Leibnizian Neoplatonism and Rational Mechanics

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—Gödel identifies himself with Leibniz more than with anybody else.
Hao Wang, *Reflections on Kurt Gödel*

One of the saliently definitive doctrines of Neoplatonism issues from the teaching of Plato's *Timaeus* 29D–30C that intelligence, reason, and value are the crucial factors for explaining and understanding the nature of the universe.

In no other major thinker in the Western tradition did this line of thought play a more central, determinative, and ultimately influential role than in the philosophy of G. W. Leibniz, who often avowed himself to be a follower of Plato, and who in turn passed his Platonic vision of things on to a long-continuing tradition. In this brief paper I can do no more than hint at the various connections that unite these thinkers. I submit three facts to be decisive in this regard, namely:

> (1) That Leibniz had in hand a characteristic project for the development of physics which was deeply indebted to Neo-Platonism—and indeed to Plato himself, through the *Phaedo* and the *Timaeus*. (2) That this project led—via the Principle of Least Action—to the development of Rational Mechanics in the era of pre-Maxwellian physics. And finally, (3) that significant aspects of this project are much alive in contemporary science, and in particular in the work and thought of Albert Einstein and of Kurt Gödel.[1]

Leibnizian Physics

The Leibnizian program in physics sought to dig through to a stratum deeper than that of the Newtonian synthesis. For Newton's own program in physics was essentially that of the ancient Greek mechanicians and astronomers.

[1] See L. E. Loemker, introduction to *Gottfried Wilhelm Leibniz: Philosophical Papers and Letters*, trans. and ed. L. E. Loemker (Dordrecht, Holland: D. Reidel, 1969), 316.

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With Archimedes and Ptolemy, it asks "What laws of nature can we stipulate to 'save the phenomena' by providing an adequate accounting for why our observations are as they are?" In in like manner, it addresses this question by looking for the laws that challenge the observable phenomena.[2] But Leibniz took a different line here, one which in effect says:

> Fine. Let us give this program our full support. But let us suppose we are successful in getting our minds around an ample sector of nature's laws. There still remains the question: viewing these laws themselves as our "phenomena" how can we best "save" them—that is, how can we account for the fact that these laws are as they are?

Thus even as standard physics studies nature's phenomenon by observation and experimentation to discern the laws governing nature's phenomenal *modus operandi*, so Leibnizian physics studies nature's laws in thought-experimental deliberation to discern the "architectonic" principles of rational economy, harmonious order, and functional efficacy governing nature's lawful *modus operandi*.

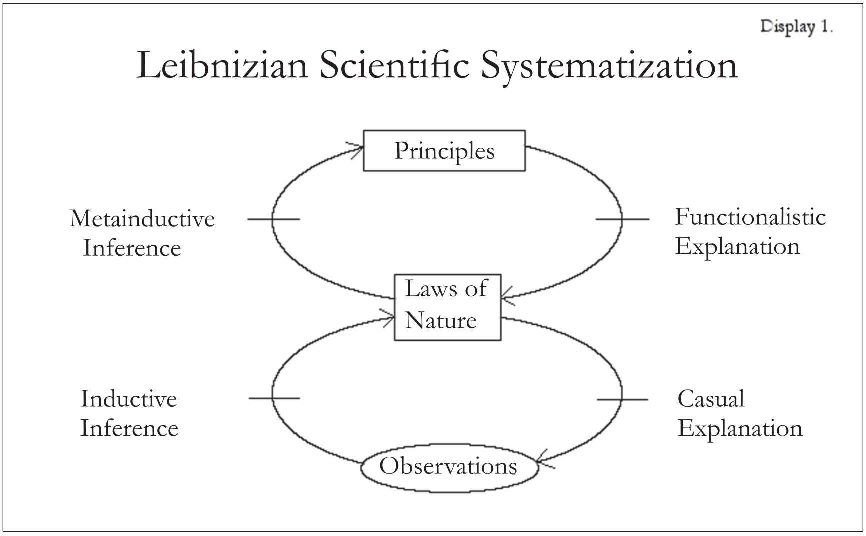
With such a methodology as "thought-experimental deliberation" at his disposal, Leibniz explains the need for more elemental principles to buttress, justify, and explain the principles of mechanics for all natural phenomena:

> All natural phenomena could be explained mechanically [i.e., scientifically] if we understood them well enough, but the principles of mechanics themselves cannot be so explained … since they depend on more substantive [i.e. deeper] principles. [These involve] sublime principles of order and perfection, which indicate that the universe is the effect of a universal intelligent power. (*Tentamen anagogicum*, GP VII 270–71 (Loemker 477–78).[3]

Leibnizian physics is thus a two-tier affair as per Display 1.

