

Robert Hanna

Science for Humans

Mind, Life, The Formal-&-Natural
Sciences, and A New Concept of Nature

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A Note on References to Kant's Works

For convenience, I cite Kant's works in parentheses. The citations include both an abbreviation of the English title and the corresponding volume and page numbers in the standard "Akademie" edition of Kant's works: *Kants gesammelte Schriften*, edited by the Königlich Preussischen (now Deutschen) Akademie der Wissenschaften (Berlin: G. Reimer [now de Gruyter], 1902–). For references to Kant's *Reflexionen*, I give the entry number in addition to the Akademie volume and page numbers. I generally follow the standard English translations of Kant's works but have occasionally modified them where appropriate. For references to the first *Critique*, I follow the common practice of giving page numbers from the A (1781) and B (1787) German editions only. Because the Akademie edition contains only the B edition of the first *Critique*, I have also consulted the following German composite edition: *Kritik der reinen Vernunft*, ed. W. Weischedel, Immanuel Kant Werkausgabe III (Frankfurt: Suhrkamp, 1968). Here is a list of the relevant abbreviations and English translations, along with the dates of their original eighteenth-century German publication followed by their Akademie volume numbers and page ranges:

C *Immanuel Kant: Correspondence, 1759-99*. Trans. A. Zweig. Cambridge: Cambridge University Press, 1999. [1749-1800, Ak 10, 11, 12]

CPJ *Critique of the Power of Judgment*. Trans. P. Guyer and E. Matthews. Cambridge: Cambridge University Press, 2000. [1790, Ak 5: 165–485]

CPJFI *First Introduction to the Critique of Judgment*. Trans. P. Guyer and E. Matthews. In *Critique of the Power of Judgment*. pp. 1–51. [1789, Ak 20: 20: 192–251]

CPR *Critique of Pure Reason*. Trans. P. Guyer and A. Wood. Cambridge: Cambridge University Press, 1997. [1781, 1787, Ak 3, 4: 1–252]

CPrR *Critique of Practical Reason*. Trans. M. Gregor. In *Immanuel Kant: Practical Philosophy*. Cambridge: Cambridge University Press, 1996. pp. 139–272. [1788, Ak 5: 1–163]

DDS "Concerning the Ultimate Ground of the Differentiation of Directions in Space." In *Immanuel Kant: Theoretical Philosophy, 1755-1770*. Trans. D. Walford

and R. Meerbote. Cambridge: Cambridge University Press, 1992. pp. 361–372. [1768, Ak 2: 375–383]

GMM *Groundwork of the Metaphysics of Morals*. Trans. M. Gregor. In *Immanuel Kant: Practical Philosophy*. pp. 43–108. [1785, Ak 4: 385–463]

ID “On the Form and Principles of the Sensible and Intelligible World (Inaugural Dissertation).” In *Immanuel Kant: Theoretical Philosophy: 1755–1770*. pp. 373–416. [1770, Ak 2: 385–419]

MFNS *Metaphysical Foundations of Natural Science*. Trans. M. Friedman. Cambridge: Cambridge University Press, 2004. [1786, Ak 4: 465–565]

Prol *Prolegomena to Any Future Metaphysics*. Trans. G. Hatfield. Cambridge: Cambridge University Press, 2004. [1783, Ak 4: 253–383]

R *Reflexionen*, aka *Kants handschriftlicher Nachlass*. Selections in *Notes and Fragments*. Trans. C. Bowman, P. Guyer, and F. Rauscher. Cambridge: Cambridge University Press, 2005.

TPP “Toward Perpetual Peace.” Trans. M. Gregor. In I. Kant, *Immanuel Kant: Practical Philosophy*. Cambridge: Cambridge University Press, 1996. pp. 317–351. [1795, Ak 8: 341–386]

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Chapters 3, 6, and 7 are based, respectively, on these three previously published articles:

“Physics For Humans: Kant, Natural Science, and The Neo-Aristotelian Natural Power Grid.” *Revue romaine de philosophie* 66 (2022): 197–216. Also available online at URL = <http://www.institutuldefilosofie.ro/page.php?146>.

“How to Complete Quantum Mechanics, Or, What It’s Like To Be A Naturally Creative Bohmian Beable.” *Journal of Philosophical Investigations* 15 (Autumn 2021): 53–71. Available online at URL = https://philosophy.tabrizu.ac.ir/article_13839.html?lang=en.

