Milton, Leibniz, and the Measure of Motion

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I

Milton's description of the "high capital / Of Satan and his peers,"[1] the aptly named Pandaemonium, leads to a memorable account of its architect's expulsion from heaven:

> Men called him Mulciber; and how he fell
> From heaven, they fabled, thrown by angry Jove
> Sheer o'er the Crystal Battlements; from morn
> To noon he fell, from noon to dewy eve,
> A summer's day; and with the setting Sun
> Dropped from the zenith like a falling Star,
> On Lemnos the Aegaean Isle: thus they relate,
> Erring; for he with this rebellious rout
> Fell long before; nor aught availed him now
> To have built in heaven high towers; nor did he scape
> By all his engines, but was headlong sent
> With his industrious crew to build in hell. (I: 740-751)

Here, as often in Milton's epic, time provides the measure of motion – recall, for instance, the war in heaven, which concludes with the anarchic descent of the defeated angels: "Nine days they fell; confounded Chaos roared, / And felt tenfold confusion in their fall" (VI: 871-72). Elsewhere space provides the measure of both time and stasis, as in an earlier,

[1] John Milton, *Paradise Lost* in *John Milton: A Critical Edition of the Major Works*, Stephen Orgel and Jonathan Goldberg, ed. (Oxford: Oxford University Press, 1991), Book I: 756-57. Subsequent citations indicated as (book: line number) in body of essay.

parallel description of the aftermath of this defeat: "Nine times the space that measures day and night / To mortal men, he with his horrid crew / Lay vanquished (I: 50-52). In these examples, falling – a continuous change in location over a duration – is measured by time's succession, whereas the duration of immobility is imagined as spatial extension, the "space" that the fallen "lay vanquished." Such shifting articulations of time and space are not surprising, since at stake are precisely motion and stasis, both of which necessarily demand relating the spatial to the temporal.

Of course, using time to tell space or vice versa is far from unusual – we do it everyday, everywhere. Indeed, Milton himself derives the choice of motion's measure from the Homeric lines being dilated upon here, describing Hephaistos' fall: "all day long I dropped, I was dead weight and then, / when the sun went down, down I plunged on Lemnos, little breath left in me."[2] But the shift in emphasis is nonetheless significant. At this juncture in the *Iliad*, Hephaistos' concern is to recount what had happened to him, in order to explain to his mother why he dare not help her now. By contrast, falling takes centre stage in Milton's retelling. And necessarily so, for in all such instances the physical event is inextricable from the all-encompassing moral, psychological, cosmological and theological event that the entire epic is designed to "justify" (I: 26): the Fall. Mulciber's headlong descent turns out to be only a latterly, and in fact imaginary ("fabl'd") repetition of a falling away from God's law that has already happened. And, further, the very mistaking of his descent upon Lemnos as the true fall expresses the conditions of man's own fallenness, Adam's error becoming the both cause and prototype of the error of a world that cannot see the fall for what it truly was and continues to be: "thus they relate / Erring." Or again, in the lines from Book VI cited above, the physical event ("they fell") literally echoes in the ensuing perceptual or psychological event ("and *felt* tenfold confusion"), these two simultaneous occurrences being themselves enveloped by the immensely larger event of "thir fall."

Milton's almost elegiac elaboration of Mulciber's fall dwells on the continuity of the

[2]Homer, *The Iliad*, trans. Robert Fagles (New York: Penguin Books, 1991), Bk I, ll. 713-15.

motion, traversing a geometrical arc whose uninterrupted unfolding is emphasised not only by repeating the middle term ("noon") that connects beginning and end, but by further integrating the flowing segments (from morn to noon, from noon to eve) into the elongated totality of "a summer's day." At the same time, though, the description retains an awareness of motion's punctuality: against the event of falling taken as totality are counterposed the two outer extremes of morn and eve between which motion extends itself. The rich word "sheer" – whose meanings range from "a sudden swerve" to "entirely, completely" – expresses the singular action initiating the fall, just as the comparison to a falling star captures the evanescent celerity ("dropt") of its ending. And just as these moments mark the fall's external endpoints, so too does the "noon," in its very repetition, mark an internal boundary that must be both reached and overcome. That such a moment exists within the extended whole of the movement further expresses its divisibility as such, that is, the fact that a given duration can only be composed out of smaller (and potentially yet smaller) temporal segments, each point conceived as a potential boundary, separating a segment that is past ("from Morn / To Noon") from one to come ("from Noon to dewy Eve") – and thereby marking as well the overgoing of that boundary, the change from one situation to another.[3]