[2] The given schematic enfolds, sight unseen, to the crucial stage of applicative testing of the laws leading either to confirmation or replacement/revision.

[3] Cf. E. Grosholz, "Plato and Leibniz against the Materialists," *Journal of the History of Ideas* 52:2 (1996): 255–76.



It sees the world's phenomena as explicable by the laws of nature, but has it that these laws themselves are to be explained with reference to deeper fundamental principles that are of an essentially evaluative sort. Ultimately, then, Lebnizian physics is a quest for the intelligent and intelligible design of the universe.

Leibniz wrote with this end in mind in a very interesting and important essay entitled *Tentamen Anagogicum*, written in 1696, wherein he states:

> [T]he principles of mechanics themselves cannot be explained geometrically, since they depend on more sublime principles which show the wisdom of the Author in the order and perfection of his work. The most beautiful thing about this view seems to me to be that the principle of perfection is not limited to the general but descends also to the particulars of things and of phenomena and that in this respect it closely resembles the method of *optimal forms*.[4]

Optimal forms, according to Leibniz, are those equations which represent maximality, morality, continuity, and conservation, while the physics he references is one effectively based on the Principle of Least Action—the front of physical lawfulness.

The salient and characteristic goal of Leibnizian physics is accordingly oriented to the discovery of principles for grounding Nature's laws: its

[4] Leibniz, "Tentamen Anagogicum" [An Anagogical Essay in the Investigation of Causes, ca 1696] in *Gottfried Wilhelm Leibniz: Philosophical Papers and Letters*, trans. and ed. L. E. Loemker (Dordrecht, Holland: D. Reidel, 1969), 477–485.

key aim is not just the discovery of laws via phenomena but preeminently the explanation of laws via finalistic principles.

The Principle of Least Action was the crux, as it were, for the discovery of, and orientation towards, the principles grounding Nature's laws. Its utility and value lay in its unifying effect; it provides a basis for axiomatic development, the axiomatic development of large sections of physical theory. Leibniz's insights, here, into the basis for axiomatic development were extended by thinkers such as Maupertius, as well as others. Perhaps the most notable developments are found in Lagrange's *Méchanique analytique*, where the principle of least action was shown to be a sufficient basis for the deduction of the laws of mechanics, and in the work of Hamilton, where Lagrange's results were extended to optics and dynamics.

Some idea of the power of this principle can be gained from the following excerpt from a paper in which Hamilton presented his results on optics to the Royal Irish Academy in 1824:

> Those who have meditated on the beauty and utility, in theoretical mechanics, of the general method of Lagrange, who have felt the power and dignity of that central dynamical theorem which he deduced in the *Méchanique analytique* …, must feet that mathematical optics can only then attain a coordinate rank with mathematical mechanics …, when it shall possess an appropriate method and become the unfolding of a central idea …. It appears that if a general methods in deductive optics can be attained at all, it must follow from some law of principle, itself of highest generality, and among the highest results of induction …, [this] must be the principle, or law, called usually the Law of Least Action.[5]

Hamilton's ideas, though, were a culmination of sorts in the development of Lebnizian insights into least action. For as the 19th century moved along, other ideas and other paradigms came into prominence and, by its end, principles like manimax, economy, simplicity, and least action were not greatly in vogue.

However, a decidedly surprising revival has transpired in the later years of the 20th century. Scientists of the first caliber found their way back into a Leibnizian state of mind; simplicity, fertility, and lawful order are now, once again, at the fore of scientific theory. Einstein wrote that "experience justifies one belief that nature is the realization of the simplest mathematical ideas that are reasonable."[6] The astronomer Mario Livio proposes a "cosmo-

[5] *Encyclopaedia Britannica*, 11th ed., s.v. "Light."

