BOOK REVIEWS

Symposium on

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by Philip Beeley

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Review of Philip Beeley's *Kontinuität und Mechanismus*

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When referring to his first efforts in philosophy, particularly those contained in his *Hypothesis Physica Nova* and *Theoria Motus Abstracta*,[2] Leibniz would often introduce them with vaguely disparaging remarks, such as "When my philosophy was not yet mature...," or "Before I became a mathematician... ." This is understandable, I would think, in terms of his desire to show how much his thought had progressed since that time, especially in mathematics. But some commentators, on being confronted with the unsystematic style of these early works and the apparent contradictions of the theory of the continuum contained in them, seem to have interpreted Leibniz's disclaimers as amounting to a complete renunciation of them. At any rate, they have been correspondingly dismissive in their estimation of the content of these early works.[3]

The same cannot be said of Philip Beeley's *Kontinuität und Mechanismus.* Building on the pioneering work of Arthur Hannequin and Willy Kabitz early in the century,[4] Beeley provides a very erudite account of the early metaphysics that not only takes seriously Leibniz's own early attempts to solve the composition of the continuum, but uses these attempts as a standpoint from which to gain perspective on the origins of much of Leibniz's metaphysics.

Now at first sight this might seem to offer only a rather narrow field of view. For on a natural interpretation, the continuum problem belongs solely to the philosophy of pure mathematics. It is the problem of determining what, if any, are the elements of a continuous quantity. Is a line, for instance, composed of points, or of infinitely small line elements? If the latter, are these indivisibles, or infinitesimal divisible parts? Or is it perhaps not composable at all? So long as the continuum problem is understood in this way, it is hard to see how it could throw light on Leibniz's metaphysics. But as Beeley points out, Leibniz understood the problem in a wider sense, as pertaining to nature itself, and the composition of material bodies (p. 1). This is how it was generally understood in the seventeenth century: Is matter infinitely divisible, as the Aristotelians claimed, or is it only finitely divisible into atoms, as Gassendi, Magnen and others had countered? Is it infinitely divided into determinate (but unquantified) indivisibles and voids (Galilei), or into "indefinite particles" (Descartes)? Similarly with motion, space and time: is motion composed of an infinity of instantaneous tendencies to move? Is space composed of points, or time of moments? Understood this way, the continuum problem is already relevant to many of Leibniz's most characteristic philosophical positions.

But in fact, from the outset Leibniz conceives the problem even more broadly still. As Beeley shows, he is first confronted with it in his early student dissertations on jurisprudence, in connection with the distinction of continuous from disjunct or discrete wholes (4-6). And it was from the authors Leibniz studied in this connection that he first met the idea that continuous wholes are held together by a soul. In this, of course, one may already see a connection with theological issues. This connection is made explicit in the *Confessio naturae contra atheistas* of 1668, where Leibniz argues that magnitude, figure and motion are not derivable from the nature of body unless each body is united by a mind (the concurrent divine mind in the case of non-human bodies), and that the cohesion of atoms can be explained only by recourse to God. Thus from the outset Leibniz conceives the insuffiency of mechanism as stemming from an inadequate solution to the continuum problem, and it is not hard to see in this original concern with true wholes the seeds of his mature philosophy of monads.[5]

So I do not think Beeley needs further apology for taking the continuum problem as his fulcrum. Nor do I think he needs much defence for concluding his study with Leibniz's first attempts on the continuum prior to his move to Paris in 1672. As he says, the study of these youthful efforts is already justified by Leibniz's lasting preoccupation with the continuum problem throughout his philosophical career (7). Moreover, Beeley argues, "if one treats a period in the philosopher's thought that can stand on its own, one before his great mathematical discoveries as well as his meetings with celebrated contemporaries like Huygens, Arnauld, Malebranche and Tschirnhaus, this will perhaps yield even more information on the originality of the beginnings of his thought than the mature philosophy does" (7-8). He might have added—and this is from the heart, of one who has spent much of the past seven years working on Leibniz's travails in the labyrinth of the continuum in the period from 1672-1686—that to have proceeded much farther than 1672 (especially with the comprehensiveness that he achieves here) would have necessitated at least another volume of commentary.

Beeley's aim is accordingly to give a clear articulation of "the fundamental importance of the problem of the continuum in the development of [Leibniz's] philosophy" by presenting "the conceptions and theories of the young Leibniz, oriented towards the central writings" (9), culminating in the ideas expounded in the HPN and TMA. Indeed, one way of regarding his book is as an elaborate commentary on the theory of the continuum contained in the latter works, supplemented by a consideration of earlier works where illuminating. From this perspective the opening lines of the *Fundamenta Praedemonstrabilia* of the TMA can be seen as prompting several chapters: "*There are actually parts in the continuum*, contrary to what the most acute Thomas White believes," writes Leibniz there, "and *these are actually infinite,* for Descartes's 'indefinite' is not in the thing, but the thinker." This bold assertion of the actual infinity of parts in the continuum, in opposition to Aristotelian orthodoxy, explains Beeley's first chapter, a careful analysis of Aristotle's theory of the continuum and distinction between potential and actual infinites. Likewise, Leibniz's prominent mentioning of Thomas White's denial that there are parts in the continuum results in Beeley's chapter 5, a thorough analysis of the conception of the continuum held by White and Kenelm Digby, together with an explanation of White's rejection of Descartes's "indefinite parts" (*partes indefinitae*) of the first element, and a comparison with the views of Cavalieri (mentioned in *Fundamentum 5* of the TMA), Galilei and Torricelli. Again, Leibniz's claim in the Preface of the TMA to have unravelled "the labyrinth that ingenious people find implicit in the compositions of the continuum and of motion"

(A VI.ii 262) –apparently a reference to Libert Froidmont's book *Labyrinthus sive de compositione continui* (1631), which Leibniz refers to by name in 1676– prompts Beeley to give a detailed exposition of Froidmont's arguments in chapter 12. This occurs after two chapters explicitly on the theory of the TMA, which contain a thorough analysis of the stimulus of Hobbes and his reinterpretation of Cavalieri's theory of indivisibles. And Leibniz's allusion to the "Anaxagoreans" in his comments on the composition of bodies in the HPN occasions a detailed treatment in chapter 8 of Anaxagoras's philosophy (again going back to the Greek sources), as well as of the early microscopists, Robert Hooke, Marcello Malpighi, Pierre Borel, and Athanasius Kircher. As he does throughout the book, Beeley avails himself here of an impressive medley of international scholarship in his analysis of the influence of this current of thought on Leibniz's emerging views.[6]

But as Beeley makes clear in some critical comments on a recent work of Konrad Moll, his aim is not merely to trace out influences.[7] Except in those cases where a concept is evidently taken up or further developed in the sense of a given tradition, "influence is more a superficial concept, best avoided in an investigation in the history of philosophy."[8] Beeley aims rather to lay bare the internal dynamic of Leibniz's conceptual development, with particular attention to the problem contexts in which his views were formed. And indeed it is his efforts in the latter direction that constitute the major part of his study. As a case in point, let me examine Beeley's illuminating treatment of the origins of what I take to be one of Leibniz's central doctrines concerning the continuum—his claim that it is actually divided into infinite parts.

Prima facie it is puzzling that Leibniz should have maintained this doctrine, and his early commitment to it is especially curious given his expressed intention at that time of reconciling Aristotle with the moderns. For not only is the assertion of the actual infinitude of these parts in opposition to Aristotle, Descartes and White (who would deny the actuality, the infinitude, and the parts, respectively), it also directly contradicts the atomism of Gassendi. Why, then, would he have adopted a position so at odds with his reconciliation project?

If one concentrates on his later works—and here I mean those of 1672 onwards—a plausible origin is suggested by the importance Leibniz attaches there to Descartes' argument for the actual division of matter into "indefinite particles." For rejecting the indefinite (with White) as "not in the thing, but the thinker", Descartes' reasoning becomes a strong argument for the actual infinity of parts in matter, depending only on Cartesian principles acceptable to the majority of moderns.[9] Moreover, it is the very argument that Leibniz himself repeatedly gives for the actual infinity of parts not only in the Paris notes (where he alludes to it as "the argument from a solid in a liquid"), but also in the dialogue *Pacidius Philalethi*, where he spells it out in detail, as well as in many other later writings.

Beeley, however, traces Leibniz's commitment to the doctrine of actual infinity back to his earliest writings, in particular his essays *Disputatio metaphysica de principio individui* (1663) and *Dissertatio de arte combinatoria* (1666), written before Leibniz displays any detailed knowledge of Descartes' views, or indeed any explicit concern with them. His concerns in these works are much more scholastic in character: the question of unity, and, in close connection with this, the ontology of number. Beeley draws attention to the fact that Leibniz explicily posits the actually infinite division of the continuum in the *Dissertatio* in the course a proof of God in which Leibniz "believes he can show that from the phenomenon of motion the existence of an incorporeal substance of infinite force can be concluded with mathematical certainty."[10] To this end he lays down as his fourth axiom that "Every body has infinite parts, or as is commonly said, the continuum is divisible to infinity" (A VI.i.169). The nub of the proof is that, since the motion of the body as a whole presupposes the coming-into-motion of every single part, and thus a moving principle in each one, the infinitude of the parts necessitates an infinite force. As Beeley points out, this clearly entails that the infinite parts of bodies referred to in Axiom 4 must be actual, and not merely potential, as they would be on the standard Aristotelian analysis.[11] The assumption of the dividedness, at least conceptually, of all bodies is, Beeley explains, one of the founding principles of Leibniz's mechanistic interpretation of his combinatoric: different species of things either have different parts, or parts in a different situation. But although this may help clarify why Leibniz assumes bodies are infinitely divided in his proof of God, it does little, Beeley remarks, to "explain why he refers in this connection to the infinite divisibility of the *continuum*" (58).

What does help to explain this, Beeley suggests, is a comparison with the views of William of Ockham.[12] "It is in Ockham that we find the view, otherwise seldom treated in scholastic philosophy (at least outside Oxford), that the parts of the continuum are not potential, but actual" (59). This refers to the view of Ockham and his followers that the *partes proportionales* into which the continuum can be divided must be regarded as genuine parts. "Every continuum is actually existent," writes Ockham, "therefore any of its parts is really existent in nature. But the parts of the continuum are infinite because there are never so many that there cannot be more (*non tot quin plures*), therefore infinitely many parts are actually existent."[13] This Ockhamist theory of the actual division of the continuum, Beeley explains, "can be regarded as a forerunner of the Leibnizian conception of the continuum in 1671" (240). For it is just as true for Leibniz as it is for the 14th century Ockhamists "that the recognition of the inexhaustibility of the line by proportional division means that the assumed division must be something essentially incomplete, and that in particular no smallest parts are to be assumed" (240). This is certainly true; and, as Beeley points out, an Ockhamist leaning is consistent with Leibniz's general commitment to a "moderate nominalism", and with his repeated favorable references to the Ockhamist position from the time of the *Disputatio* onward. Moreover, I might add, an Ockhamist origin would also explain why the denial of minima always seems to go hand-in-hand with the actually infinite division of the continuum in Leibniz's thought. With the exception of a period from February to May of 1676 (as well as perhaps in December of that year), when Leibniz finds himself reluctantly forced to the conclusion that actually infinite division must after all issue in true minima, the two theses stand firm through Leibniz's rapidly changing conceptions of the continuum.