“Can Physics Explain Physics? Anthropic Principles and Transcendental Idealism.” In L. Caranti (ed.), *Kant and the Problem of Knowledge in the Contemporary World*. London: Routledge, 2022. pp. 136–145.

And an earlier version of section 3.2 also appeared in the now-discontinued online journal *Critique* in 2018, under the title “Kant’s Neo-Aristotelian Natural Power Grid: On *Kant and the Laws of Nature*.”

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Chapter 1

Introduction



Abstract In this introductory chapter, against the backdrop of the contemporary crisis in the formal-&-natural sciences, and the three basic problems that jointly constitute that crisis, I briefly describe the purpose of this book, which is to solve these three basic problems by presenting and defending what I call *the neo-organicist turn*, including *manifest realism* and the three sub-parts of *organicism*: *liberal naturalism*, *mind-life continuity*, and *explanatory inversion*, i.e., the dependency of the mechanical on the organic. Or more briefly and simply put, the purpose of this book is to present and defend *science for humans*. Science for humans is an original and paradigm-shifting conception of formal science, natural science, and the natural universe alike.

Up to now it has been assumed that all our cognition must conform to the objects; but all attempts to find out something about them a priori through concepts that would extend our cognition have, on this presupposition, come to nothing. Hence let us once try whether we do not get farther with the problems of metaphysics by assuming that the objects must conform to our cognition, which would agree better with the requested possibility of an a priori cognition of them, which is to establish something about objects before they are given to us. This would be just like the first thoughts of Copernicus, who, when he did not make good progress in the explanation of the celestial motions if he assumed that the entire celestial host revolves around the observer, tried to see if he might not have better success if he made the observer revolve and left the stars at rest. (*CPR* Bxvi)

To sum up, we may say that the characteristic feature of the actual development of the system of theoretical physics is an ever extending emancipation from the anthropomorphic elements, which has for its object the most complete separation possible of the system of physics and the individual personality of the physicist. One may call this the objectiveness of the system of physics. In order to exclude the possibility of any misunderstanding, I wish to emphasize particularly that we have here to do, not with an absolute separation of physics from the physicist—for a physics without the physicist is unthinkable—but with the elimination of the individuality of the particular physicist and therefore with the production of a common system of physics for all physicists....

[E]ach great physical idea means a further advance toward the emancipation from anthropomorphic ideas. This was true in the passage from the Ptolemaic to the Copernican cosmical system, just as it is true at the present time for the apparently impending passage from the so-called classical mechanics of mass points to the general dynamics originating in the

principle of relativity. In accordance with this, man and the earth upon which he dwells are removed from the centre of the world. It may be predicted that in this century the idea of time will be divested of the absolute character with which men have been accustomed to endow it. ...

In the definition of irreversibility, as well as in that of entropy, reference is made to the possibility of carrying out in nature certain changes, and this means, fundamentally, nothing more than that the division of physical processes is made dependent upon the manipulative skill of man in the art of experimentation, which certainly does not always remain at a fixed stage, but is continually being more and more perfected. If, therefore, the distinction between reversible and irreversible processes is actually to have a lasting significance for all times, it must be essentially broadened and made independent of any reference to the capacities of mankind.

[T]he essential, and therefore the final division of all processes occurring in nature, is into reversible and irreversible processes, and the characteristic difference between these two kinds of processes, as I have further separated them, is that in irreversible processes the entropy increases, while in all reversible processes it remains constant.... Since in nature the entropy can only increase, it follows that the state of a physical configuration which is completely isolated, and in which the entropy of the system possesses an absolute maximum, is necessarily a state of stable equilibrium, since for it no further change is possible.