[6] Quoted in M. Livio, *The Accelerating Universe: Infinite Expansion, the Cosmological Constant, and the Beauty of the Cosmos* (New York: John Wiley & Sons, 2000), 34. Einstein speculates that considerations of simplicity alone may determine the laws

logical aesthetic principle" encompassing such functions as simplicity, symmetry, and continuity. The physicist Anthony Zee has the universe continuing in creative terms such functions as "unity and diversity, absolute perfection and boistrous dynamism, symmetry and lack of regularity."[7] The physicist Freeman Dyson maintains that nature's simple laws appear to be designed to "make the universe as interesting as possible."[8] The astronomer Carl Sagan argues that the universe exhibits a fertility that is "lavish beyond imaging."[9] Cosmologists Julian Barbour and Lee Smolin see the universe as exhibiting "extremal variety."[10] The idea of a physical domain combing that salient feature of Leibnizian physics is fashionable once again.[11]

Shift from Physics to Mathematics

In the twentieth century, it transpired that with Einstein and Gödel, as with Leibniz before them, there is a Platonic realm of truth based not on human preferences but in inherent harmonization within the rational economy of the larger scheme of things.

Gödel's Neo-Leibnizianism

As Leibniz looked back to Plato, so Gödel looked back to Leibniz—and through him to Plato. He took in hand the Leibnizian "baton" in the relay race of Neoplatonism. In particular, Gödel, like Leibniz before him, refused to identify axiomatic provability with rational validation. For him, as for Leib-

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of nature: "What really intrigues me is whether God could have created the world any differently; in other words; whether the demand for logical simplicity leaves any freedom at all." See also, A. Calaprice and F.J. Dyson, eds., *The Expanded Quotable Einstein* (Princeton, NJ: Princeton University Press, 2000), 221. When Einstein said "I believe in Spinoza's God" he committed a not altogether uncommon act of self-misperception, seeing that the God to which his views committed him was in fact Leibniz's.

[7] A. Zee, *Fearful Symmetry: The Search for Beauty in Modern Physics*, Princeton Science Library (Princeton, NJ: Princeton University Press, 1999), 211.

[8] Quoted in J. Horgan, *Rational Mysticism: Spirituality Meets Science in the Search for Enlightenment* (New York: Haughton Mifflin, 2003), 172.

[9] C. Sagan and A. Druyan, "On Earth as it Is in Heaven: The Origin of the Earth and the Solar System," *Omni*, October 1992, 44–49.

[10] J. Barbour and L. Smolin, "Extremal Variety as the Foundation of a Cosmological Quantum Theory," submitted on March 17, 1992, htt://www.arxiv.org/hep-th/9203041.

[11] I am indebted to William C. Lane for some of the preceding references.

niz, the fact that some truth was indemonstrable by axiomatic means did not mean that one could not provide an *a priori* account of its reason for being—of why it should be what it is and indeed has to be so.

For Leibniz the validating rationale of contingently unprovable truth lay in a Principle of Perfection that envisioned its grounding in *optimality*—and thus *a priori* and independently of mere observation. Gödel was in fact prepared to go down exactly this same road. He saw no reason why that which cannot be axiomatically demonstrated or proven cannot be rationally validated *a priori* on principles of *rational fitness*. For just this is at issue with what has come to be called Gödel's "interesting axiom,"[12] to the effect that "nothing that happens in the world is due to accident or stupidity"—that there always is a cogent rationale for why things are as they are, not because this is how it *has to be* (demonstrable necessity) but because that is how it *ought to be* in that its being so is for the best relative to principles of systemic fitness. What is at issue here is, in effect, the "Principle of Perfection." For as Hao Wang, who knows his thought as well as anyone, puts it, Gödel "apparently convinced himself that no good reason has been presented by history or philosophy [or science!] to warrant departing fundamentally from a Leibnizian approach."[13]

Gödel's ideal of science was a body of theory based not on empirical confirmation but on systemic harmonization. He saw himself to be, like Plato and Leibniz, a "rationalist" and an "idealist," and he manifested disdain for Aristotle by calling him an "empiricist" and a "materialist."[14] In Gödel's vocabulary these were emphatically not terms of commendation.[15]

On one occasion Gödel wrote that "In the world of mathematics, everything is well poised and in perfect order," and he went on to add "shouldn't the same be assumed (expected, *angenommen*) for the world of reality, contrary to appearances?"[16] Yet, Gödel was not, when assimilating

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[12] R. Goldstein, *Incompleteness: The Proof and Paradox of Kurt Gödel,* Great Discoveries (New York: W.W. Norton, 2005), 48 and also 20–21, 30–21, 55, and 236.

[13] H. Wang, *Reflections on Kurt Gödel* (Cambridge, MA: MIT Press, 1987), 240. Leibniz was certainly prepared to recast the characteristic theses of a logical system in arithmetical form. But Gödel's ingenious stratagem of so casting meta-systematic claims about the *relationships* of theses in the system and then reconstituting these meta-systematic theses as meta-systematic claims asserted by propositions within the system itself. This quintessentially Gödelian device was not even remotely on Leibniz's horizon.