Beeley does not claim to have a smoking gun, an explicit citation by Leibniz of Ockham in this connection. Nevertheless, he finds crucial hints of Ockham in the wording of a piece from the second half of 1671 ("On the Nature of Corporeal Things: A Specimen of Demonstrations from the phenomena"; hereafter *Specimen*). Under "To be demonstrated," Leibniz lists "Every continuum has infinite parts," then "Body is divided in such a way that it is impossible for any of its parts to separate from, or become more distant from, any other, in other words, into infinite parts" (A VI.ii 308-9). This coincides rather well with what Ockham said:

> Nor should one say as some do that these infinite parts of the continuum do not exist *in actu* but only *in potentia*. For they really exist, just as a man's head exists actually, though they do not exist separate from one another, any more than a man's head exists separate from his body, but it does not follow from this that they are not actual existents in nature. The Philosopher sometimes called them *in potentia*, but not because they do not really exist, but because they do not actually exist separate from one another."[14]

As Beeley admits, though, there are some crucial differences between the views of Leibniz and the Ockhamist school. For Ockham sees his view not as opposed to Aristotle's, but as an interpretation of it. The parts of the continuum for the Ockhamists, though actual, cannot be regarded as separate without this bringing with it the destruction of the continuum.[15] An actual infinity of separate parts in the continuum can therefore exist just as little on Ockham's view as it can on Aristotle's.[16] Leibniz, on the contrary, regards the parts of the continuum as actually existing in a strong sense: body must be divided into actually infinitely many independently existing distinct parts, if each has its own principle of motion.

Notwithstanding this divergence in their understanding of actually infinite parts, however, Beeley sees a further trace of Ockham in what he calls Leibniz's "ontological relativization of the concept of a point" (243). For in both authors' cases the commitment to actually infinite parts in the continuum brings with it a commitment to actually infinite points in a line. Now for Ockham, as for Aristotle, points are only the endpoints of lines. This might be thought to lead to a difficulty, in that whereas in Aristotle's case, the points, like the lines they bound, are only potential, Ockham's points will be as actual as the lines they bound, thus destroying the homogeneity of the continuum. But, as Beeley explains (243), Ockham gets around this difficulty nicely by denying that a point is anything positive or absolute. This is achieved by a nominalist reduction according to which nothing more is involved in the bounding of a line than the line's having a particular length. "Consequently the meaning ... of the word 'point' can be approximately represented by expressions such as 'a line of such and such length' or 'a line which cannot be further lengthened or extended'."[17]

Leibniz's treatment in the TMA differs. "Instead of replacing the point conceptually by a line with a determinate length, he makes it a kind of line, namely one ... that is 'smaller than every line that can be given'" (245). Despite this difference, though, Beeley sees a commonality in the fact that both authors prevent the existence of actual points in the continuum from spoiling its homogeneity by "relativizing the concept of the point". In Leibniz's case, this involves a rejection of the usual interpretation of a point, defined in Euclid's *Elements* as "that which has no parts", in favour of a point as something with magnitude, but unextended. Since Leibniz regards magnitude as a multiplicity of parts, a point must have parts; but since its ratio to a line must be unassignable, these parts cannot have distance from one another. Thus his definition in the TMA:

> A point is not that which has no parts, nor that whose part is not considered; but that which *has no extension*, or, whose parts are indistant, whose magnitude is inconsiderable, unassignable, is smaller than can be expressed by a ratio to another sensible magnitude unless the ratio is infinite, smaller than any ratio that can be given.

As Beeley observes, this is also directed against Hobbes's definition of a point as "that whose quantity is not considered."[18] Whereas Hobbes's point is really extended, being a line whose length the mathematician chooses not to consider in his demonstration, Leibniz's point is not. For although it has parts, these are not *partes* *extra partes* (parts beyond parts), as the customary definition of extendedness requires, but "mutually penetrating" or "indistant" parts. The fact that the points of the TMA, though unassignably small, have magnitudes, and are consequently comparable to one another, also distinguishes them from Galilei's *parti non quante*. One point may be bigger than another, given the proportionality of points to endeavours (*conatus*). For a point is the space traversed by a body with a given endeavour in an instant, and whilst all instants are assumed equal, the endeavour of a faster motion is correspondingly stronger. Indeed, one point may even be infinitely bigger than another, as Leibniz argues by appealing to angles of contact.

This inner complexity of Leibniz's points means that they, and endeavour and moment too, are only "quasi-elements" of their respective continua (326). "On the one hand," Beeley explains, Leibniz uses the actuality of infinite division to explain "the existence of analogous levels of progressively smaller size, while on the other, he postulates 'elements' of such a kind as to at least satisfy the requirements of a composition, even while they do not fulfill other criteria of conceptual elements."[19] This constitutes what Beeley calls "the relativization of the infinite," and it is this that allows the existence of elements that do not break the homogeneity of the continuum.[20] There are no smaller points in relation to the line; but they are not last elements or true minima, as is revealed by their possessing magnitude.

Space precludes me from delving much deeper into Beeley's subtle analysis of Leibniz's early theory of the continuum. Suffice to say that in the "restricted synthesis" constituted by Leibniz's relativization of points, lines, and surfaces in the TMA, Beeley sees the beginnings of a move away from a synthetic conception of the continuum in favor of a decidedly more analytic approach. This is a trend that Beeley sees becoming consolidated in Leibniz's mature work, where the continua of space, time, and motion are displaced "onto a level of higher abstraction, where the question of composition falls completely away."

All this is, I think, insightful, and provides a helpful gloss on Leibniz's difficult and apparently contradictory positions in the TMA. But I'm not convinced that in the end Beeley himself avoids getting distracted by questions of influence, particularly in regard to Ockham. For even though he is careful never to claim to have shown more than that the Ockhamist theory "can be regarded as a forerunner of the Leibnizian conception of the continuum of 1671" (240), the detailed comparisons with Ockham's position would lose their point if they were given only as analogies, rather than arguments for influence. Now granting an Ockhamist origin for Leibniz's doctrine of actual infinity of parts in the continuum, it is true that one can see some suggestions of Ockham elsewhere in the TMA—for instance, in Leibniz's characteristic marriage of the actual infinite with a syncategorematic formula for the infinitely small as "smaller than any that can be assigned." But this is also compatible with a direct reading of Aristotle's countenancing of the infinite by division,[21] so that this opens up the whole question of how Leibniz interpreted Aristotle, as Mercer and Smith point out in their contribution to this symposium. Again, one could as well see traces of Gassendi in Leibniz's assimilation of this formula to "smaller than any *sensible* magnitude" (my italics). One could see Gassendi, too, in Leibniz's distinction between mathematical and physical points, and his distinction of both from incorporeal indivisibles, and in his emphasis on how the problem of the continuum is underdetermined by what is perceivable to the senses[22]—although Beeley, for reasons I cannot divine, seems appalled at the prospect of a Gassendian influence, despite Leibniz's own candid admissions of it (referenced by Beeley on his p.1). And for all the subtlety of Beeley's comparison of Leibniz's relativization of points with Ockham's, this similarity seems to me slight in comparison with the obvious common ground between his nominalism and Hobbes's. So, even granting Ockhamist influence, it seems strange to me that Beeley should want to lay so much emphasis on this, rather than acknowledging the syncretist nature of Leibniz's thought, especially given his remarks on influence quoted above. For, as Beeley says, it is in his highly creative synthesis of diverse influences that Leibniz's originality is to be found.

Secondly, it seems to me that the Ockhamist features that Beeley discerns in Leibniz's theory are in any case shortlived. For, by his own admission, already by the end of 1672 Leibniz had diverged considerably from the Ockhamist sounding statements in the *Specimen* of the previous year, in that by then he sees "no contradiction in there being infinitely many mutually separated parts in a finite continuum" (242). Here Beeley refers to the *Accessio ad arithmeticam infinitorum*, in which Leibniz mentions proofs that there is "no line so small that it does not contain, not only infinitely many points, but infinitely many lines (and therefore infinitely many parts actually separated from each other)".[23] Notably, by this time too Leibniz has rejected indivisibles, assimilating them to "things lacking parts, i.e. minima" (A VI.iii 95), without giving up the claim that "there are in the continuum infinitely small things, that is, things infinitely smaller than any given sensible thing" (A VI.iii 98). This is a crucial change, as I have argued elsewhere, given the close link between minds and indivisibles in the TMA. For a mind cannot be contained in a partless Euclidean point; nor can it be said to be indestructible because it is contained in an indivisible, if it is instead contained in an infinitely small thing that is not indivisible. This leads Leibniz, or so I argue, to resuscitate atoms, which then act as insensible but indestructible kernels, each with its own mind. The rejection of indivisibles in 1671-2 is also significant for another reason, in that the actually infinitely small is now justifiable only in terms of the proportionality with endeavours. This leads Leibniz to conclude in his "On Minimum and Maximum..." of 1672 that there are no infinitesimals where there is no motion, and that consequently "there is no matter in body without motion" (A VI.iii 100). The idea that unassignables can only be defined through motion also leads him to a more dynamic conception of the continuum which, after many twists and turns, issues in the emphasis on transformation through time seen in his mature Principle of Continuity. Thus however attractive Leibniz continues to find Ockham's nominalism after 1672, it seems to me that by then he is already a long way from Ockham in his thinking on the continuum.

Things are similar with the interpretation Beeley gives of Leibniz's analysis of motion in his Letter to Thomasius of April 30, 1669, where again he sees signs of Ockham. In the case of bodies, as we saw, Ockham had claimed that the supposition of indivisibles as real entities in the continuum is superfluous. But in the case of motion his nominalism is the other way up: here, in Beeley's rendition of his view, it becomes superfluous to suppose motion as a real entity "in that it dissolves into instantaneously attained states of the moving thing, coming into existence one after the other" (132-133). This is the position, Beeley suggests, that Leibniz is adopting in his letter to Thomasius when he argues that the existence of God follows from his analysis of motion in terms of "continuous creation". In the draft of this letter that was received by Thomasius, Leibniz wrote:

> Hence, strictly speaking, motion does not belong to bodies as a real entity in them, but as I have demonstrated, whatever moves is continuously created, and bodies are something at any instant in an assignable motion, but nothing at any time between the instants in an assignable motion—a view that has never been heard of till now, but which is clearly necessary, and will silence the atheists" (Ak II.i 23-24; L 102).

This is a very curious passage for a number of reasons. The proof of God through continuous creation is certainly redolent of Descartes, so that one might construe it as a Cartesian variant, as did Loemker, taking the reference to continuous creation "merely to mean the source of all motion in God" (L 104). But there seems more to it than that, and in any case, construing his position as Cartesian would render Leibniz's claim for originality very odd, since he would surely expect Thomasius to be familiar with the Cartesian view. Beeley does not attempt to explain the boast of originality (which he does not include in what he quotes of the Latin), but sees the theory as being marked off from another prominent theory of discontinuous motion of the time, that of the Spanish philosopher Arriaga, in that the latter uses intervals of rest as a means to explain the discontinuity.[24] (The same analysis is more famously associated with Gassendi.)[25] In contrast to the latter theory, Beeley claims, "Leibniz expressly denies that bodies so moved are found at rest in the time between two acts of creation, or between their corresponding moments; instead this time is simply skipped over by bodies" (133).