[W]ith the aid of the calculus of probability and with the introduction of the hypothesis of elementary disorder, we have seen that all irreversible processes may be considered as reversible elementary processes: in other words, that irreversibility does not depend upon an elementary property of a physical process, but rather depends upon the ensemble of numerous disordered elementary processes of the same kind, each one of which individually is completely reversible, and upon the introduction of the macroscopic method of treatment. From this standpoint one can say quite correctly that in the final analysis all processes in nature are reversible. (Planck, 1915: pp. 15–16, 34–35, and 134)

The two fundamental aims of science are, **first**, the discovery of truths and the achievement of knowledge about the natural universe, including ourselves—i.e., rational, but also “human, all-too-human” (i.e., finite, fallible, and thoroughly normatively imperfect in every other way too) minded animals—and our social institutions, and **second**, the construction of an organized, systematized, and (at least ideally) unified body of such knowledge. All science is theoretically driven from the top down by *formal science* (especially logic and mathematics), and also theoretically driven from the bottom up by *natural science* (especially physics, chemistry, and biology). In this book, I present and defend an original and paradigm-shifting conception of formal science, natural science, and the natural universe alike, that’s fully pro-science *and* pro-humankind, but also at the same time neither theological or God-centered, nor solipsistic or self-centered, nor communitarian or social-institution-centered, nor scientistic or science-valorizing, nor materialist/physicalist or reductive, nor—above all—mechanistic. Let me briefly explain how and why this is the case, before proceeding to the fifteen chapters that follow this introductory chapter.

Nicolaus Copernicus’s sixteenth and seventeenth century scientific revolution said that instead of naively assuming that humanity occupies the central place in the

natural universe, as per Ptolemaic cosmology, we postulate that humanity's Earth-based home be displaced away from the cosmological center and made relative to circular or elliptical (Keplerian) motion around the sun. Immanuel Kant's eighteenth century "Copernican Revolution" in epistemology and metaphysics in the *Critique of Pure Reason* (1781/1787), explicitly building on Copernicus's Gestalt-shifting scientific revolution, said that instead of assuming that our rational, conceptual, and sensible (i.e., perceptual, imaginal, and memory-based) human cognitive capacities passively conform either to mind-independent, noumenal objects, as per classical Rationalism, or to subjective, mind-dependent, phenomenal objects, as per classical Empiricism, we postulate instead that the manifestly real world of objective veridical appearances necessarily conforms to the innately-specified structures of our rational, conceptual, and sensible human cognitive capacities. And the early twentieth century scientific revolution carried out by The Special Theory of Relativity and The General Theory of Relativity, together with Quantum Mechanics (or for short, STR-GTR/QM), following on from the nineteenth century neo-Kantian tradition, said that space, time, matter, energy, and causation necessarily conform to—are relativized to—the properties of experimental detection-devices and measuring devices, as used by scientific experimenters or observers (e.g., clocks, light-signal-sensitive equipment like cameras, measuring rods, the Michelson interferometer, microscopes, telescopes, particle-tracking and wave-tracking equipment including single-slit devices, two-slit devices, the Mach-Zehnder interferometer, and so-on, weigh-scales of various kinds, etc.), and also introduced *the mechanistic worldview*, which makes everything in the natural universe metaphysically dependent on fundamentally physical facts and properties, and on *formal*—i.e., Turing-computable, decidable (Boolos & Jeffrey, 1989)—mechanical systems and/or *natural* mechanical systems, and also—as Max Planck rightly points out—*dehumanizes* physics:

To sum up, we may say that the characteristic feature of the actual development of the system of theoretical physics is an ever extending emancipation from the anthropomorphic elements, which has for its object the most complete separation possible of the system of physics and the individual personality of the physicist. One may call this the objectiveness of the system of physics....

[E]ach great physical idea means a further advance toward the emancipation from anthropomorphic ideas. This was true in the passage from the Ptolemaic to the Copernican cosmical system, just as it is true at the present time for the apparently impending passage from the so-called classical mechanics of mass points to the general dynamics originating in the principle of relativity. In accordance with this, man and the earth upon which he dwells are removed from the centre of the world. It may be predicted that in this century the idea of time will be divested of the absolute character with which men have been accustomed to endow it. (Planck, 1915: pp. 15–16)

At the same time, however, and in fact inconsistently, Planck also holds that

[i]n order to exclude the possibility of any misunderstanding, I wish to emphasize particularly that we have here to do, not with an absolute separation of physics from the physicist—for a physics without the physicist is unthinkable,—but with the elimination of the individuality of the particular physicist and therefore with the production of a common system of physics for all physicists. (Planck, 1915: p. 14)

For even if the physicist were *an alien*, and not specifically *human*, they'd also have to be a rational, concept-using, conscious, self-conscious, sense-perceiving, imagining, and remembering *minded animal* alien, and so STR-GTR's/QM's dehumanization of physics *wouldn't* escape at least the necessary conformity of physics to the physicist.