[14] See Wang, *Reflections on Kurt Gödel*, 160.

[15] As Gödel saw it, theoretical physics at its highest level has little (if any?) empirical basis. See Wang, *Reflections on Kurt Gödel*, passim.

[16] J. W. Dawson, *Logical Dilemmas: The Life and Work of Kurt Gödel* (Wellesley, MA: A. K. Peters, 1997), 2.

mathematics to physics, endeavoring to make mathematics into an empirical science, rather his intent was to effect the very reverse. He sought to endow physics—at least at the level of fundamental principles—with the same sort of systemic necessitation that has traditionally been ascribed to mathematics. In coordinating these disciplines, Gödel wasn't trying to physisize mathematics but to mathematicize physics along metaphysically systemic lines. As Hao Wang has justly observed, Gödel "wishes to continue Leibniz's attempt to analyze the concepts [of physics] deeper so that the physical concepts are merged with the truly primitive [i.e. basic] concepts of metaphysics. Hence in particular, he is not satisfied with Kant's 'metaphysical foundation' of (Newtonian rather than Leibnizian) physics."[17]

So when Gödel responded to Noam Chomsky's query about what he was currently writing on by assaying "I am trying to prove that the laws of nature are *a priori*,"[18] he was indicating that, like Leibniz before him, he was seeking to establish that the basic laws of physics are inherent in fundamental general principles of systemic fitness. And when Gödel told John Bahard "I don't believe in natural science,"[19] what he meant (and very possibly said) was "I don't believe in *empirical* science" because for him, as for Leibniz, science is property to be grounded not in mere observation but in rational reflection relating to what is optimal in the larger scheme of things. Thus Gödel saw matters in a decidedly Leibnizian perspective and deserves to be ranked among the most dedicated of the aficionados of Leibnizian physics.[20]

Gödel and Einstein

As regards these Platonic-Leibnizian affinities, Gödel did not stand alone. Gödel had known Einstein since 1933 when they were introduced to each other by Paul Oppenheim,[21] and their relationship became far closer after

[17] Wang, *Reflections on Kurt Gödel*, 165.

[18] Goldstein, *Incompleteness: The Proof and Paradox of Kurt Gödel*, 32.

[19] Goldstein, *Incompleteness: The Proof and Paradox of Kurt Gödel*, 31.

[20] During 1949-51 when I was writing my Princeton doctrinal dissertation on the philosophy of Leibniz, I found that the books I was using had recently been used by—and in some instances had to be recalled from—Kurt Gödel at the Institute for Advanced Studies. I don't know where he kept his books. On the one occasion in the autumn of 1951 I visited his small office at the Institute and found him absent, I observed that his room was virtually barren of books, with only a few stacks of reprints on the bookshelves.

[21] On the Oppenheim connection see Wang, *Reflections on Kurt Gödel*, 176. The Oppenheims continued their salon-reminiscent facilitation of contact among scholars after resettling in Princeton in 1937. It was at their house at 57 Princeton Avenue, that I myself met Einstein and his disciple Hans Reichenbach in 1951. For further

Gödel and Einstein joined Oppenheim in Princeton.[22] In the end, late in his life, Einstein observed that "he only went to the office to have the privilege of walking home with Gödel."[23]

On several occasions Gödel said "I see Einstein almost daily."[24] When Einstein was well, they walked to the Institute together; and when he was ill, Gödel visited him and made notes on his state of health with the care of an attending physician. They became "soul-mates," in a way, allies in the shared pursuit of explanatory principles for a reasonable universe.

Einstein too, of course, was deeply committed to a deeper rationality of nature that precluded any prospect of arbitrariness and "relativism" of chance or choice in physics. And it was his tragedy that people insisted on seeing his *relativity* as a support for *relativism*. One Gödel scholar has observed that "The work of Gödel and Einstein is commonly grouped as among the most compelling reasons modern thought has given us to reject the myth of objectivity."[25] But on this those two great but not-so-modern theorists saw matters very differently. Both propounded a view of things by which objectivity sustained its place on the pedestal of science where it had been placed by Plato and Aristotle in classical antiquity. It was not for nothing that Gödel repeatedly characterized his own position as Objectivism.[26]

Gödel firmly believed in an objective—this is to say, mind-independent—mathematical reality and in a realm of mathematical truth determined by its own inner normative exigencies rather than being a mere artifact of human contrivance. As he saw it, not human decision and action but impersonal reason determines mathematical truth. Yet, this was not a matter of demonstrability—of logico-conceptual necessitation—but rather one of systemic verification (in the old sense of truth-making). The crux, then, is not a proof by derivation for axioms but a validation on the basis of rational optimality.