I'm not so sure of this. In favor of Beeley's reading, Leibniz's denial of motion "as a real entity in bodies" is certainly suggestive of Ockham. But as Beeley himself points out, the reality of motion is something that Leibniz, in opposition to Ockham, wants to retain. The key, I believe, is to see this in context. Leibniz had argued in the *Confessio* that all the mechanical properties of bodies are derivable from motion, but had criticized mechanism for not being able to make motion part of the essence of bodies. But of course if motion is part of the essence of bodies, then *a body at rest will be nothing.* Thus if what Leibniz is proposing here is that continuous motion is to be parsed in terms of a body's being created at each of the instants at which it is in assignable motion—its being nothing for the unassignable times between these instants when it is at rest—then this does indeed constitute a new theory. It has features in common with the Ockhamist, Cartesian, and Gassendian-Arriagan theories, yet is different from each of them. Such a syncretist reading seems to me more in keeping with Leibniz's conciliatory tendencies than ascribing to him a purely Ockhamist theory.[26] Moreover, if this interpretation is right, the theory of the Letter to Thomasius is equivalent to what Leibniz calls "transcreation" or "transproduction" when he returns to a discontinuist account of motion in 1676, as Beeley himself assumes without argument.

But this leads me to another criticism. This is that Beeley does not come good here on his promise to lay bare the internal dynamic of Leibniz's own thought. His offhand identification of the 1669 continuous creation argument with transcreation, accompanied by the laconic remark that "the transcreationist theory itself is never an enduring part of Leibniz's philosophy, although he sporadically returns to it (perhaps prompted by Malebranche) even after 1669, for example in his writings *Infinite Numbers* and *Pacidius Philalethi* (both 1676)," seems rather to steamroll over any changes in the internal dynamic. Nor does he explain the curious fact that Leibniz excises both passages involving the continuous creation theory from the version of this Letter that he publishes in 1670 in his edition of Nizolius. After mentioning this, Beeley refers us to the seminal article by Daniel Garber on Leibniz's early metaphysics of motion cited earlier, and then makes the wholly untenable remark that the letter of April 1669 "serves Leibniz not so much to expound his own standpoint, since such a standpoint in not available to him at this point in time, but more to assert mechanism against the Scholastic philosophy" (134). Here I have the unfair advantage over him of having read Christia Mercer's brilliant analysis, in a draft of her forthcoming book, of Leibniz's metaphysics of this period, seen against the backdrop of his theological writings. Drawing on this, I suggest the following as a plausible description of the movement of Leibniz's thought on the continuum in this period.

In the *Confessio* of 1668, Leibniz holds each body to be a union of body and mind, in the case of non-rational bodies a union of body with the concurrent divine mind (CDM). This is in part offered as a solution to a defect he sees in contemporary mechanism, that motion cannot be derived from the nature of body if this is conceived just in terms of extension and antitypy. An adequate definition must include a principle of motion, which Leibniz identifies as mind. But as Mercer has cogently argued, there is a problem with this that Leibniz gradually came to recognize between 1668 and 1670: while a CDM may be regarded as a principle of motion within bodies, it is not part of the nature of body, so that it is no more true of Leibniz's 1668 theory than it is of Descartes' that motion is derivable from the nature of body. This difficulty, I contend, is only compounded by the analysis of motion as continuous creation that Leibniz offers Thomasius in 1669 as evidence that he "has penetrated more deeply" since the previous year. For on that account the principle of motion is even more obviously not located in the nature of body, but in God's direct creative action. This explains why, on developing his neo-Hobbesian construal of the continuity of motion in terms of endeavours in 1670, Leibniz drops all reference to the discontinuist account of motion. Motion is now a true continuum composed of endeavours, and it is in terms of the ability to sustain these for longer than a moment that Leibniz is able to give an account of "the true distinction" of rational from non-rational minds. God is no longer directly the cause of continued motion, but only indirectly through conservation of conatus. Such an account, as I argue in my forthcoming book, has the merit of explaining why Leibniz returns to the transcreationist view in 1676. For it is in early 1676 (and for very complex reasons that I shall not go into here) that his endeavour theory collapses, and with it the foundation Leibniz had provided for the continuity of motion. This in turn explains why the discontinuist account disappears when Leibniz is again able to locate the source of continuity of being in force, instead of motion.

I have similar criticisms of Beeley's treatment of the development of Leibniz's thought on atomism, which I do not find at all convincing. I certainly do not have the space to go into details here,[27] but by my lights there's a systematic underrating of Leibniz's earlier commitment to atomism; for it is this that explains why the solving of the problem of cohesion is such a triumph for his first theory in the TMA. Again, however, this triumph seems to be short-lived, and even in works and letters of late 1671 (after he has rejected indivisibles) one can find Leibniz entertaining the hypothesis of atoms. I am not too convinced by Beeley's suggestion that Leibniz's remark in the HPN about atoms containing "*worlds within worlds to infinity*" can be interpreted as "a sideswipe against the modern atomists" (201), if only because this fails to take into account the variety of atomisms of the period. But whatever one makes of Leibniz's references to atoms in the early-to-mid-1670s, it is certainly the case that he returns to atomism very explicitly in 1676. So why, one must ask Beeley, if in 1671 Leibniz was already completely opposed to atomism, and already had his mature objection, would he return to embrace atomism in 1676? Could this be the result of Malebranche's influence? Maybe this was a factor, but by appealing to it alone Beeley would undermine his own methodological precept that Leibniz's originality is to be sought in the internal development of his ideas, rather than in trying to reduce all such developments to external influences.

These criticisms, it seems to me, indicate a shortcoming of Beeley's general approach. Having identified early manifestations of dominant later views, there is a tendency at the same time to assume a continuity from one to the other. But the apparent continuity in position may be illusory, masking an honest consideration by Leibniz of all kinds of rival hypotheses. What I'm trying to suggest is that the *labyrinth* is a true image of Leibniz's path through the composition of the continuum. The illusion of continuity is projected onto this path in retrospect. It is as if Theseus, paying out Ariadne's thread as he explores the Cretan maze (having covered up all the blind alleys by retracing his steps and gathering up the line again), also cut out all the loops formed by his re-encounters with the thread.

But these are more quibbles than quarrels. I'm not even confident that in so short a space I have made them intelligible to those who have not labored as long as Beeley and I have in Leibniz's labyrinth. There is of course far more to his book than the suggestion of Ockhamist roots to Leibniz's thought, and in a more balanced review I would have said much more on my extensive agreements, both with Beeley's historical approach, and with his specific conclusions. His main aim, I believe, has been to show that Leibniz's early attempts to solve the continuum problem are of cardinal importance for understanding the genesis of Leibnizian philosophy, and that these attempts are part and parcel of his critique of mechanism. I am thoroughly convinced on both counts. And even if I cannot agree that Beeley has been completely successful in articulating the development of Leibniz's views, I enthusiastically applaud his efforts to do so, congratulate him on what he has achieved, and admire the tremendous erudition that he has brought to bear on the subject.

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[1]I am very much indebted to my Middlebury colleague Roman Graf for taking the time to look over my German translations in an early draft of the paper; any remaining errors are mine alone!

[2]Here I am following Beeley (among others) in taking *Hypothesis Physica Nova* (hereafter HPN) and *Theoria Motus Abstracta* (hereafter TMA) as the titles of the two parts of the treatise sent to the English and the French, resp., in 1671. They are given in the Academy edition, series VI, vol. ii, pp. 219-257, 258-276 (hereafter abbreviated A VI.ii 219, etc.). However there is some justification for taking *Hypothesis Physica Nova* as the title for the whole work (whose first part is then *Theoria Motus Concreta*, the heading at the top of the text), since the physical hypothesis is invoked in the theorems and special problems of the TMA, if not in the theoretical foundation.

[3]Thus Leroy Loemker calls the HPN "a somewhat incoherent program of new physical and cosmological principles," and the TMA "an unassimilated combination of Cavalierian, Hobbesian and Cartesian ideas" (L. E. Loemker, *Leibniz: Philosophical Papers and Letters*, 2nd edition, Boston/Dordrecht: D. Reidel, 1969; p. 139; hereafter abbreviated L 139, etc.). In this connection, Loemker cites Hofmann's remark about Leibniz's proposing his early views in "proud ignorance" (Joseph Hofmann, *Leibniz in Paris, 1672-1676*, Cambridge: Cambridge University Press, 1974; p. 4). Hofmann's charge of ignorance is undeniably correct concerning Leibniz's knowledge of mathematics prior to his stay in Paris, but not, I believe, concerning his knowledge of foundational issues, or even of physics. See also John Earman's criticisms in his "Infinities, Infinitesimals and Indivisibles: The Leibnizian Labyrinth", *Studia Leibnitiana*, 7 (1975), pp. 236-251.

[4]Arthur Hannequin, *La premiére philosophie de Leibnitz*, pp. 17-224 of *Études d'histoire des sciences et d'histoire de la philosophie*, vol. 2, ii (Paris, 1908). Willy

Kabitz, *Die Philosophie des jungen Leibniz. Untersuchungen zur Entwicklungsgeschichte seines Systems* (Heidelberg, 1909).

[5]«Unter den Autoren, die Leibniz zitiert, herrscht allgemeine Zustimmung, daß das Ganze in diesem Falle durch eine Seele (sp[i]ritus) zusammengehalten wird» (p. 5).

[6] «Jahre später, nach eingehender Behandlung des Problem des Kontinuums, greift Leibniz in seiner Monadenlehre auf diesen Begriff zurück, er rehabilitiert die substantiellen Formen, um auf mechanistischer Grundlage die Einheit der organischen Körper zu erklären» (5).

[7]Just to give some idea of his erudition: in this chapter alone, Beeley draws on the work of Gregory Vlastos, Marie Boas, Marshall Clagett, Thomas Kuhn, Charles Singer, Catherine Wilson, Harry Torrey, François Duchesneau, John Fletcher and Lynn Sumida Joy in English; Reijer Hooykaas, Ernst Bloch, Christoph Meinel, Hans Diller, Olof Gigon, and his teacher Hans Poser in German; Luigi Belloni in Italian; René Jasinski and Arthur Hannequin in French; and all this in addition to his primary sources, Anaxagoras, Aristotle, and Sextus Empiricus in Greek, and Kircher, Malpighi, and Leibniz in Latin.

[8]«Tatsächlich aber besteht der Schwerpunkt seiner [sc. Moll's] Untersuchen darin, jene Schlüsselgestalten ausfindig zu machen, die entscheidenden Einfluß auf Leibniz' frühes Denken ausgeübt haben sollen» (8), «Wer nur nach möglichen Einflüssen auf einen Denker wie Leibniz forscht, negiert am Ende die Spontaneität eines schöpferischen Geistes» (9).

[9]«Einfluß ist, abgesehen von solchen Fällen, in denen von der Aufnahme und Weiterentwicklung eines Begriffes oder einer Idee im Sinne einer Tradition die Rede sein kann, eher ein oberflächliches Konzept, das man am besten in einer philosophiegeschichtlichen Untersuchung vermeidet» (9).