Moreover, the STR-GTR/QM revolution, for all its theoretical and social-institutional success, and indeed hegemony, nevertheless remains fully impaled on the horns of a nineteenth century neo-Kantian and Vienna Circle Logical Empiricist/Positivist philosophical dilemma: EITHER formal and natural science capture a godlike or superhuman noumenal insight into humanly-inaccessible hidden reality, OR formal and natural science express only a skeptically-inflected, relativistic, subjective idealist (whether solipsistic or communitarian) construction of a phenomenal world of falsidical appearances. And never the twain shall meet. This is also what Steven L. Goldman aptly calls the *science wars* (Goldman, 2022). Let's call that *problem A*.

Furthermore, ultimately, STR-GTR/QM cannot explain manifestly real *organismic life, conscious mind, negentropy, irreversible processes, and unidirectional or asymmetric time*, except by appealing to *random fluctuations* in a Boltzmannian universal probabilistic or statistical indeterministic micro-world of atomic particles, energy quanta, and waves, and their micro-states. In particular, because "all irreversible processes may be considered as reversible elementary processes," then "in the final analysis all processes in nature are reversible" (Planck, 1915: p. 134). In short, irreversible processes are ultimately *explained away*. And the same ultimate explaining-away goes, mutatis mutandis, for life, mind, negentropy, and unidirectional or asymmetric time. But precisely *what* are "random fluctuations" and how are relevantly different from what Isaac Newton called "occult qualities"? In my opinion, they're *not* relevantly different. So the explanation-by-explaining away is grounded on a *metaphysical mystery*. Let's call all that *problem B*.

Nor, finally, can STR-GTR/QM actually unify STR-GTR and QM themselves into a single consistent and complete theory. For example, it's entirely unclear how *gravitational force*, as modeled by curved four-dimensional spacetime around large material objects—such as planets—in GTR, as the weakest of the four fundamental forces, (i) applies to the paradigmatic quantum-mechanical items—particles, waves, and energy quanta—that can be either massless (i.e., gluons and photons) or whose masses, densities, and weights can be virtually infinitely small, and (ii) applies at the center of a black hole, where spacetime curvature can be virtually infinitely great. Let's call that *problem C*.

Now, in the third decade of the twenty-first century, roughly a century after the hegemonic but nowadays troubled and even crisis-ridden (Smolin, 2013; Hossenfelder, 2018) STR-GTR/QM revolution, enter the *neo-organicist turn*, which has two parts.

First, manifest realism, which says that the natural universe is, at least in principle, *directly accessible* to rational human pure or a priori intuition and human sense perception alike, precisely because the natural universe consists of a complete, unified, structuralist system of *objective veridical appearances*, such that

anything X appears to be F (or G, or whatever) to us if and only if (i) X *really and truly* is F (or G, or whatever), and (ii) the fact of X's being F (or G, or whatever) is, at least in principle, *intersubjectively directly accessible* to all actual or possible rational human minded animals, and *not* idiosyncratically restricted to any single rational human individual or to any particular rational human community/social institution or special set of such communities/social institutions.

And **second**, *organicism*, which says (i) that mental properties are at least as fundamental as physical properties in the natural universe, that they don't exclude each other in the same substances, and indeed that they're *necessarily complementary* in minded animals (liberal naturalism), (ii) that conscious mind and organismic life are metaphysically continuous with one another (mind-life continuity), and (iii) that instead of assuming that the world is fundamentally mechanical, so that manifestly real conscious mind, organismic life, negentropy, irreversible processes, and unidirectional or asymmetric time all explanatorily and metaphysically mysteriously *pop out of* fundamentally physical, non-living, computable, entropic, and reversible mechanical systems, only in order ultimately to *pop back into them* in the state of maximum entropy, we instead postulate the natural universe is *fundamentally organic* and therefore all formal and natural mechanical systems are metaphysically dependent on and derivable from uncomputable, negentropic, irreversible, processual, purposive, self-organizing, and time-unidirectional or time-asymmetric organic systems (explanatory inversion).