My somewhat pointed re-description of Milton's verse is designed to open a passage in two directions: on the one hand, to reveal the traces here of Aristotle's analysis of motion,

[3]It is no accident that our everyday language concerning motion shares with Milton's description the duality between continuity and divisibility. For all its undoubted complexity, Aristotle's analysis remains very close to the basic intuitions implicit in our quotidian understanding. From this perspective, what is decidedly unintuitive is in fact the early modern separation of space from time in describing how a movement occurs. As Gilles Châtelet persuasively argues,

> the modern graph [which typically plots distance along the ordinate and time along the abcissa] immediately seeks to focus all attention on the distance actually travelled by the moving body by reducing it to an output; such a quantity of time at at such a velocity 'transmits' such a quantity of length, and the relationship L=VT is satisfied by making this bit of the x-axis 'correspond' with that bit of the y-axis, thus atrophying the horizontality of the x-axis and the verticality of the y-axis.

See Gilles Châtelet, *Figuring Space: Philosophy, Mathematics, and Physics* (Dordrecht: Kluwer Academic Publishers, 2000), 39. Mary Crane's recent *Losing Touch with Nature: Literature and the New Science in Sixteenth-Century England* (Baltimore: Johns Hopkins University Press, 2015) offers an engaging account of the emerging schism between embodied human experience and scientific explanation resulting from the erosion of Aristotle's authority.

especially in the *Physics*, perhaps the most consequential theory with and against which the seventeenth century contended; and, on the other, to connect, through the problem of the Fall, Milton's treatment of movement in *Paradise Lost* to Leibniz's subsequent efforts to thread what he memorably called the labyrinth of the continuum. To uncover the mathematical as a terrain shared by their respective theodicies is the primary burden of this essay. For, as we shall see, the relationship between continuity and unassignable or vanishing movements plays a central role for Leibniz as well in negotiating a path through the other labyrinth of abiding concern to Milton, that of freedom or free will. But the centrality of the Aristotelian legacy for both these writers, vexed as it was, necessitates first a propaedeutic to specify more precisely the problem that motion posed for Aristotle and his medieval successors.

II

The revolution in mechanics spurred by Kepler and Galileo and culminating in Newton has led to our thinking about motion primarily in terms of local movement – that is, as change of place – thereby rendering less visible the more capacious earlier concept. Aristotle's use of *kinesis* or *metabole*, however, treats it as virtually identical with nature itself. As the *Physics* puts it,

> Since Nature is the principle of movement [kineseos] and change [metaboles], and it is Nature that we are studying, we must understand what 'movement' is; for, if we do not know this, neither do we understand what Nature is.[4]

Likewise, for the Scholastics, *motus localis* was no more than one specific mode of a generalised concept that conceived movement, following Aristotle's lead, "as the transition from potentiality to actuality or vice versa, ... [and therefore occurring] in every formal category

[4]Aristotle, *The Physics*, trans. Philip H. Wicksteed and Francis M. Cornford (Harvard: Harvard University Press, 1970), Bk. III: 200b12-15, p. 191. Aristotle uses *kinesis* (movement) and *metabole* (change) interchangeably to indicate the most general concept of motion. On this nexus of movement and temporality, see Martin Heidegger, *The Basic Problems of Phenomenology* (Bloomington: Indiana University Press, 1988), 233-35.

in which the distinction between actual and potential being can be made."[5] The four such categories were substance, quantity, quality, and place. So, motion comprised the creation and dissolution of substances (*generatio* and *corruptio*); the quantitative increase and decrease in material (*augmentatio* and *diminutio*) or in volume (*rarefactio* and *condensatio*); the qualitative alteration in substances, including the increase and decrease in intensity of a characteristic (*intensio* and *remissio*); and, finally, change of place (*motus localis*).

Generally speaking, the Scholastics eliminated the first of these in their discussions of motion because they added another requirement, itself drawn from Aristotle: that the transition between actuality and potentiality be a successive rather than an abrupt one. Insofar as generation and corruption were seen as instantaneous mutations rather than successive movements, they no longer counted as motion. But quantitative, qualitative, and spatial change remained bound together as different formal instantiations of movement understood as "the acquisition or loss, in successive stages of a categorical attribute, a so-called 'perfection'."[6] This restriction indeed lays bare what for Aristotle was the fundamental difficulty of grasping movement conceptually, whatever its modality: holding together the two aspects identified above in Milton's depiction of Mulciber's descent from heaven, that is, falling as both a continuous unity and as a set of successive segments.