[10]Descartes had elaborated the distinction between the infinite and the indefinite in his *Principia philosophiae*, part 1, §§ 26-27, and applied it to the actual division of matter in part 2, §§ 34-35. Among Cartesian sympathisers who could not accept this distinction were not only White but More, Newton, and Spinoza; the latter attached great importance to Descartes' argument for actually infinite division, drawing his own conclusions from it in his Letter on the Infinite.

[11]«In diesem Beweis [in der *Dissertatio*] glaubt Leibniz zeigen zu können, daß sich aus dem Phänomen der Bewegung die Existenz einer unkörperlichen Substanz von unendlicher Kraft "ad mathematicam certitudinem" folgern läßt» (56).

[12]The suggestion that this axiom does concern actual parts has been made before, though never, I think, explained as clearly as here. See Daniel Garber, "Motion and Metaphysics in the Young Leibniz," pp. 160-184 in Michael Hooker, ed., *Leibniz:*

Critical and Interpretive Essays (Minneapolis: University of Minnesota Press, 1982), p. 168.
[13]«Eine mögliche Erklärung dafür, daß sich Leibniz in diesem Zusammenhang auf den Kontinuumsbegriff stützt, bietet sich, wenn man seinen Begriff des Körpers von Ockham her interpretiert.»
[14]William of Ockham, *Opera Philosophica* (New York: St. Bonaventure, 1974-88), V, 562 (translated from Beeley's Latin quotation, p. 60). Outside Oxford, the same view was adopted by Gregory of Rimini: "Every continuum has several parts, and there is no number of finite parts such that it does not have more (*non tot finitas numero quin plures*), and it has all its parts actually and at the same time; therefore every continuum has, simultaneously and actually, infinitely many parts" (translated from Beeley's Latin quotation, p. 59, n. 36).
[15]Ockham, *Exp. phys.*, I, 2, § 1, OP IV, 110; translated from Beeley's quotation, 62. See also *Exp. phys.*, VI, 13, § 6, OP V, 564.
[16]«Für Ockham und seine Schüler bedeutet die wirkliche Trennung der Teile im Kontinuum nicht nur dessen Zerstörung, sondern fällt außerdem—gemäß seiner Abwandlung der aristotelischen Terminologie—mit der Herstellung eines aktuellen Unendlichen zusammen» (241).
[17](242). Thus, continues Beeley, "when Ockham says that the infinitely many parts in the continuum are actually there he means this existence in another sense, still comprising the Aristotelian "*in potentia*", which conceives the division as a conceptual act: the mind "takes" (*accipit*) the parts of the continuum in a definite proportion, which parts must, on the one hand, be there as genuine parts of the continuum, but which, on the other hand, are infinite as *partes proportionales*, and thus cannot be exhausted" (242).
[18]«Folglich kann die Bedeutung bzw. der designatorische Gehalt des Wortes "Punkt" etwa mit Ausdrücken wie "eine Linie von der und der Länge" (linea tantae vel tantae longitudinis) oder "eine Linie, die sich nicht weiter verlängert oder ausdehnt" (linea non ulterius protensa vel extensa) wiedergegeben werden» (244).
[19]Hobbes, *De Corpore*. Hobbes defends this definition in his *Six Lessons to the Savilian Professors of the Mathematics* as equivalent to Euclid's, which he gives as *Signum est, cujus est pars nulla* (*The English Works of Thomas Hobbes,* vol. VII. London, 1845; reprinted by Scientia Verlag Aalen, Germany, 1966; pp. 200-202).
[20]«Auf der einen Seite geht er von der Möglichkeit oder sogar—gemäß seinem eigenen Kontinuumsbegriff—von der Wirklichkeit der unendlichen Teilung aus und begründet damit das Vorhandensein analoger Ebenen bei fortschreitender Kleinheit, während er auf der anderen "Elemente" solcher Art postuliert, die den

Erfordernissen einer Zusammensetzung zumindest genügen, auch wenn sie andere Kriterien des Elementenbegriffes nicht erfüllen» (326).

[21]«Und selbst die Möglichkeit, daß Elemente angenommen werden, die die Homogenität des Kontinuums nicht verletzen, wird nur durch die Aufhebung der Absolutheit bzw. durch die Relativierung des Unendlichen gegeben» (330).

[22]I suggest exactly this in my forthcoming Yale Leibniz volume, that Leibniz might have read Aristotle "as having countenanced the actual infinite by division, whilst denying the actual infinite by extent". See my Introduction, fn. 30, and fn. 4 of Appendix A, which contains my translation of some of the relevant parts of Aristotle's *Physics*. It is, I suggest there, "conceivable that Leibniz derived his early commitment to the actually infinite division of the continuum from reading Aristotle this way... This, at any rate, is suggested by Aristotle's discussion in Book 6, where all his denials of the actual infinite seem to apply only to the second type of infinite, and his refutation of Zeno's dichotomy seems to allow for an actual infinity of divisions of both space and time."

[23]Compare Leibniz's remarks in the *Uses* of the TMA that "in sensible bodies" it "suffices for the phenomena" to show that "no sensible error disturbs our reasons", and that "sensation cannot discriminate whether some body is a continuous or contiguous unit, or a heap of many discontiguous ones separated by gaps" (A VI.ii 273) with Gassendi's "this does not prevent every body that is not really divided into parts from being called continuous, in accordance with common usage, and inasmuch as the senses cannot reach as far as atoms or their joints" (*Animadversiones,* Lyons, 1649, 306-7). Note, too, that Gassendi construes the distinction between the continuous and the discrete in the same way as Ockham: it consists "in the fact that *the parts of a continuous quantity can indeed be separated, but are not in fact separated*, whereas *the parts of a discrete quantity are actually or really separated*" (*ibid.*).

[24]Beeley suggests, plausibly, that Leibniz might have been led to this view by his work on infinite series at that time, when he first encountered Gregory of St. Vincent's views concerning the summation of a finite line from an infinite series.

[25]In composing my book on Leibniz and the continuum, I was unable to find a copy of the relevant works by Arriaga, (whom I had discovered quite incidentally through the unspecific references to his views in Charleton and Bayle), so I found the detailed quotations given by Beeley (298-9) from Arriaga's *Cursus philosophicus* (Antwerp, 1632) most useful. Beeley takes Kabitz to task for not having distinguished Leibniz's view from Arriaga's (133, n. 86).

[26]Beeley suggests (in agreement with Olivier Bloch) that Gassendi did not adopt

this analysis of motion as his own, but merely proposed it for the sake of argument in a discussion of Zeno's aporia: it "could very well be only a hypothesis proposed ad hoc, which is supposed to show a possible solution of this aporia" (300). This seems to me at odds with Gassendi's approving words: "should I add that slowness arises from the intermixture of rests? Certainly ... we may conceive the motion with which we infer Atoms are carried through the Void ... as the swiftest; then all the degrees there are from this to a pure rest, are made up of more or fewer particles of rest intermixed. Accordingly, when there are two moving bodies, one of which is going twice as fast as the other, it must be conceived that for every two moments during each of which the faster is moving, the slower moves in only one and remains at rest in the other... Nor may you object that a motion of this kind will not then be continuous in itself; for it will still be continuous to the senses" (Gassendi, *Animadversiones*, 455-6). Curiously, though, Beeley's suggestion is consistent with the contemptuous rejection of Arriaga's hypothesis by Gassendi's chief followers in France (Bernier) and England (Charle-ton).

[27]Also, if Leibniz himself knew it was simply Ockham's position, this would make his boast for originality not only hollow but disingenuous. I might add, too, that we have Leibniz's own testimony that he once believed "motion to be interrupted by little rests".

[28]I have presented a paper on this subject under the title "The Enigma of Leibniz's Atomism," which I am in the process of working up into an article.

Review of Philip Beeley's *Kontinuität und Mechanismus*
by Christia Mercer and Justin Smith, Columbia University

For too long scholars have ignored the complicated role that the continuum problem played in the evolution of Leibniz's philosophy. That the problem was of great importance to Leibniz has been clear. What has remained unclear is exactly how Leibniz's attempts to solve the problem informed his philosophical opinions. Leibniz did not see the labyrinth of the continuum as primarily a mathematical one: it was also constituted of time, matter, and motion. It is not surprising therefore that the important scholarly work that has been done on Leibniz's mathematics has failed to explain the precise relevance which the cluster of issues surrounding the problem had for Leibniz's philosophy. In his *Kontinuität und Mechanismus*, Philip Beeley traces the various twists and turns in the labyrinth of the continuum. As the title of his book suggests, Beeley is concerned to examine the complex of issues generated by the problem of continuity within the context of the mechanical physics of the mid-seventeenth century.

The problem of the continuum has generally been considered a mathematical problem about how a line or any other continuous mathematical quantity can be composed out of things like points or indivisible line segments. While it is true that Leibniz was deeply interested in this mathematical puzzle and that his invention of the infinitesimal calculus grew out of that interest, he was equally concerned to answer a number of related questions. The central puzzle concerning material atoms is neatly summarized by Catherine Wilson in her book, *Leibniz's Metaphysics: A Historical and Comparative Study*. Wilson writes: "are there atoms? If there are no atoms, what are things made of? If there are atoms, why is it that these things and not their parts are the atoms?"[1] The same puzzle applies to moments of time and parts of motions. Beeley amply supports his claim that the problem of continuity, "like hardly any other problem in the tradition of occidental thought, is able to exemplify the interwovenness of philosophy, mathematics, and natural science" (p. 12). He does a fine job of showing this "interwovenness" in Leibniz's own thought. By such means, Beeley forces the problem of the continuum out of the mathematical corner of Leibniz studies into its proper place on center stage; and he provides a helpful account of the development of Leibniz's philosophical views in relation to the problem of continuity. As Beeley makes clear, Leibniz was interested in the continuity and composition of time, motion, and matter and was especially interested in the continuity of motion. Given the grand nature of these questions, it is not surprising that any philosopher who attempted to answer them would be driven to metaphysics; and it is a central thesis of Beeley's book that Leibniz's concern to answer just such questions strongly influenced the development of key elements in his philosophy.

Kontinuität und Mechanismus has four goals: (1) to lay out in detail the historical background to the complex of problems related to the continuum in the mid-seventeenth century; (2) to identify some of the major sources of possible influence on Leibniz's own approach to the problem; (3) to present some of Leibniz's solutions to these problems; and (4) to suggest the exact role these problems played in Leibniz's early philosophical development. Since the other contributors to this symposium, Richard Arthur and Catherine Wilson, are experts on the the physical and mathematical issues which surround the problem of the continuum both in seventeenth-century thought in general and in Leibniz in particular, their efforts will be spent primarily on goals (2) and (3). We will focus on goals (1) and (4). While we strongly endorse the historical methodology of the book, we think that the application of this method is often unsuccessful. For this reason, *Kontinuität und Mechanismus* is not entirely successful in satisfying goals (1) and (4). Its lack of success in this regard gives rise to a number of interesting questions both about historical methodology in general and about the study of Leibniz in particular. In our discussion below, we will focus primarily on such methodological questions.