According to organicism, then, what is the explanatory and metaphysical or ontological function of mechanical systems? It's nothing more and nothing less than to provide a relatively fixed, rigid, and static *skeleton* for channelling, distributing, focusing, framing, and more generally supporting the essentially richer informational or representational and causal powers of organic systems, just as the relatively fixed, rigid, and static skeleton inside a living animal channels, distributes, focuses, frames, and more generally supports the essentially richer informational or representational and causal powers of the organism itself. And when formal or natural organic systems fully unfold, naturally die, or otherwise creatively realize themselves and achieve closure, then the skeletons of their embedded mechanical systems continue to exist, either in a state of computable, decidable, recursive, and yet creatively inert formal perfection or else in a state in a state of calcified or frozen thermodynamic energy dispersal and equilibrium, i.e., *heat-death*. Therefore, trying to explain or construct organic systems from mechanical systems is *like confusing living animals with their skeletons*. To be sure, paleontologists can learn a great deal about living animals from the genetic information stored in skeletons.¹ But as someone who, as a university student, had a regular summer job working in a zoo, I can personally confirm that there's a world of difference between being in the same cage with a living lion, and being in the same cage with its skeleton, even though they share the same DNA.

¹ I'm grateful to one of the anonymous readers at Springer Nature for reminding me of this fact, and suggesting that I finesse my skeleton metaphor accordingly.

Manifest realism solves problem A, because it defines formal and natural scientific objectivity in such a way as to avoid noumenal realism and subjective idealism alike.

And organicism solves problem B, because it provides a natural and fully non-reductive explanation of manifestly real conscious mind, organismic life, negentropy, irreversible processes, and unidirectional or asymmetric time alike, while *also* effectively explaining the existence and specific character of formal and natural mechanical systems.

Furthermore, when taken together, as jointly constituting *neo-organicism* (NO), manifest realism and organicism collectively solve problem C, as follows.

On the negative side, NO fully avoids what I call *The Representation → Represented Fallacy*, committed by STR-GTR and QM alike, which consists in mistakenly inferring directly from the representational and quantitative properties of experimental devices, to objective properties of what's represented and measured by those devices. Correspondingly, NO rejects Einstein's postulation of *the speed of light*, i.e., 186,000 miles per second, as an absolute causal speed limit in the natural universe, in favor of the thesis that there's pervasive non-local causality in the natural universe via complementarity and entanglement. Moreover, on the one hand, NO rejects Einstein's spinozistic classical *macro-determinism*. But on the other hand, NO equally rejects the non-classical Boltzmannian universal probabilistic or statistical *indeterminism* of atomic particles, energy quanta, and waves, and their *micro-states*. Relatedly, as Einstein famously remarked, God doesn't play dice with the universe; but that's only because *God, and God's noumenal, dehumanizing standpoint, doesn't play ANY sort of substantive role in neo-organicist physics*, which resolutely focuses on the standpoint of rational "*human, all-too human*" minded animals.

On the positive side, NO postulates the fundamental and manifestly real existence of *non-deterministic* and also *non-indeterministic* uncomputable, negentropic, irreversible, processual, purposive, self-organizing, and time-unidirectional or time-asymmetric organic systems. Furthermore, NO adopts what I call *the no-layered scalar dynamic world-picture* of the manifestly real natural universe, which says (i) that the cosmos has three basic scales: *mega-* (i.e., very large-sized) scale, *meso-* (i.e., middle-sized) scale, and *micro-* (i.e., very small-sized) scale, all of which are calibrated solely by reference to the egocentrically-centered, spatiotemporally orientable, embedded standpoint of rational "*human, all-too-human*" minded animals, and (ii) that complementarity, entanglement, and non-locality pervade manifest natural reality at *all* basic scales. In turn, and finally, NO also postulates the fundamental and manifestly real existence of what I call *the rubber sheet cosmos*: an infinite, expanding, unbounded, torus-shaped natural universe in which all organic systems and their dependent, derivative mechanical systems are fully embedded, at all basic scales.

The purpose of this book, then, is to present and defend the neo-organicist turn, including manifest realism and the three sub-parts of organicism: liberal naturalism, mind-life continuity, and explanatory inversion. Or more briefly and simply put, the purpose of this book is to present and defend *science for humans*.