Movement needs to be captured in the middle, so to speak, or as Friedrich Kaulbach puts it, "between the boundary and the overgoing of the boundary, between multiplicity and the continuous unity of the multiple. Movement is always hovering: it is simply a continuum that hangs together, but a unity that as it were emerges on the back of the boundaries, out of the many."[7] As continuous totality, movement is undivided and as such indivisible in the specific

[5]Annaliese Maier, "The Nature of Motion," in Steven D. Sargent (ed. and trans.), *On the Threshold of Exact Science* (Philadelphia: University of Pennsylvania Press, 1982), 22.

[6]Annaliese Maier, "Nature of Motion," in *On the Threshold of Exact Science: Selected Writings of Annaliese Maier on Late Medieval Natural Philosophy*, Steven Sargent, ed. and trans.(Philadelphia: University of Pennsylvania Press, 1982), 23.

[7]Friedrich Kaulbach, *Der Philosophische Begriff der Bewegung: Studien zu Aristoteles, Leibniz und Kant* (Köln: Bühlau Verlag, 1965), 3. Translation mine. This essay leans heavily on Kaulbach's nuanced account of how Aristoteles and Leibniz conceive movement, as well as on Anneliese Maier's groundbreaking work on the Scholastics, and in particular the essays, "Das Zeitproblem" and "Bewegungskräfte und Energien,"

sense that an individual entity cannot be divided. From this perspective, each segment of the movement makes immediately makes present the undivided flow of the movement as a whole. But insofar as we can always introduce internal boundaries into that totality, from another perspective any movement is infinitely divisible. To cite Kaulbach again, "a path, over which a movement passes, is unequivocally determined as a path through its endpoints, its from-where and its to-where, but the possibilities of dividing this path are infinitely many." Whereas indivisibility demands "that the view into the totality of the movement not be interrupted at any moment,"[8] this homogeneity in turn necessitates the possibility of division without end. To return to the Miltonic example, Mulciber's fall is fixed as an undivided totality by its temporal and spatial endpoints – thrown at morn from Heaven's crystal battlements and dropped at the setting sun on Lemnos – but its infinite divisibility is nonetheless asserted by the possibility of being segmented without limits, the successive sequence of morn to noon and noon to eve expressing one of infinitely many possible beginnings and endings.

The paradox of movement is brought to its sharpest instantiation in Zeno's famous arrow paradox, which treated the temporal continuum as if it were composed of infinitely many duration-less instants. At any such moment, the arrow neither moves to where it is (because it is already there) and nor does it move to where it is not (because, the instant being without temporal extension, no time passes for it to move); consequently, motion is impossible. Aristotle's refutation focuses on Zeno's re-constituting the arrow's movement as an *actual* infinity of instants or temporal points, a hypostasisation of the infinite divisibility of the time and space occupied by arrow's flight. But time, responds Aristotle, "is not composed of indivisible nows any more than any other magnitude is composed of indivisibles."[9] In effect, each point – or, were one to divide the arrow's path into segments, each join between two

in her *Metaphysische Hintergründe der Spätscholastischen Naturphilosophie* (Rome: Edizioni di Storia e Letteratura, 1955), pp. 45-137 and 225-69 respectively.

[8]Kaulbach, *Der Philosophische Begriff der Bewegung*, 11.

[9]Physics VI, Part 9, 239b5.

segments – interrupts and thereby destroys the movement's unity. It is an error, then, to trace the arrow's flight as if it were forced to follow each individual point or segment successively. Rather, each possible instant needs to be seen from the perspective of the whole movement, which expresses itself as a totality in it: "one must observe the divisions introduced by the calculations of the understanding from the perspective of. . . the indivisibility [of the whole]: otherwise what is lost is the movement itself."[10] From such a viewpoint, the "now"s are not simply indifferent atoms constituting the movement; quite the contrary, each "now" is pregnant with both past and future, of the journey to that moment and the goal towards which the movement aims. The echoes of this conception may be heard in Milton's now as well: "for he with this rebellious rout / Fell long before; nor aught availed him now / To have built in Heaven high towers" (I: 748-49). Bringing together each instant of the present falling with the totality of the event itself, Mulciber's "now" bears with it – and indeed is a veiled expression of – a fall that is past, whose consequences it iterates and which endlessly reverberate beyond this moment itself. The placement of the "now" is itself bivalent. In its primary sense, the adverb modifies the preceding verb: nothing "avail[s]" him in this present instance, the moment of his fall. But the now also lightly attaches itself to the verb that follows – "have built" – in the sense of "by this time," suggesting that the history of Mulciber's past accomplishments in heaven culminates (futilely) in this present now of falling. Indeed, ironically, it is only now, very now, that he perhaps realises most fully the telos of his architectural prowess, to be hurled off the very towers he built, "headlong sent" to build elsewhere.