Einstein and Gödel were drawn together by a profound ideological affinity in their views of the world. Gödel endorsed without hesitation Einstein's belief that we live in a rationally constructed universe, a universe whose arrangements reflect the harmonious order of a creator who "doesn't play dice."[27] As Gödel saw it, there is one single arithmetic underlying reality

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details regarding the Oppenheims, see my "H2O: Hempel-Helmer-Oppenheim: An Episode in the History of Scientific Philosophy in the 20th Century," *Philosophy of Science*, 64 (1997): 779–805.

[22] Wang, *Reflections on Kurt Gödel*, 31.

[23] Wang, Ibid., 31.

[24] Wang, Ibid., 32.

[25] Goldstein, *Incompleteness: The Proof and Paradox of Kurt Gödel*, 37, 55.

[26] See Wang, *Reflections on Kurt Gödel*, 199–208, and also 21, 28, 151, 161–62, 188–89, 199–208, 228, and 285.

[27] Dawson, *Logical Dilemmas: The Life and Work of Kurt Gödel*, 262.

and one definite and decided truth, even in branches of mathematics that are incomplete with a formalization that admits of alternative models.[28] Exactly as with Einstein's view in quantum physics, incompleteness is a feature of our formalizations, and emphatically not one of the underlying reality they are designed to address.

From this vantage point of consideration, Gödel and Einstein are, once again, in effectively the same boat. Gödel thought, exactly on account of axiomatic incompleteness, there to be an objective (Platonic?) *mathematical reality* that is definite and admits of no indeterminacy. Einstein thought that, quantum indeterminacy notwithstanding, there is a *physical reality* that admits of no indeterminacy—however undecidable the issue may be within the sorts of physical-law frameworks accessible to human investigators.

Gödel was wont to say that "*Die Welt ist vernünftig*," which does not just say (as is often claimed) that the world is *intelligible* but also encompasses the idea that "The world is *intelligent*."[29] And according to Ernst G. Straus who was Einstein's assistant during 1944-47:

> Einstein often mentioned that he felt that he should not become a mathematician because the wealth of interesting and attractive problems was so great that you could get lost in it … up with anything of genuine importance. In physics, he could see what the important problems were and could, by strength of character and stubbornness, pursue them. But he told me once, "Now that I've met Gödel, I know that the same thing does exist in mathematics." Of course, Gödel had an 'interesting axiom' by which he looked at the world; namely, that nothing that happens in it is due to accident or stupidity.[30]

A profoundly Platonic tendency moved Einstein to this same position and to insist that "God does not play dice with his universe!"

A close personal bond existed between Gödel and Einstein whose natural explanation lies in a deep kinship of viewpoint rooted in the common conviction of the rationality of nature. This common conviction, tracing back to Plato's *Timaeus*, qualifies these two monumental scientists to count among the 20th century's outstanding neo-Platonists. But in Gödel's case the way he worked this program out was such as also to make him the 20th century's prime neo-Leibnizian. It was with sharp self-insight that Gödel described himself, *ipsissimis et expressis verbis*, as "following Leibniz rather than

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[28] Ibid., 263.

[29] Goldstein, *Incompleteness: The Proof and Paradox of Kurt Gödel*, 21.

[30] Harry Woolf, ed., *Some Strangeness in the Proportion: A Centennial Symposium to Celebrate the Achievements of Albert Einstein* (Reading, MA: Addison-Wesley, 1980), 485. See also Wang, *Reflections on Kurt Gödel,* 31–32.

Spinoza."[31] But when Einstein made the oft-quoted remark "I believe in Spinoza's God who reveals himself in orderly harmony of what exists"[32] he was, in fact, far closer to the optimalistic God of Leibniz and Gödel than to the necessitarian God of Spinoza. And all three of them, Leibniz, Einstein, and Gödel were walking in Plato's footsteps—even though only the first of them—Leibniz—was aware of it.

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[31] Dawson, *Logical Dilemmas: The Life and Work of Kurt Gödel*, 6.
[32] Wang, *Reflections on Kurt Gödel*, 39.