In the first paragraph of this chapter, I said that “in this book, I present and defend an original and paradigm-shifting conception of formal science, natural science, and the natural universe alike.” I meant—in a contemporary context, roughly a century after the world-changing but now problem-ridden, crisis-beset STR-GTR/QM revolution. To be sure, there are many important influences on science for humans that flow from earlier works by brilliant philosophers and formal or natural scientists, especially including: Kant’s *Critique of Pure Reason* and *Critique of the Power of Judgment* (Kant, *CPR*, *CPJFI*); some of F.W.J. Schelling’s writings (see, e.g., Gare, 2011); some of Georg Cantor’s mathematical writings (Cantor, 1891, 2019); Henri Bergson’s *Matter and Memory* (Bergson, 1911a) and *Creative Evolution* (Bergson, 1911b/1944); A.N. Whitehead’s *The Concept of Nature* (Whitehead, 1920/1971), *Science and the Modern World* (Whitehead, 1927/1967), and *Process and Reality* (1929/1978); some of Kurt Gödel’s logico-mathematical writings (Gödel, 1931/1967, 1947); Erwin Schrödinger’s *What is Life?* (Schrödinger, 1944/1967); Edmund Husserl’s *Crisis of European Sciences* (Husserl, 1954/1970); Maurice Merleau-Ponty’s *Phenomenology of Perception* (Merleau-Ponty, 1945/1962); Ilya Prigogine’s *End of Certainty* (Prigogine, 1997); Thomas Nagel’s *Mind and Cosmos* (Nagel, 2012); and Lee Smolin’s *Time Reborn* (Smolin, 2013). These are the giants on whose shoulders I’m standing, trying to see further than they did (Newton, 1675).

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Chapter 2

Mind Is a Form of Animal Life: The Essential Embodiment Theory Now



Abstract In this chapter, I do four things. First, I briefly and compactly re-present and re-motivate what Michelle Maiese and I, in (Hanna R, Maiese M, Embodied minds in action. Oxford University Press, Oxford, 2009), call *the essential embodiment theory* of the mind-body relation and mental causation (Sect. 2.2). Second, I equally briefly and compactly present and motivate three later significant elaborations and extensions of the essential embodiment theory: (i) an original and paradigm-shifting theory of free agency that I call *natural libertarianism*, (ii) a correspondingly original and paradigm-shifting conception of nature and the formal and natural sciences that I call *the neo-organicist worldview*, and, as directly entailed by the neo-organicist worldview, (iii) the metaphysical doctrine of *liberal naturalism* (Sect. 2.3). Third, I even more briefly and compactly critically compare-&-contrast the essential embodiment theory with an increasingly popular contemporary theory of the mind-body relation that's commonly known as *Analytic panpsychism* (Sect. 2.4). And fourth and finally, I conclude the chapter with something I call a *semi-autobiographical quasi-Whiteheadian postscript* (Sect. 2.5).

It is never our objective [and fundamentally physical and mechanical] body that we move, but our phenomenal [and fundamentally living and organic] body, and there is no mystery in that, since our body, as the potentiality of this or that part of the world, surges towards objects to be grasped and perceives them. (Merleau-Ponty, 1945/1962: p. 106; square-bracketed material added)

[S]omeone who wishes to maintain that the brain state and the pain are identical must argue that the pain A could not have existed without a quite specific kind of configuration of molecules. If A = B, then the identity of A with B is necessary, and any essential property of one must be an essential property of the other.... In sum, the correspondence between a brain state and a mental state seems to have an obvious element of contingency.... Here I have been emphasizing the possibility, or apparent possibility, of a physical state without the corresponding mental state. The reverse possibility, the mental state (pain) without the physical state (C-fiber stimulation) also presents problems for the [mind-brain] identity theorists which cannot be resolved by appeal to the analogy of heat and molecular motion. (Kripke, 1972/1980: 147–148, 154)

The Necker Cube Argument.

1. Our conscious visual perceptions of the two enantiomorphic, or mirror-image-reversed, representations of the Necker Cube—call them *the subjective experience of Necker aspect A* and *the subjective experience of Necker aspect B* respectively—occur spontaneously.
2. Now suppose that in the actual world brain state α partially embodies the subjective experience of Necker aspect A. It is ... conceivable and therefore logically possible ..., assuming that all physical properties in the natural world, including functional and behavioral properties, are held fixed, that brain state α might have partially embodied the subjective experience of Necker aspect B.
3. So mental properties do not logically strongly globally supervene on fundamental physical properties.
4. Therefore both explanatory reduction and ontological reduction are false, and PIM [i.e., the physical irreducibility of the mental] is true. (Hanna & Maiese, 2009: p. 281, square-bracketed material added)

2.1 Introduction

Fifteen years ago, Michelle Maiese and I published a 400-page book in the philosophy of mind with Oxford University Press, called *Embodied Minds in Action* (Hanna & Maiese, 2009). In that book, we worked out what we thought was—and still continue to think is—an original and paradigm-shifting theory of the mind-body relation and mental causation.