But how is one to hold together these two aspects of movement, the flowing of an indivisible unity with the logical possibility of infinite division? Aristotle's key idea here is that of symphysis, a principle internal to nature (physis) that eventuates in a growing or melting together of the segments into which a single movement can be divided. Consider yet again Milton's evocative description of Mulciber's fall: "from morn / To noon he fell, from noon

[10]Kaulbach, *Der Philosophische Begriff der Bewegung*,13.

to dewy eve, / A summer's day. . . ." As we have noted, the summer's day divides into two segments, which touch each other at noon. But if we see in this as a division into two *separate* sections, then each has its own pair of delimitations (morn–noon and noon–eve), and we have in effect two "noons," two boundaries, that merely lie together at a single instant. So conceived, the original movement has simply been broken into two independent pieces, each with its own terminations, and what has been lost is precisely the continuity of the initial totality. To avoid this Zenoistic result – and thus to grasp movement properly – the boundary must be thought differently: not simply as a logical division but simultaneously as the very possibility of the continuum itself, as something that equally disappears through the movement that flows through it; that is, through the falling, the two noons merge, melting together into one. In discussing this process, Kaulbach cites a pertinent Aristotelian example, that of grafting. The existing boundaries delimiting the slip from the branch of a tree must be overcome at the point of contact, so that a single movement or process emerges, leading to the existence of a single tree. The pre-condition for such a growing-together is the contact between slip and branch, but in itself contact is insufficient; what is necessary is a principle internal to nature, symphysis, which ensures that a continuum grows out of touching, making slip and branch one.[11]

In the sixteenth century yet another momentous fall would shatter the natural bonds of symphysis: the dropping of a stone from a tower. For Aristotle, the total movement from tower to ground expresses an internal principle effective in the stone, its striving to reach its natural place, the earth; the multitude of temporal instants are bound into a unity through the stone's striving to go from top to bottom, the duration of its descent a function of its weight. But, by demonstrating that objects of different mass fall with the same acceleration, the Galilean experiment would undermine the internal connection Aristotle had posited between weight and time, thereby decisively shifting the kind of question natural philosophy sought to address. Rather than treating movement as a whole, that is to say, seeking to grasp

[11]See Kaulbach, *Der Philosophische Begriff der Bewegung*, 15ff.

what movement is, Galileo focuses instead on calculating *how* the stone behaves over the course of its descent. In so doing, he severs the Aristotelian totality of movement, dissolving it into its constituent spatial and temporal parts. In Kaulbach's words,

> Out of the event of this movement, Galileo liberates a temporal and a spatial component, conceives each of these as a line, comprised of points, and matches each point on the line of time with a corresponding point on the line of space. This matching takes place through a rule, which expresses itself in a mathematical formula. This formula enunciates the law of free fall.[12]

It is, of course, with the Newtonian rejection of 'hypotheses' that we get the most decisive formulation of the mechanistic philosophy initiated by Galileo's experiment. In his often-cited letter to Roger Cotes in 1713, for instance, Newton would insist that "anything which is not deduced from phenomena ought to be called a hypothesis, and hypotheses of this kind, whether metaphysical or physical, whether of occult qualities or physical have no place in experimental philosophy."[13] The consequences of the mechanistic revolution are far-reaching. Nature is no longer understood in terms of an internal principle of change which provides each particular movement its telos: in place of nature's "occult" bond enters "the bond produced by the understanding, with which it fetters and binds nature."[14] In lieu of the unity of its essence, movement receives its unity from without, through the mathematical law revealed by experimentation.

Nevertheless, as we have already glimpsed in Milton, the question concerning the "what" of movement could not be easily put to rest, and certainly not for the seventeenth-century – even if it proved equally impossible to return to a *status ante quo*. To paraphrase Kaulbach, the truth claims of Aristotelian physics are not settled by an emergent mechanistic philosophy of nature that assigns to cognition the task of tying natural phenomena into a bundle –

[12]Kaulbach, *Der Philosophische Begriff der Bewegung*, 30. See also pp. 25-7.