The Historical Context of the Problem of the Continuum for Leibniz

It seems obviously true that, for any philosophical problem, before we can fully appreciate the solution proposed by an historical figure, we need to discern exactly how the problem was understood by that figure. But in the seventeenth century this is often an enormously complicated task. Not only did Leibniz and his contemporaries inherit the whole history of philosophical discussions about all the traditional philosophical topics, they interpreted these discussions through their own very definite prejudices and they generated a number of their own philosophical concerns. What is admirable about Beeley's study is that he attempts to situate Leibniz's approach to the problem of the continuum within its proper philosophical setting. To this end, Beeley offers a summary of the most important ancient, medieval, and early modern discussions of the problem of the continuum and thereby attempts to reconstruct Leibniz's perspective on this complex of topics. It is against this background that Beeley examines both Leibniz's responses to the problem and "the role" that his evolving solutions played in "the development of his first philosophy" (p. 1).

One of the things that makes working on Leibniz difficult is that so much of the material necessary to understand his philosophical proposals stands outside the texts. It is often impossible either to discern clearly or to evaluate properly his solution to a problem on the basis of the material he presents. Since his texts usually fail either to explain the subtleties of the problem at hand or to articulate the proposals to which he was reacting, it is often necessary to go outside the text to discover them. But where does one go? Leibniz himself rarely provides directions. As Beeley rightly assumes, the first place to look, both for a thorough understanding of the problem at hand and for a proper evaluation of Leibniz's solution, is at the entire history of philosophy. That Leibniz was thoroughly familiar with that history is clear, as is the fact that he mined it constantly for inspiration and arguments. More often than not, the details of the problem at hand can be identified and the proposed solution evaluated only once the full historical context has been laid out.[2]

The difficulty of working on the continuum problem is especially great because Leibniz faced such a wide range of interrelated problems which he acquired from various predecessors and contemporaries, with which he and his contemporaries were thoroughly familiar, and about which he had no reason to be explicit. Moreover, there is no single complete presentation of his views on continuity. Although Leibniz wrote no systematic account of his early thought, he often devoted short essays or parts of long ones to a topic (e.g., the problem of evil, the nature of corporeal substance). The same is not true for the problem of continuity. The scholar of Leibniz's theory has to piece it together from comments which are scattered across a number of texts and embedded in a number of discussions.

Beeley's strategy is impressive in its effort to situate Leibniz's theory of continuity both historically and textually. He attempts to survey both the historical background to the problem of the continuum and the intellectual context in which Leibniz confronted it. This detailed survey is presumably supposed to allow us to discern how Leibniz construed the problem and to evaluate both the originality and success of his solutions. While we wholly support both Beeley's scholarly goal and his historical methodology, we believe that ultimately the book has not attained this goal because its historical survey is incomplete. Before we identify some of the less successful parts of the historical sections of the book, let's note some of its genuine achievements.

In Beeley's historical survey, which is interspersed with a discussion of Leibniz's views, he begins with Aristotle, works steadily through the early and late scholastics, and stops only after a discussion of Leibniz's most important contemporaries. There is much that is helpful here. For anyone remotely concerned with the history of the problem of the continuum, Beeley's historical summary will serve as a useful introduction. Although there is nothing highly original in Beeley's account of the major characters who preceed the seventeenth century, it is impressive that they are all there. To have Aristotle's views on time and motion (chapter 1) side by side with the most important medieval and early modern theories about *quantitas continua* (chapter 2) and accompanying Anaxagoras' conception of matter (chapter 8) provides a good introduction to the issues clustering around the continuum problem.

What *is* original is Beeley's survey of the major figures in the seventeenth century part of the story. A large part of this survey contributes to our understanding of seventeenth-century thought. Of special interest are the heroes in the story, Libert Froidmont and Thomas Hobbes, and the previously unrecognized protagonists, Kenelm Digby and Thomas White. The attention that Beeley gives to Froidmont is especially important since his influence on Leibniz has not been recognized. Beeley argues that it is Froidmont who offers the first early modern solution to the continuum problem using a non-atomistic approach. What was singularly important about Froidmont was his interest in motion as the most troubling problem concerning the extremely small. For many in the seventeenth century, motion was a property or mode of matter (e.g., for Descartes and the Cartesians). For Leibniz in the early 1670s, it played a much greater ontological role: a body only exists at each assignable instant of its motion, that is, a body only exists in virtue of the fact that it moves. Because Froidmont focuses his attention on the problem of continuity as it presents itself in motion, and because he understands that the solution to the problem of continuity in motion will ultimately be the solution to the same problem in space and time and the number line, Froidmont appears to have had an impact on Leibniz. Though ultimately Leibniz would differ greatly from Froidmont in his view of the composition of the continuum, Beeley claims that Froidmont's anti-atomism was central in the development of Leibniz's view (see especially section 12.5).

Also of particular interest to scholars will be the position Beeley assigns to the English Catholics and early mechanical philosophers, Thomas White and Kenelm Digby. Although neither of these figures is very well-known, both were widely read and well-respected in their day. By drawing attention to a part of their thought that has not been seriously studied, Beeley has made it clearer than it already was that a thorough philosophical and historical analysis of these figures is well overdue. There are aspects of Digby's conception of magnitude in his major philosophical work of 1644 (entitled *Two Treatises in the one of which the nature of bodies, in the other, the nature of souls is looked into in a way of discovery of the Immortality of*

Reasonable Souls) that are mysterious. This is partly due to the difficulties of the text, and partly due to Digby's lack of concern with details. While Beeley's account of Digby's solution to the problem of the continuum does not make all of the Englishman's views about corporeity perspicuous, it does situate them in their proper philosophical perspective and thereby adds significantly to our estimation of Digby's proposals in natural philosophy.

Each of these parts of Beeley's historical story is interesting; each contributes information relevant to Leibniz's approach to the problem of the continuum. But in *Kontinuität und Mechanismus*, the whole is less than the sum of its parts. The general methodological strategy of the historical sections of the book is unclear. There are two immediately obvious problems with its historical material, both of which concern the status of this material and the lack of continuity between it and Leibniz's philosophy. The first involves the tension between the historical survey that Beeley presents and his account of Leibniz's views. On the one hand, the book contains many more details than are necessary if the point is to contextualize Leibniz's position; on the other, there are not enough details if the point is to survey the history of the topic before Leibniz and thereby to offer a reasonably complete history of the continuity problem. The second problem concerns the exact relevance of some of this historical material to Leibniz's thought. While a familiarity with Zeno, Anaxagoras, Aristotle, scholasticism (particularly that of Suárez), and early modern corpuscularianism will surely help in the evaluation of Leibniz's movement within the labyrinth of the continuum, Beeley gives an explication of many of the views of these philosophers without indicating their exact relevance to Leibniz. Often Beeley simply deposits his summary of the theory of an historical figure without attempting to connect those views directly to Leibniz. It is striking for example that Beeley gives such a neat summary of the views of White and Digby and then does not display the relation that these philosophers had to Leibniz. We are not demanding that Beeley trace the direct influence of any one source on Leibniz: this is often difficult and Beeley says that it is not his goal. But we are suggesting that Beeley present all the available facts about the relation between Leibniz and his predecessor (e.g., which books by the author does Leibniz cite and which were in his library?) and that he offer some account of the philosophical similarities between the relevant theories. Two examples will suffice to suggest the nature of the problem. While the reader can glimpse some apparent similarity between the views of White and Leibniz, Beeley never offers a comparison of their positions. It would be enormously interesting to know much more about the relation between Leibniz on the one hand and figures like Digby and White on the other.

Another case is even more striking. Beeley devotes chapter 1 to a summary of Aristotle's theory of the continuum and then in the remainder of the book barely refers to this material. One is unclear about the status of this material and its exact relevance to Leibniz.

Such problems with Beeley's use of his historical material suggest a number of grand methodological questions. We would like to consider some of these now. As source material, we will turn first to Beeley's account of Aristotle's views on the continuum and then briefly to his treatment of the theories of some of Leibniz's contemporaries.

At first glance, it seems perfectly obvious that in order to present the philosophical background to Leibniz's position on the continuum, one should begin at the beginning of the historical story. Aristotle is the first figure in the history of western thought to give a complete theory of the infinite, and he understood clearly that "the infinite manifests itself in the continuous" (*Physics* III.1., 200b17). Beeley reasonably selects Aristotle for the beginning of his historical account. But the decision to begin with Aristotle raises a number of difficult methodological questions. In the context of a book on Leibniz, it is not at all obvious how to treat Aristotle's views: should we summarize the ancient position with as much accuracy as possible or should we present that position as Leibniz's would have inherited it? If the latter, then how do we decide which of the extant interpretations of Aristotle's views most appealed to the young man? To understand Leibniz's relation to the philosophy of Aristotle in general is a very complicated matter. Leibniz inherited Aristotle's texts, sundry scholastic textbooks explicating the ancient philosophy, the interpretation that his humanist mentor Jakob Thomasius offered of Aristotelian thought, and a relatively new set of Protestant theological problems which had to be solved in a way consistent with certain Aristotelian doctrines. For Leibniz, Aristotelianism was a number of things at once. In other words, we know that Leibniz had a genuine interest in Aristotle's philosophy and was thoroughly familiar with the ancient texts, but we also know that he was familiar with scholastic commentaries, took notes on the textbooks of contemporary Aristotelians, and studied with one of the most important specialists on Aristotle in Germany. It appears that to attempt to determine Leibniz's relation to Aristotle's theory of the continuum would itself be to enter a labyrinth.

Beeley's approach to the treatment of figures like Aristotle seems to be the easiest and most straightforward one: to take the thought of the historical figure on its own terms. This appears to be a perfectly proper approach to Aristotle, especially since Beeley obviously thinks that the position of the ancient has philosophical as well as historical interest. That Beeley intends to give a thorough presentation of those views seems a perfectly reasonable goal. But again things are not as easy as they at first seem. Once one chooses to summarize Aristotle's views, questions arise about how thorough that summary should be. Aristotle's theory itself was elaborated largely in response to a concern with the problems of continuity and infinite divisibility that were widespread in his day. In other words, Aristotle's theory has its own historical situation: he was responding to Zeno's paradoxes, which in turn were first presented in defense of Parmenidean monism as theoretical weapons in the denial of the reality of plurality and motion. Aristotle's theory of infinity was on the one hand a denial of monism and on the other a denial of the Anaximandrean conception of the unlimitedness of the cosmos. In this case it would seem that in order to explain fully Aristotle's theory, one has to go even further back.

But perhaps this revised methodological strategy is mistaken. Perhaps in the context of a book on Leibniz the goal should not be to give a thorough account of Aristotle's position, but rather to present enough of the position so as to set up the subsequent history. Such a methodological strategy stands in between the attempt to give a relatively complete history of the problem and the attempt to reconstruct the complicated relation that Leibniz had to Aristotle's views. In fact, Beeley could claim that he adopted this more focused approach and note that he did not so much intend to present a thorough account of Aristotle's ideas and a complete history of the continuum problem prior to Leibniz as to summarize the source of the Aristotelian background to Leibniz's views. In this regard, Beeley might say that he hoped only to present Aristotle's theory as the beginning of the Aristotelian-scholastic discussions that led to Leibniz. It is surely relevant that the scholastic commentators to whom Beeley devotes a chapter were unaware of the intellectual circumstance of Aristotle's account and that, after the presentation of the ancient views in chapter 1, Beeley does not return to use that material in his later discussions.

