an immediate reason for rejecting the Cartesian philosophy of body, as Leibniz characterizes it. This leaves us a long way from the claim that this notion of force cannot be accounted for within the Cartesian metaphysics of body—the task ascribed to §17 by Sleigh. But its utility is clear, when considered as an argument intended for a broadly Cartesian audience; it is a propaedeutic which shows that widely held notions must be false. As Leibniz was to tell De Volder a decade later, when trying to persuade him of the virtues of his account of force:

I have learned that you find it more important to throw light upon the activity of substances than to estimate forces. I believe the same thing and approve of

your judgment. Yet it has always seemed to me that the latter question is the gateway through which to pass to the true metaphysics, since the mind is surely gradually freed from the false notions of matter motion, and corporeal substance which are held popularly and by the Cartesians (G.II.195[L.523]).²³

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¹ I shall use the following abbreviations to refer to Leibniz's texts throughout: **AG**. *Philosophical Writings*. Ed. and trans. by Roger Ariew and Daniel Garber. (Hackett: Indianapolis, 1989); **G**. *Die philosophischen Schriften von G.W. Leibniz*. Ed. by C.I. Gerhardt (Berlin, 1875-90. Reprint. Hildeshiem: Georg Olms, 1966); **GM**. *Mathematische Schriften*. Edited by C.I. Gerhardt (Halle 1849-63. Reprint. Hildeshiem: Georg Olms, 1963); **L**. *Leibniz: Philosophical Papers and Letters: 2nd. Edition*. Trans. by Leroy Loemker (Dordrecht: Reidel 1969); **LA**. *The Leibniz-Arnauld Correspondence*. Ed. and trans. by H. T. Mason (Manchester: Manchester University Press 1967); and **WF**. *Leibniz's 'New system' and Associated Contemporary Texts*. Ed. and trans. by R. S. Woolhouse and Richard Francks (Oxford: The Clarendon Press 1997).

² Robert Sleigh Jr., *Leibniz and Arnauld: A Commentary on their Correspondence*. (New Haven: Yale University Press, 1990) p. 117.

³ *Ibid.* The full, and somewhat lengthy, title of the paper that Sleigh refers to as the *Brevis demonstratio* is as follows: *A Brief Demonstration of a Notable Error of Descartes and Others Concerning a Natural Law, According to Which God is Said Always to Conserve the Same Quantity of Motion; a Law Which They Also Misuse in Mechanics*. It was originally published in the *Acta eruditorum* for March 1686 (GM.VI.117-19 [L.296-98]).

⁴ The term 'speed' is perhaps more appropriate here, since Leibniz is concerned with scalar rather than vector quantities. However, I have retained Sleigh's use of 'velocity' wherever this is essential for ease of understanding. Because of this, 'velocity' and 'speed' should be regarded as interchangeable ways of expressing the same scalar quantity.

⁵ Sleigh (1990, 117).

⁶ AG.51.

⁷ I shall refer to the argument that is common to the *Brief Demonstration*, DM.17, and the letter to Bayle as ‘the *Brief Demonstration*’.

⁸ Cf. Sleigh (1990, 117).

⁹ Op. Cit., 118. Cf. GM.VI.436(L.437).

¹⁰ Ibid.

¹¹ AG. 49.

¹² AG. 50 — italics added. Also see GM.VI.118(L.297) for the same point in the *Brief Demonstration* itself.

¹³ That Leibniz had this as his primary goal is also noted in Gregory Brown “‘*Quod ostendendum suspeceramus*’: What did Leibniz undertake to show in the *Brevis Demonstratio*?” *Studia Leibnitiana Sonderheft* 13 (1984) pp. 122-37; Daniel Garber “Leibniz: Physics and Philosophy,” in N. Jolley, ed. *The Cambridge Companion to Leibniz*. Cambridge: Cambridge University Press (1995) pp. 384 n.107; R. S. Woolhouse, *Descartes, Spinoza, Leibniz: The Concept of Substance in Seventeenth Century Metaphysics*. (London: Routledge 1993) p. 122.

¹⁴ AG. 50. The *Brief Demonstration* again follows the same pattern (cf. GM.VI.118[L.297]).

¹⁵ See Garber (1995, 279). The the view is found throughout Leibniz’s subsequent writings. See the letter to Arnauld of December 8, 1686 (LA.81); *Critical Thoughts on the General Parts of the Principles of Descartes* from 1692 (G.IV.370[L.395]); *A Specimen of Dynamics* from 1695 (GM.VI.245[L.443]); the letter to De Volder from 1698 (G.II.156); and *On Body and Force Against the Cartesians* from May 1702 (G.IV.398/GM.VI.104 [AG.255]).

¹⁶ Although I have suggested that the product of mass and the square of velocity is irrelevant to the concerns of DM. 17 and 18, there is also a problem with the way in which Sleigh rules this measure out in his analysis of the Bayle letter. Sleigh’s claim is that no one would have regarded such an “abstract composite entity” as a mode. One worry is the fact that he provides no direct evidence for this claim. But it is more puzzling that Sleigh rejects this possibility while allowing that Leibniz’s ‘impetus’, measured by the product of mass and velocity, is perfectly acceptable.

¹⁷ One might also wonder why Sleigh insists that there are no modifications of extension, other than impetus or Cartesian motion, that could serve as candidates for the job of motive force.

¹⁸ This is also suggested in *Specimen of Dynamics* from 1695 (GM.VI.276[AG.131]), and a letter to Jacquetot, written in 1703 (G.III.458[WF. 201]).

¹⁹Sleigh himself provides an excellent discussion of Leibniz's reasoning here (1990, 110-15).

²⁰ AG.51.

²¹ AG.49.

²² GM.VI.117(L.296). Also see WF.51; G.IV.398(AG.255); G.IV.540(L.587).

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