[13]Isaac Newton, *Correspondence of Isaac Newton*, 7 vols. (Cambridge: Cambridge University Press, 2008), V: 397.

[14]Kaulbach, *Der Philosophische Begriff der Bewegung*, 24.

uno fasciculo colligare, to cite a formulation Kepler repeatedly uses –,[15] since the inductive processes of the latter cannot lead to the kind of deductive truth promised by the former.

The felt need for something beyond the physical to account for what movement is, that is to say, for a metaphysical understanding of the very category of substance, is everywhere evident in what Stephen Fallon aptly terms Milton's "animist materialism."[16] Book I of *Paradise Lost* closes with a description of how the fallen angels enter Pandemonium for "the great consult" (I: 798) that will eventuate in Satan's fateful flight to "this pendent World":

> . . . they anon
> With hundreds and with thousands trooping came
> Attended: all access was thronged; the gates
> And porches wide, but chief the spacious hall
> . . .
> Thick swarmed, both on the ground and in the air,
> Brushed with the hiss of rustling wings. As bees
> In springtime, when the Sun with Taurus rides,
> Pour forth their populous youth about the hive
> In clusters[,]. . . . . [s]o thick the aery crowd
> Swarmed and were straitened; (I: 759ff)

To convey a sense of the infernal multitude, Milton's language reaches beyond the discrete measure of enumeration ("with hundreds and with thousands") to settle first on words that turn count into mass: "thronged," "Thick swarmed," and so on. The movement into Hell's capital gathers up individuals to merge them as amassed bodies, just as the sheer number of bees in spring fuse into clusters, so that individuals cannot be singly distinguished. But neither numbers nor even the analogy from the natural world proves sufficient, for the fixed

[15]See Kaulbach, *Der Philosophische Begriff der Bewegung*, 33.

[16]See Stephen Fallon, *Milton among the Philosophers: Poetry and Materialism in Seventeenth-Century England* (Ithaca: Cornell University Press, 1991), 2-3.

space of Pandemonium demands even more, if all of Satan's army is to be accommodated. Certainly, the density of the crowd continues to increase, the devils "straitened, until, Milton continues, "the signal is given." And then:

> Behold a wonder! they but now who seemed
> In bigness to surpass Earth's giant sons
> Now less than smallest dwarfs, in narrow room
> Throng numberless. . . .
> Thus incorporeal Spirits to smallest forms
> Reduced their shapes immense, and were at large,
> Though without number still amidst the hall
> Of that infernal court. (I: 778ff)

Bees are, after all, merely bodies, and geometrical extension, the sole property Cartesians would cede to bodies, does not capture what matter and substance are truly capable of. This capacity is revealed in a second, qualitatively different movement wherein the "incorporeal Spirits to smallest forms / Reduce[] their shapes immense," compressing through their own capacities what was still rareified, without thereby losing their identity – or indeed even, Milton jests, their size, for they remain "at large," although smaller now than "smallest dwarfs." The paradoxes of substance and movement in episodes such as these suggest Milton's own desire to locate in material substance – a category not coextensive with corporeality or body – a latency that exceeds the grasp of mechanistic natural philosophy.

In this endeavour, Leibniz is a kindred soul, for he too would voice such a need, despite acknowledging the validity of Cartesian and Newtonian mechanism:

> Although I am convinced that everything is done mechanically in corporeal Nature, I nevertheless also believe that the very principles of mechanics, that is to say the first laws of motion, have a more sublime origin than pure mathematics can furnish. . . . There is in matter something other than the purely geometric,

> that is, than the extension and its alteration.... One realises that some superior or metaphysical notion, that is, of substance, action and force must be added....[17]

Thus it is that Leibniz would later recount his intellectual trajectory as a *return* to Aristotle, although the detour through mechanism would thoroughly transform the peripatetic origin.

> I had penetrated deeply into the land of the Scholastics, when mathematics and modern authors made me withdraw from it while I was still young. Their beautiful ways of explaining Nature mechanically charmed me, and with good reason I despised the method of those who use only forms or faculties of which nothing is understood. But later, after trying to explore the principles of mechanics itself in order to account for the laws of Nature which we learn from experience, I perceived that the sole consideration of extended mass was not enough but that it was necessary, in addition to use the concept of force, which is fully intelligible, although it falls within the sphere of metaphysics.[18]

As Châtelet argues, by resuscitating the crucial Aristotelian distinction between actuality and potentiality in motion, Leibniz "radically extend[s] the Galilean project," in that his conception of force "carries off the world of the boundary forms of pure geometry, above figures and identities, to meet the causal connections of the the world of bodies."[19] And to this end, Leibniz invents a new physico-mathematical being, the differential, that would imbue each instant of motion with a virtuality or potentiality, thereby bridging the chasm between mathematical ideality and physical reality.