But any such defense of this more focused methodological strategy faces real problems. Concerning Beeley's own approach, it is curious that his rhetoric strongly suggests that he intends to present Aristotle's theory of infinity and not merely the version of the theory that the scholastics absorbed. Concerning this methodological approach in general, it is extremely important that Leibniz was first inspired to read "Aristotle himself" by his professor Jakob Thomasius. As Leibniz put it:

> As soon as I arrived at the Academy, by a rare fortune I met, as a Master, the well known J. Thomasius who ... engaged me very strongly to read Aristotle, announcing to me that, when I would have read this great philosopher, I would

> have a wholly different opinion than that offered by his scholastic interpreters. I soon acknowledged the wisdom of this advice and saw that between Aristotle and the scholastics, there was the same difference as between a great man versed in the affairs of state and a monk dreaming in his cell. I therefore took of Aristotle's philosophy another idea than the common one.[3]

In this context, it is significant that Leibniz subsequently maintained that the ancient thinker had provided a largely correct account of continuity, while the scholastics had "darkened him with their prattling".[4] In other words, Aristotle's theory of the continuum was not merely the beginning of a long history that Leibniz inherited: it was a philosophical position with which Leibniz was actively engaged. In an important fragment of 1671, entitled *On Prime Matter*, Leibniz explicitly says that he accepts the Aristotelian account of matter.[5] Such facts strongly suggest that Leibniz took Aristotle's view very seriously.

What's a person to do? We suggested above that to attempt to determine Leibniz's relation to Aristotle's theory of the continuum might itself be a labyrinthine enterprise. We want to suggest now that it need not be such a heroic task. Regarding the relation between Leibniz and Aristotle, we propose that the scholar (1) indulge in as many details of Aristotle's views as are necessary to identify the ones especially relevant to Leibniz and (2) attempt to identify those contemporaries of Leibniz who might have influenced his perception of the ancient thought. As an argument for point (1) we want to show that in fact a relatively complete analysis of Aristotle's views on the continuum uncovers some important points which are relevant to Leibniz and which Beeley's account ignores.

It is well known that Aristotle affirmed the existence of potential infinity and denied the existence of actual infinity. It is almost as well known that this distinction is somewhat misleading. For instance, in maintaining that a line is potentially infinitely divisible, Aristotle does not wish to claim that there is some possible process that would result in a line's actually being divided into an infinite number of sections; rather he only intends to claim that, given any section of the line, still more sections could be made from it. According to Beeley, Aristotle held the continuum to be strictly an object of physics and therefore that, when Leibniz treats the continuum as a conceptual object, he is going beyond Aristotle's theory. Beeley writes: "We do not find in Aristotle a purely conceptual treatment of the continuum, in which the undifferentiated continuum is held to be an object of thought" (pp. 39-40). We disagree with this interpretation and think that Leibniz's approach to the continuum may have much more in common with Aristotle's than at first meets the eye. Let's explain. In a paper entitled "'Aristotelian Infinity," Jonathan Lear claims that there are important connections in Aristotle's thought between the concept of infinity and the concept of matter.[6] In order to see this, one must grasp what it is that Aristotle is revolting against, namely, the mostly Anaximandrean conception of *to apeiron* (the Unlimited) as it existed in Aristotle's time. Lear claims that it is the assimilation of *to apeiron* to matter that is "at the heart of the conceptual revolution [that Aristotle] is trying to achieve" (p. 69). Lear's argument goes roughly as follows. Besides distinguishing between the potentially and actually infinite in the way noted above, Aristotle distinguishes between them by contrasting 'infinity by addition' and 'infinity by division'. There is no infinity by addition, he claims, for we can never arrive at the end of a process that will leave us with an infinite number of discrete objects. There is however infinity by division. Let's suppose that for Aristotle the infinite by division is synonymous with the potentially infinite (see *Physics* 206a 14-17). Aristotle suggests as much when he writes: "[it] does not exist potentially in the sense that it will ever exist actually and separately; it exists only in thinking. The potential existence of this activity ensures that the process of division will never come to an end, but not that the infinite exists separately" (*Physics* 1048b; our emphasis). According to Lear, the infinite is immanent in nature and not transcendent: we have infinity only in the continuous and by division; there is not infinity by addition or in never-ending space (*Physics* 200b 17). In the same way, prime matter is not transcendent, but only exists when informed. Thus, on Lear's account, matter and infinity exist only *in potentia*: there is no actually existing prime matter and there is no actually existing set of infinitely many discrete objects. Infinity and matter are imaginary entities. On this interpretation, it is wrong to suppose that for Aristotle continuity is an exclusively physical problem.

There are other similarities between Aristotle and Leibniz in their approach to the problem of the continuum which are not apparent without situating Aristotle more fully in his historical situation. Once Aristotle's reflections on the continuum are set against their proper presocratic background, other points of comparison between Leibniz and his ancient predecessor can be seen. The presocratic denial of continuity was first and foremost a rejection of multiplicity. The monists claimed that if there were more than one real thing, then there would be an infinity of real objects; since there cannot be an infinity of real objects, there can only be one thing. Thus, for Aristotle and his monist opponents, the question was how there could be multiple objects. Aristotle's account of the continuum is an attempt to solve one aspect of this problem. Aristotle's theory of concrete corporeal substance can be seen as an attempt to solve another part of the problem: his theory populates the world with substantial individuals which are identifiable subjects of change. Throughout his philosophical career, Leibniz struggled with the question of how to situate genuinely unified beings in a world whose matter was apparently infinitely divisible and whose properties were apparently constantly changing.

The details of our disagreements with Beeley about the relation between Aristotle's views and those of Leibniz are not so important as the methodological moral here. For a scholar interested in presenting the Aristotelian background to Leibniz, it will be important to present an account of that background that is rich enough to include at least most of the relevant parts of that history. Surely, it will be difficult to discern the exact relevance that Aristotle's theory had for Leibniz unless all the relevant aspects of that theory are given. Of course, it will not be easy at first glance to identify exactly which aspects of that theory are relevant. For help, one might reasonably attempt to identify the contemporary scholars of Aristotle who most influenced Leibniz. Surely one of the most obvious places to go for a sense of Leibniz's relation to Aristotle's continuum theory is to the texts of Jakob Thomasius. Not only was Thomasius considered one of the foremost scholars of Aristotle in Germany in the second half of the seventeenth century, he was Leibniz's mentor and the person for whom the young Leibniz wrote the most important early summaries of his ideas. Nor does a survey of Thomasius' texts disappoint. They are full of discussions of matter, ether, the problem of cohesion, and other topics related to the continuum problem. In his *Exercitatio de Stoica mundi exustione*, for example, Thomasius is especially concerned to discuss the nature of matter and the possibility of unity within it (see esp. pp. 186-93). In *Physica, Perpetuo dialogo*, Thomasius also treats these and related topics.[7] It seems likely that the views espoused by "our most famous Thomasius" (A VI ii 426), especially those concerning Aristotle, would have colored the adoring student's perception of the topics related to matter and the continuum. It is striking that in an exchange of letters in 1671, Thomasius and Leibniz agree that some of the theories espoused in the *Physica, Perpetuo dialogo* are similar to those presented in Leibniz's *New Physical Hypothesis* and *Theory of Abstract Motion* which had just been published and which contain an account of the continuum (see A Series II, Vol. I, pp. 73; 77f). Another obvious place to look in an attempt to unearth the Aristotelian part of Leibniz's intellectual heritage is the textbook by the progressive Aristotelian, Daniel Stahl. It is striking that, of all the contemporary Aristotelian textbooks available in the early 1660s, the young Leibniz chose to take copious notes on Stahl's *Compendium Metaphysicae* (see A VI i 21-41). A look at Stahl's text might reveal a version of Aristotle's theory that particularly influenced Leibniz. Neither Thomasius nor Stahl are included in

Beeley's bibliography; there unfortunately is no index.[8]

We do not mean to claim that it would be possible to unearth all the important sources of Leibniz's views about Aristotle, but we do propose that it would be desirable to uncover as much about Leibniz's relation to the Aristotelian theory as possible. If the desire is to present the Aristotelian background to Leibniz's views, then it is simply insufficient to deposit a partial account of Aristotle's theory alongside the views of a few scholastic commentators. There will not be an accurate account of the relation between the thought of Aristotle and Leibniz on the continuum problem until a more accurate picture of Aristotle's theory is composed and the most relevant contemporary versions of that theory are thoroughly explored.

As noted above, part of Beeley's account of the seventeenth-century philosophical context of Leibniz's development is both original and helpful. But the presentation is uneven and some parts suffer from the same gaps that we have witnessed in his account of Aristotle's theory. For example, while Beeley rightly chooses to discuss some of the scientific options which Leibniz considered and which have bearing on the continuity problem, his presentation is often so focused that one does not acquire an adequate picture of the relevant facts. In fact, Beeley's account of the relation between Leibniz and his contemporary microscopists is seriously flawed. In the *New Physical Hypothesis* of 1671, Leibniz criticizes the microscopists of his day for failing to go beyond the search material causes. He seemed to think that as the microsopists drew closer to finding the primary constituents of composite substances, they paid dangerously little attention to the formal causes in the subvisible worlds which their work had discovered. For Leibniz, material causes by themselves cannot be adequate causes. According to Beeley, Leibniz thought of Anaxagoras, along with atomists like Democritus and Epicurus, as "a quintessential symbol of materialistic thought" (p. 208). Since Leibniz took Anaxagoras to be a materialist, he was prone to call anyone who tended toward materialism an "Anaxagorist". Apparently for this reason he labeled his contemporary microscopists, Athanasius Kircher and Robert Hooke, "Anaxagorists". From these facts, Beeley reasons that Leibniz took microscopy to be excessively materialistic. Beeley writes: "Leibniz's criticism of the microscopists consists in this, that the analogies that they point out do not extend beyond material causes" (p. 205). But this is incorrect. As Catherine Wilson has shown, the discoveries of the microscopists had an immense impact on the development of Leibniz's mature metaphysical system, a system anything but materialistic. In her book, *The Invisible World*, Wilson argues that "Leibniz's particular brand of pananimism, which ... fills the world with a plenitude of visible and invisible creatures, rested on the discovery of minute insects" (p. 207). While Leibniz may have rejected some of the conclusions drawn by Hooke and Kircher, his disapproval of these two microscopists did not extend to others. For example, he most certainly did not disapprove of the work of Marcello Malpighi and Antoni van Leeuwenhoek. Although Beeley discusses the "compatibility of Leibniz's concept of matter with contemporary natural science" in chapter 8 (esp. section 3), the material given is inadequate as an introduction to the important influence that the natural science of his contemporaries had on Leibniz's development. In other words, we once again find the historical material presented by Beeley to be overly focused and therefore misleading as an introduction to Leibniz's thought. There is a good deal more to be said about the relationship between Leibniz's responses to the continuum problem and seventeenth-century natural science.