[17]G. W. Leibniz, 'Letter on the Question of whether the Essence of the Body consists in the Extension' (18 June 1691). Cited in Gilles Châtelet, *Figuring Space: Philosophy, Mathematics, and Physics* (Dordrecht: Kluwer Academic Publishers, 2000), 22.

[18]G. W. Leibniz, "A New System of the Nature and Communication of Substances, as well as the Union between Soul and Body" (1695), in *Philosophical Papers and Letters,* trans. Leroy G. Loemker (Chicago: University of Chicago Press, 1956), Vol. II, 740-41. .

[19]See Châtelet, *Figuring Space*, 23.

In defending his own account of human and divine freedom, Leibniz often returns to yet another kind of falling – the crashing of waves upon a shore – to illustrate how we extract unified apperceptions from a confused welter of sensory perceptions. In the preface to his *New Essays on Human Understanding*, Leibniz writes that

> there are a thousand signs which make us think that there are at all times an infinite number of *perceptions* in us, though without apperception and without reflexion; that is to say changes in the soul itself which we do not apperceive because their impressions are either too small and too numerous, or too unified, so that they have nothing sufficiently distinctive in themselves, though in combination with others they do not fail to have their effect and to make themselves felt, at least confusedly, in the mass. . . .

In order to facilitate an understanding of the nature of these indistinguishable perceptions, Leibniz iterates an analogy that he had used earlier as well in his debate with Arnauld over the possibility of conceiving an Adam who had not sinned. "I generally make use of the example," Leibniz continues,

> of the roar or noise which strikes us when we are on the shore. To hear this noise. . . we must surely hear the parts of which the whole is made up, that is to say the noises of each wave, although each of these little noises only makes itself heard in the confused combination of all the others together,. . . and would not be noticed if the wave which makes it were the only one. For it is necessary that we should be slightly affected by the motion of this wave, and that we should have some perception of each of these noises, however small they may be; otherwise we would not have the perception of a hundred thousand waves, since a hundred thousand nothings cannot make up a something.

Each minimal movement, to which we cannot assign an identity in itself, is correlated by Leibniz with a vanishing perception that cannot be discretely isolated as conscious apper-

ception, but that nonetheless constitutes with infinite others a series of determinate relations from which a singular apperception derives: integrated into the roar that we hear. These minute perceptions are, as Gilles Deleuze puts it in in his unpublished lectures on Leibniz, "differential[s] of consciousness which [are] not given in consciousness."

Their consequences are more "efficacious," Leibniz insists, "than we think."

> They it is that constitute that indefinable something, those tastes,... those impressions which surrounding bodies make on us, which include the infinite, that link which connects every being with all the rest of the universe. It may even be said that as a result of these minute perceptions the present is big with the future and laden with the past, ... and that in the smallest substance eyes as piercing as those of God could read the whole sequence of things in the universe: *Quae sint, quae fuerint, quae mox futura trahuntur.*

"The things that are, the things that have been, and those that are presently to come": Leibniz' concluding phrase seems especially apt as it is drawn from Virgil's description in the *Georgics* of Proteus, that ultimate figure of the manifold, of mobility and change, who "will melt into fleeting water and be gone" unless tightly fettered.

III

But how may we fetter the shifting, mobile multiplicity of the world? One answer, for Leibniz, is differential calculus, the mathematical domain that he (along with, though independently of, Newton) invents. It is impossible in the scope of this essay to detail the logic that connects Leibniz's mathematical to his metaphysical innovations. But, briefly sketched, the story begins with the distinctive idea of truth with which Leibniz operates: the notion that every true proposition must be analytical, that is to say, whatever is attributed to the subject of proposition must be contained in the notion of that subject in just the same way as the predicate of having three sides is contained within the notion of a triangle. While this may

seem uncontroversial in the case of such basic mathematical propositions, Leibniz extends the criterion to encompass existent things as well, so that for him the truth of "Adam sinned" depends upon demonstrating that the predicate of sinning at a particular moment belongs to or is included in the complete notion of Adam.

But, once we say this, we can no longer stop, as Deleuze points out, for

> it is sufficient for you to attribute to [Adam] a single thing with truth in order for you to notice with fright, that from that moment on, you are forced to cram into the notion of the subject not only the thing you attribute to it with truth but the totality of the world.

Opened up thereby is the inevitability of an infinite analysis that seeks to grasp the entire chain of causal relations radiating out in time and space from the single subject of Adam to touch every other thing in the world. And, as we shall see below, it is only God who can perform such an analysis – and indeed already has:

> We must not... conceive of a vague Adam, that is to say a person to whom certain of Adam's attributes belong, when it is a question of determining whether all human happenings follow from the supposition of him; we must attribute to him a notion so complete that everything that can be attributed to him can be deduced from it. Now there is no room for doubt that God could form such a notion of him, or rather that he finds it ready made in the country of possibles, that is, in his understanding.[20]

For us, however, from whom the infinite is withheld, there remains only the possibility of a symbolic fiction that imitates or approximates the divine. It is in this sense that Leibniz' differential calculus is, as Deleuze puts it, "a kind of union of mathematics and the existent,... it is a symbolic of the existent." And as a symbolic form, it both compensates for and reinforces our finitude.

[20]Leibniz, *Correspondence with Arnauld*, 56.

Milton's *Paradise Lost* stages a comparable dialectic during Books VII and VIII in particular, which repeatedly invoke the limits of human understanding, emphasising *ipso facto* the discontinuity between human and divine measure. Having described the creation of the world, Raphael concludes Book VII of *Paradise Lost* by asking Adam to say "if else [he] seek[s] / Aught, not surpassing human measure" (VII: 639-40). Encouraged, Adam asks in effect that Raphael resolve the dispute between Ptolemaic and Copernican models of the universe, wondering

> How Nature wise and frugal could commit
> Such disproportions, with superfluous hand
> So many nobler Bodies to create...
> ...and on thir Orbs impose
> Such restless revolution day by day
> Repeated, while the sedentary Earth...
> ...receives,
> As Tribute such a sumless journey brought
> Of incorporeal speed, her warmth and light;
> Speed, to describe whose swiftness Number fails. (VIII: 26ff)

The angel's noncommittal response mocks the mis-measure of the man who dares "to model Heav'n / And calculate the Stars" (VIII: 79-80), reminding him instead of the inscrutable power of divinity:

> The swiftness of those Circles attribute,
> Though numberless, to his Omnipotence,
> That to corporeal substances could add
> Speed almost Spiritual; mee though think'st not slow,
> Who since Morning hour set out from Heav'n
> Where God resides, and ere mid-day arriv'd

In *Eden*, distance inexpressible

By Numbers that have name. (VIII: 107-14)

It is a sign of a shared problematic that both Milton and Leibniz turn to the paradoxes of infinity when confronted with question of how to justify the ways of God to man. If we see, though erring, Mulciber's fall as a bounded one, the celerity of Raphael's descent, by contrast, compresses a transfinite distance into the bounded temporal interval between morning and mid-day. Indeed, the gap between God's power and man's grasp is redoubled by the nature of what we can only call Raphael's dis-analogy: his incorporeal speed partakes of an order of infinity greater even than that of the numberless circles, whose motion itself already eludes human measure – which can at best only "gird the Sphere / With Centric and Eccentric scribbl'd o'er, / Cycle and Epicycle, Orb in Orb" (VIII: 82-84).

Milton's insistence on the failure of number to describe celestial motion or of "numbers that have name" to express the distance between divine and human realms finds a parallel in Leibniz' recourse to surd ratios to explain the infinite analysis demanded in the case of truths of existence or contingent truths. For these, as we have seen, although the predicate is included in the subject – so that the complete notion of Adam includes the predicate that he will sin – "one never arrives at a demonstration or an identity, even though the resolution of each term is continued indefinitely." In such cases, Leibniz continues, "only God, who comprehends the infinite at once,... can see how the one is in the other, and can understand *a priori* the perfect reason for contingency."[21] On this basis, Leibniz likens the situation of a contingent truth to "the ratios of incommensurable numbers" (e.g., ratio between the square root of 3 and the square root of 2):

> just as the larger number contains another which is incommensurable with it, though even if one continues to infinity with a resolution, one will never arrive at a common measure, so in the case of a contingent truth you will never arrive

[21] "Necessary and Contingent Truths," 57.

> at a demonstration, no matter how far you resolve the notions.