The Problem of the Continuum and the Development of Leibniz's Philosophy

It is a central claim of *Kontinuität und Mechanismus* that Leibniz's attempt to solve the problem of the continuum strongly influenced the development of key elements in his philosophy. By so clearly displaying the whole range of topics related to the problem of continuity, Beeley convincingly shows the significance of the problem in Leibniz's thought. While there can be little doubt that the problem concerned Leibniz for years and that he yearned to solve it cogently, we want to insist that it was only one among several problems which interested Leibniz and that it was not the most important one. Moreover, it seems to us extremely unlikely that the young Leibniz's evolving views about the continuum influenced the core features of his metaphysics. In short, we find Beeley's account of Leibniz's early philosophical development and the place that the continuum problem played in it unconvincing. In the previous section, we centered our discussion around methodological matters. We would like to do the same here. Once again, we think that the problems with Beeley's account suggest a number of grand methodological problems. We would like to discuss some of these here while also noting some of our disagreements with Beeley's interpretation.

At first glance it seems clear that in order to present Leibniz's views about the continuum one should focus on the published discussions of the topic. This is what Beeley does. Through a careful analysis of the discussions in Leibniz's very early publications, Beeley identifies two distinct solutions to the problem. In earliest adolescence, according to his own account, Leibniz began grappling with the problems of the continuum. His first attempt to solve the problem reflects his recent acceptance of the new mechanical physics and philosophy. As Leibniz explains it, "since I was not yet versed in geometry, I persuaded myself that the continuum consists of points, and that a slower motion is one interrupted by small intervals of rest".[9] According to Beeley, in the *Dissertation on the Combinatorial Art* of 1666, Leibniz's solution to the problem of continuity is atomistic: he agrees that the continuum is infinitely divisible, but maintains that any part will have some extension. Also according to Beeley, it was not until *Theory of Abstract Motion* and the *New Physical Hypotheis* of 1671 that Leibniz was prepared to present a coherent account of the continuum. In Chapters 10 and 13 of his book, Beeley presents a plausible interpretation of Leibniz's theory of continuity in this important two-part work. Beeley nicely shows that in 1671 Leibniz was primarily concerned with the continuity of motion. However, since a theory of least motions crucially depends on an account of physical and temporal parts, Leibniz's account of motion was also an account of matter and time. Leibniz denies that the movement of an object involves extremely short intervals of rest; by analogy, he also wants to deny that a line is composed of extremely short line segments and that time is composed of extremely short time segments. Beeley very nicely ties together these different strands of the continuum problem in Leibniz's thought. It follows from Beeley's account of the continuum theory proposed in the *Theory of Abstract Motion* that in 1671 Leibniz has developed a theory about the reality of continuity in the physical world. As Beeley points out, Leibniz feels secure enough about his views to present them as theorems (p. 141).

We applaud Beeley's careful analysis of these early texts and the attention paid to the shift and changes within them. Beeley's account of the views expressed in these works is subtle. But there is much more going on at this time than Beeley suggests. Once again we find gaps and inaccuracies in his account; once again we propose that these are due to an inappropriate methodological strategy: Beeley is both too limited in his philosophical focus and too focused in his textual range. If the goal is to trace the details of Leibniz's views about the continuum, then the textual base for such a study should be much wider. According to Beeley, in 1671 Leibniz has rejected his earlier atomism. Yet there are other texts from 1671 which suggest a commitment to atomism. In a letter to Lambert van Velthusysen of 1671, Leibniz writes: "I will explain...how God can make a body...that is naturally indissolvable.... I will explain [some theological matters] by starting with the nature itself of indivisible things, with as much clarity as one sees when the sun shines" (A Series II, Vol. I, p. 97). In a letter to Johann Friedrich and an attached essay on resurrection, both of 1671, Leibniz talks about "a core" or "flower" of corporeal substance which is indestructible. According to Leibniz, "the core of the body" is such that "no force can damage it" (A Series II, Vol. I, p. 109). Finally, in an essay of 1671 entitled *Hypothesis Concerning the System of the World*, Leibniz proposes the existences of atoms and two other "grades of bodies" (A Series VI, Vol. II, p. 294). By focusing primarily on Leibniz's published works, Beeley has glimpsed only one part of Leibniz's comments about the metaphysical matters which relate to continuity. Once we combine the published materials with the whole range of letters and personal notes, a much more complicated story emerges. We will not engage in the details that concern Leibniz's early conception of substance and its fundamental unity here. Suffice it to say that in 1671 Leibniz was not at a stable point in the development of his ideas either about continuity or about body. Nor does he seem to have reached stability for several years: among his Paris papers (written between 1672 and 1676), there are a number of different accounts of continuity. On the basis of a thorough study of such texts, Richard Arthur persuasively argues in the Introduction to his *Yale Leibniz: Writings on the Continuum* that, throughout the late 1660s and early 1670s, Leibniz was in the process of considering and reconsidering his ideas about the continuum. Arthur nicely describes the rich complications of Leibniz's unpublished texts, especially his personal notes. Arthur writes: "there is an engaging frankness and spontaneity about his changes of mind displayed [in the writings on continuity] that Leibniz could never have duplicated in a formal treatise, and, to the degree that he might have been successful in reducing his ideas to a more logical order, he would inevitably have masked their fascinating and tortuous development."[10] Despite the subtlety of Beeley's account of Leibniz's position in his youthful published works, a wider range of texts does not support the claim that Leibniz was genuinely committed to one account of the continuum in 1671. The methodological moral that we want to draw from this is that, in any attempt to discern Leibniz's views on any topic during any period, one needs to use the widest possible textual scope.

But another methodological moral lurks here. If the goal is to excavate Leibniz's early philosophy, then Beeley has focused too much on the problem of the continuum to the exclusion of other problems. At first glance it seems obvious that, for someone interested in Leibniz's views on the continuum, it is appropriate to focus on those parts of those essays in which matters concerning the continuum are discussed. But with Leibniz things are never simple: because he rarely worked on one problem at a time, it is seldom the case that his solution to a problem is proposed in isolation from his consideration of a number of others. While there is little doubt that Leibniz was interested in the problem of the continuum during these years, he was even more concerned to solve a number of theological problems. As his writings make clear, what most interested Leibniz during the late 1660s were the theological problems which stood at the center of the debate between the Catholics and various Protestant sects. He wrote essays on the the immortality of the soul, the resurrection of the body, the trinity, traduction, transubstantiation, and so on. It is striking that he took notes on Thomas White's account of the Eucharist, but none on White's proposals about the continuum (see A Series VI, Vol. I, pp. 502-07). The outline that he composed in 1668-69 for a large project on theological issues bears witness to the vastness of his goals. As we can see in his *Conspectus*, the range of topics which Leibniz planned to include in this grand work is stunning: from the possibility of the immaculate conception, the beatific vision, and the salvation of non-Christians to the nature of space, body, and angels (see A Series VI, Vol. I, pp. 494-99). Nor is that all. While he was worrying about angels, he was also committed to the construction of a metaphysics that would be fundamentally Aristotelian (or what he considered to be such) and yet consistent with mechanical physics. Leibniz liked to keep busy. During the late 1660s and early 1670s he spent most of his time on these projects and wrote various essays which contain his first metaphysical proclamations. Beeley is fully aware of Leibniz's theological and reconciliatory concerns. Chapter 4 is devoted to a discussion of such topics in the *Confession of Nature Against the Atheists* of 1668. But despite Beeley's interesting observations about some of the proposals in this essay, he fails to mention the metaphysical assumptions which Leibniz is considering there for the first time. Nor does Beeley seem to recognize the central position that the various theological problems listed above had in Leibniz's intellectual evolution. If the goal is to trace some of the major steps in Leibniz's development, then such theological concerns must be considered. As most of the best recent work on Leibniz's metaphysics proudly proclaims (e.g., by Robert Sleigh, Robert Adams, and Donald Rutherford), theological problems stand at the center of Leibniz's thought both early and late.

In her forthcoming book, *Leibniz's Metaphysics: Its Origins and Development*, Mercer presents a detailed account of the various interests and concerns which informed Leibniz's philosophical reflections during these early years.[11] Mercer argues that Leibniz had a clearly articulated conception of substance as early as 1668-69 and that this conception primarily grew out of his concern to solve a number of pressing theological matters while remaining consistent with a specific set of metaphysical assumptions. She also claims that these assumptions and the general features of this account of substance form the basis for Leibniz's later conception of substance. Although it is debatable whether or not Leibniz retained those commitments throughout his Paris years (e.g., commentators like Mark Kulstad, Robert Adams, and most recently Paul Lodge maintain that in Paris Leibniz went through a period either of occasionalism or Spinozism or both before embracing his mature conception of substance[12]), it is clear that many of the metaphysical assumptions that inform, say, the philosophy of the *Discourse on Metaphysics* are evident in the essays of 1668-69. Given the fact that such assumptions are discernible in those essays and given the fact that, as Beeley maintains, Leibniz only proposed his first thorough account of continuity in 1671, then it would seem to follow that the problem of the continuum could not have strongly influenced some of the most basic elements of his metaphysics. Mercer has noted that Leibniz changes some crucial features of his original conception of substance between 1669 and 1671, and she has argued that these changes were mostly motivated by a tension that he discovered between his original account of substance and some of his metaphysical assumptions. Leibniz's increased fascination with the problem of the continuum in 1670 surely played a role in the evolution of his views, but he did not change his mind during this period about his most basic metaphysical assumptions. We will not present here the elaborate textual support that Mercer offers for her interpretation. But we will offer what we take to be the methodological moral to the story: in approaching Leibniz's texts in general and the evolution of his views in particular, it is always dangerous to isolate one problem from the others on which he was invariably working. Leibniz did not limit his attention in this way, nor should we.

Conclusion

Despite our disagreements with some of the main claims of *Kontinuität und Mechanismus*, we heartily agree with others: Beeley has successfully displayed the complicated nature of the problem of the continuum and appropriately drawn attention to its significant metaphysical relevance. And despite our reservations about some of its methodological strategies and historical details, we warmly embrace its attempt to situate Leibniz's early thought in its proper historical context. Beeley's historical approach is one that has not been used on Leibniz's theory of continuity. Manuel Luna Alcoba's excellent *La ley de continuidad en G. W. Leibniz* devotes only an introductory chapter to the context of Leibniz's inquiry,[13] while Fabio Bosinelli is primarily interested in the formal properties of Leibniz's theory of infinity and the impact of this theory on subsequent mathematics.[14] A similar difference of emphasis is to be found in the work by Herbert Breger, John Earman, and Hans Poser.[15] The historical material in Beeley's book breaks new ground in its attempt to present the history of the problem of the continuum that Leibniz inherited. In summary, Beeley has offered an original scholarly work both on the historical background to the problem of the continuum and on Leibniz's original and complicated attempts to solve that problem. *Kontinuität und Mechanismus* contains much that is original, subtle, and true.[16]

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[1]Catherine Wilson, *Leibniz's Metaphysics: A Historical and Comparative Study* (Princeton: Princeton University Press, 1989), p. 3.
[2]In chapters 1, 2, and 6, of her forthcoming book, Mercer argues in detail for these claims about Leibniz's relation to the history of philosophy. See *Leibniz's Metaphysics: Its Origins and Development* (Cambridge: Cambridge University Press, 1998).
[3]Foucher de Careil, *Mémoire sur la philosophie de Leibniz*, 6f; my emphasis. According to Foucher de Careil, the passage cited here was written during the 1660s (5).
[4]*Gottfried Wilhelm Leibniz: Sämtliche Schriften und Briefe*, Akademie der Wissenschaften, Berlin (hereafter A), Series II, Vol. I, p. 21.
[5]See A Series VI, Vol. II, p. 279f. Leibniz claims in this essay that "Aristotle's primary matter is the same as Descartes' ethereal matter".
[6]See J. Lear, "Aristotelian Infinity", in *Infinity*, ed. A. W. Moore (Brookfield, Vermont: Dartmouth University Press, 1993), pp. 55-78.
[7]See *Physica, Perpetuo dialogo, suis tamen capitibus interciso, sic adornata, ut scientia naturalis non tantum definendo ac dividendo, sed etiam celebrioribus attingendis controversiis, idque plana methodo nec difficili, explicetur*, which was first published in Leipzig in 1670, just at the time that Leibniz was first developing his first full-blown account of the continuum.
[8](Footnote deleted from our penultimate draft and added after receiving Beeley's response:) The obscurity of Beeley's German style often makes it difficult to make

out his point.

[9]Quoted in *Physis* 28, 1991, p. 803.

[10]Richard Arthur, "Introduction" to *The Yale Leibniz: Writings on the Continuum* (New Haven: Yale University Press, forthcoming), p. 6.

[11]For a thorough account of these points, see *Leibniz's Metaphysics: Its Origins and Development*, (Cambridge: Cambridge University Press, 1998), esp. chapters 2-7; for a summary of some of these points, see Mercer and R. C. Sleigh, Jr.,"The Early Metaphysics to the Discourse on Metaphysics" in *The Cambridge Companion to Leibniz*, ed. N. Jolley (Cambridge: Cambridge University Press, 1995), 67-123.

[12]Mark Kulstad, "Causation and Pre-Established Harmony in the Early Development of Leibniz's Philosophy", *Causation in Early Modern Philosophy*, ed. Steven Nadler (University Park: Pennsylvania State University Press, 1993); "Did Leibniz Incline toward Monistic Pantheism in 1676?" Presented in July at the International Leibniz Kongress, 1994; Robert M. Adams, *Leibniz: Determinist, Theist, Idealist* (Oxford: Oxford University Press, 1994), sect. 3.1; Paul Lodge, "When Did Leibniz Adopt the Pre-established Harmony?" *Archiv für Geschichte die Philosophie* (forthcoming).

[13]Manuel Luna Alcoba, *La ley de continuidad en G. W. Leibniz*. Doctoral dissertation, Universidad de Sevilla, 1994.

[14]Fabio C. M. Bosinelli, "Über Leibniz' Unendlichkeitstheorie," in *Studia Leibnitiana*, Band XXIII, Heft 2, 1991.

[15]See, e.g., Herbert Breger, "Le continu chez Leibniz," in *Le Labyrinthe du continu*, ed. Jean-Michel Salanskis and Houyra Sinaceur (Paris, Berlin: 1992), pp. 76-84; John Earman, "Infinites, Infinitesimals, and Indivisibles," in *Studia Leibnitiana*, Band VII, Heft 2, 1975, pp. 236-251; Hans Poser, "Die Idee des Unendlichen und die Dinge. Infinitum und Immensum bei Leibniz," in *L'infinito in Leibniz. Problemi e terminologia*, ed. Antonio Lamarra (Rome: Pubblicazioni del Lessico Intellettuale Europeo), pp. 225-233.

[16]We would like to thank Richard Arthur for helpful comments on a draft of this review.

Review of Philip Beeley's *Kontinuität und Mechanismus*
by Catherine Wilson, University of Alberta

Leibniz-intepretation presents exceptional problems of critical distance. If the commentator stands too close to the text, Leibniz's work appears as a jumble of fragments and reactions which can be quoted and recombined endlessly without falling into a readable pattern. Too far from the text and the interpretation is merely formulaic—and easily contradicted by the exhibition of a quotation or two. This difficulty is pronounced with the Leibniz of the 1660s and 1670s who offers the reader little in the way of finished work, the *Pacidius Philalethi* and the *Confessio Philosophi* constituting the exceptions. An overdistanced commentator approaches Leibniz's early jottings and sketches in the expectation of finding anticipations of that elusive object of desire—Leibniz's mature metaphysics; the underdistanced commentator wanders in Leibniz's range of learned references and momentarily-adopted trial positions. Philip Beeley has adroitly placed himself in relation to his subject and brings exceptional order and clarity to a restricted but at the same time critical period of Leibniz's philosophical evolution. This is a reliable and illuminating study which covers effortlessly its historical, physical, mathematical, and philosophical ground.

As is well known, Leibniz thought there were two labyrinths: the problem of freedom and the problem of the continuum, and the latter was arguably the richer source of materials for speculation. The problem of the continuum was launched when Aristotle attacked the atomists, arguing that least elements did not compose continuous substances because a line could not be composed of points, an observation generalized to mean that an entity of n-dimensions cannot be composed of entities of n-1 dimensions; points exist as limits, not as constituents. In ruling out atomism seemingly for reasons of a high level of generality, Aristotle had apparently demolished the foundations of a nexus of doctrines associated with atomism: moral epicureanism, mortalism, the democritean reduction of qualities, and atheism; correspondingly to admit atoms was to be seen as endorsing the other doctrines, so that the existence of "forms" which gave substances their substantiality had a strong ideological value.

But religion and morality were only incidentally served; the good arguments—mathematical and physical—appeared to be on the side of continua and continuous substance: if a body was composed of discrete particles, what held its smallest particles together so that it acted as a macroscopic unit? Why didn't objects in the macroscopic world fly apart as the earth turned? If there were void spaces between macroscopic bodies or atoms, what prevented every atom in the universe from being sucked together into a single lump? But atomism, first in a qualitative, then for a while in an abstract form represented by Boyle and Locke, later again in a qualitative form, was the working philosophy of the chemists. The atomist could identify the recombinant entities in chemistry, could explain why substances could disappear and then be recovered in chemical processes without the destruction of forms, and could account for many types of action at a distance including contagion, poisoning by vapours, and other occult effects by reference to subvisible but material particles.

Beeley's study is addressed to Leibniz's early efforts to reconcile the usefulness of atoms in physical theory with metaphysical and mathematical arguments for the continuum. It focuses on his writings between his first defense of the new philosophy in the Letter to Thomasius (1670-1), and the *Pacidius Philalethi*, through the two parts of the *Hypothesis phvsica nova* (1671) and into the "Paris Notes" or *De Summa Rerum* (1674-6). He finds Leibniz seriously engaged with the English: with the corpuscles and microscopic entities of Boyle and Hooke, with Hobbes, Thomas White and Kenelm Digby, as well as Galileo (an immaterial atomist) and Cavalieri. Beeley discounts earlier claims for the influence of the atomist Gassendi and shows Leibniz to be almost entirely ignorant of Descartes and the Cartesians in this period. Clearly, Leibniz was deeply intrigued by Hobbes because, alone among the physical atomists, he had interwoven infinitistic notions into his explanations and accounts. But it is also remarkable that, as Beeley shows, Leibniz sought first-hand knowledge of the ancients. And he suggests, in a fascinating discussion of Leibniz and Anaxagoras, that Anaxagoras's vision of the "structural infinity of matter" was one of the avenues for Leibniz into the theory of universal containment and universal mirroring. Anaxagoras had taught that every substance contained bits of every other substance within, i.e. bone contained bits of blood, bits of stone, bits of milk, bits of gold, etc. each of which contained bits of all the others, and this, he thought, accounted for the phenomena of nutrition and decomposition. Though, Beeley says, Leibniz rejected the Anaxagoras's multiplication of qualitatively distinguished entities, the idea that each fragment of matter contains in some sense the entire world struck him forcibly. Beeley is similarly helpful in pointing out the frequency of passages on "little worlds" and little minds, sometimes in connection with "atoms" "solids" and even "vortices" in Leibniz's early writings. He leaves no doubt that an adequate formulation of the mechanical philosophy was his overarching intellectual aim in these years, consistent with Leibniz's own account of his youthful endeavors, and that Leibniz hoped by this route to produce a really effective alchemy and pharmacology. Beeley supplies the best available account in any language of the basic principles of the *Hypothesis physica nova*, and shows how Leibniz proposed to reconcile there all the major contending accounts of his time: the three elements of the chemists, the four elements of the Aristotelians, acids and alkalis, elasticity, magnetism, and light, with the help of an aetherial wind and full and empty "bullae" or corpuscles. At the same time, Leibniz could not, in his early years, give his full metaphysical commitment to atomism; the arguments for the infinite divisibility of space, time, and matter, were simply too powerful. Evidence from the newly-invented microscope for atoms was ambiguous: clearly, ordinary objects were made up of entities very different from themselves under their macroscopic aspect, but attempts to glimpse corpuscles came to naught. The idea that science requires a distinct level of explanation from metaphysics suggested itself to Leibniz early, inducing a break from English natural philosophy as well as the scholastic tradition.

One result of Beeley's study is however to frustrate attempts to backdate Leibniz's immaterial atomism far into his youth and to cast doubt on the depth and sincerity of Leibniz's seemingly positive reception of Aristotle. Beeley is excellent on how Leibniz, in the letter to Thomasius, is charged with the problem of making his corpuscularian mechanism attractive to his old teacher. What comes through in the early years is Leibniz's commitment to producing a physically and chemically coherent mechanical philosophy which is not, as are his later schemes, intermingled with moral and religious ideals. Beeley firmly dispels misconceptions about the Hobbesian *mens momentanea* as a precursor of a lower monad and correctly postpones the evolution of immaterial thinking atoms to a later period.

This is a selective and focussed study of the young Leibniz: it is not concerned with Leibniz's encyclopedia projects (another example of his early finitism), or with his logico-linguistic essays, or the doctrines of the "Confessio," and it bypasses for the most part Leibniz's earliest discussions of phenomenalism and the harmony of perceptions. Leibniz's preoccupation with matter-theory and the somewhat pathetic longing of the young Mainz philosopher and historian, never to be realized, to be a part of English natural philosophy, is firmly in the center. The question that naturally preoccupies the reader—the precursor Leibniz having been effectively demolished—is the route from here to the *Discourse on Metaphysics* of 1686 when, no longer a free and Democritean thinker, Leibniz firmly affixes his physical theories to a Malebranchian theory of perception in lieu of a Hobbesian, and decides to admit substantial forms after a fashion and to allow the multiplication of entities—individual substances—to infinity. What happened to cause this (fortunate) collapse and reorganization? This question lies beyond the scope of Beeley's study, which nevertheless brings the question into distinct focus.

The exposition is easy to follow and the author is firmly in charge of his material at all times. *Kontinuität und Mechanismus* should be read by anyone concerned with Leibniz's philosophy of mathematics, or with his envisioning of a derivative or "phenomenal" role for mechanism in his later philosophy, or simply with his earliest philosophical orientation. The bibliography is selective, but covers a range of languages and authors both recent and hallowed. The lack of an index is greatly to be regretted. One sentence deeply puzzled the reviewer. "Die Welt sei nämlich ein erhabener Staat, in dem die Geister gleichwie Kinder oder Feinde, die sonstigen Geschoepfe gleichwie Sklaven sind." (p. 210). I expect "hostes," here translated as "Feinde" or "enemies," could be translated as "guests." Even so, what was Leibniz thinking of in this passage?

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