In his brief essay on freedom, Leibniz emphasises again that truths of existence call for an infinite analysis, of which only God is capable.

> [I]n the case of contingent truths, even though the predicate is in the subject, this can never be demonstrated of it.... Instead, the analysis proceeds to infinity, God alone seeing – not, indeed, the end of the analysis, since it has no end – but the connexion of terms or the inclusion of the predicate in the subject, for he sees whatever is in the series....

What God sees – and what we humans can at best only approximate through reason or experience – is the infinite series as actually given, the infinite aggregate of infinitesimal relations that connect Adam to Eve to the serpent to the apple and beyond. In other words, God grasps the continuity itself – the unending series of what Deleuze calls "evanescent differences" – which traverses a particular subject and thereby expresses its peculiar link with the rest of the universe.

And what defines the best of all possible worlds? Precisely, a world in which continuity is maximised, a world so full that between any one element and another there is an infinite series of infinitesimal relations connecting them. Despite itself, even Voltaire's merciless mockery of Leibniz' philosophy testifies to what such a continuity entails:

> For if Columbus, when visiting the West Indies, had not caught [syphilis], which poisons the source of generation, which frequently even hinders generation, and is clearly opposed to the great end of Nature, we should have neither chocolate nor cochineal.[22]

We see that what is best is not necessarily what we think the ends of Nature ought to be – syphilis frustrates, after all, the divine injunction to go forth and multiply – but rather

[22] *Candide*, 30.

the existence of series of connections that leads one from any one element in the world – Columbus – to any other – here, chocolate or cochineal. The world that has passed from being merely possible into actually existing is precisely the one that God sees as maximally full because the most continuous, in which the relations of what Leibniz calls compossibility are maximised.

For Milton, as for Leibniz, though, it is that singular event of generation, Creation, that exemplifies above all the fullness of world as it exists. Leibniz's *Monadology* conceives of the world as arising from the art of infinite division, through which "the Author of Nature" subdivides each portion of matter "without end, each part into further parts, of which each has some motion of its own; otherwise it would be impossible for each portion of matter to express the whole universe." As a consequence, "each portion of matter may be conceived as like a garden full of plants and like a pond full of fishes. But each branch of each plant, each member of every animal, each drop of its liquid parts is also some such garden or pond." In Milton's case, the abundant lists of of Book VII, where Raphael seeks to communicate to human ears the infinite variety of the world, offer the epic counterpart to this vision of fullness, produced "more swift / Than time or motion" (VII: 175-76). In the bounded interval between the Ev'n and Morn of each day, abundance, multiplicity and plenty hold sway:

> And God said, let the Waters generate
> Reptile with Spawn abundant, living soul;
> And let Fowl fly above the Earth...
> And God created the great Whales, and each
> Soul living, each that crept, which plenteously
> The waters generated by thir kinds ....
> Forthwith the Sounds and Seas, each Creek and Bay
> With Fry innumerable swarm....(VII: 387ff)

Throughout Raphael's retelling of Genesis, the tension between number and the innumerable makes itself felt. The "numerous hatch" gives rise to a litany of birds who soar above earth and sea, but these are themselves the support for the "unnumber'd plumes" which fan the air as they pass. From Leviathan, "hugest of living Creatures," we pass to the "Minims of Nature," exemplified by

> The Parsimonious Emmet, provident
> Of future, in small room large heart enclos'd,
> Pattern of just equality perhaps
> Hereafter, join'd in her popular Tribes
> Of Commonality; swarming next appear'd
> The Female Beee that feeds her Husband Drone
> Deliciously....
> ...the rest are numberless,
> And thou thir Natures know's, and gav'st them Names. (VII: 484ff)

These evanescent differentials of creation, swarming numberless and innumerable, invert the logic of space and time – in the ant, the future is already provided for in the present of its creation, largeness is already contained in its minuteness.

The very act of naming, Adam's privilege, marks the gathering up of these "minims" into a type that can be named, but only at the cost of letting go the infinity of individuals that are thus integrated into the singular Name. Their shared recourse to the paradoxes of infinite enumeration in order to express the gap between divine omnipotence and human dominion draws Leibniz and Milton together, but also leads them to different symbolic systems: the former to the symbolic fiction of the differential calculus, the latter to the symbolic fictions of poetry, and in particular of his epic. Both are, we might suggest, the limit forms through which we grasp in approximation the texture of the world, even as we rehearse in them our incapacity, our fall.