Sadly, however, like David Hume's *Treatise of Human Nature*, our book “fell dead-born from the press, without reaching such distinction, as even to excite a murmur among the zealots” (Hume, 1776/2022: p. 6). In other words, it was completely ignored by the leading mainstream Analytic philosophers of mind—including David Chalmers, Andy Clark, Daniel Dennett, Jaegwon Kim, and John Searle—not to mention also being completely ignored by all *other* philosophers, whether Analytic philosophers or so-called “Continental” philosophers. One minor exception was a short review by a young and relatively unknown Analytic philosopher of mind, who merely described its basic contents and then said that the book was “highly ambitious,” which is an Analytic philosopher's dog-whistle or coded speech for “not to be taken seriously; safely ignored.” A second minor exception was another young, but also more professionally ambitious and nowadays better-known, mainstream Analytic philosopher of mind, who wrote in his personal blog at the time that *he was “amazed” that this book was actually published by OUP, since he literally didn't understand a single word of it, especially all that long-discredited Kantian stuff*. Really? Not a single word? Not even the title? And what's so bad about Kantian philosophy anyway? But over and above the all-too-familiar anti-Kantian dogmatism and prejudice that's characteristic of what I've called “the Kant wars” (Hanna, 2020a), and in order to be rationally extra-charitable to the blogger, one could, I suppose, from a mainstream Analytic philosophy of mind point of view, be officially “amazed” at OUP's audacity, or temporary idiocy, in

actually publishing a book that creatively and critically updates, re-works, and re-deploys Kant’s “highly ambitious” cognitive semantics and transcendental idealist modal metaphysics in the *Critique of Pure Reason* (Hanna, 2001, 2006a), for the specific purpose of rethinking the foundations of the philosophy of mind. What a scandal.

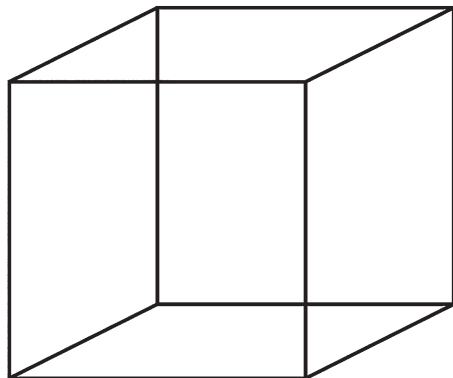
In a more upbeat spirit, however, also circa 2009, by way of a third and last minor exception, some advanced graduate students at a university somewhere in the American South, who were doing a self-directed study group on *Embodied Minds in Action*, wrote that a super-short but accurate synopsis of the book would be:

Merleau-Ponty Meets The Kripke Monster

and I’ve always liked that witty microsynopsis of our book. Indeed, there’s definitely something bang-on-target correct about it, *methodologically* speaking, in that it’s absolutely true that *Embodied Minds in Action* combines (i) a set of thoroughly non-reductive existential-phenomenological descriptions and also (ii) a substantive appeal to evidence supplied by contemporary empirical psychology, both as per Maurice Merleau-Ponty in his 1945 masterpiece, *The Phenomenology of Perception*, together with (iii) the formally rigorous logico-semantic methods of contemporary Analytic modal metaphysics, as per Saul Kripke in his 1972 masterpiece, *Naming and Necessity*. So we methodologically triangulate phenomenology, empirical psychology, and modal metaphysics. And then (iv) they’re all philosophically distilled, refined, and transmogrified in the alembic of a broadly Kantian approach to cognitive semantics and transcendental modal metaphysics that’s directly inspired by Kant’s 1781 masterpiece, the first *Critique*. So we *methodologically triangulate* and then *kantify*.

An excellent example of this triangulation-&-kantification method is our *Necker Cube Argument* for the physical irreducibility of the mental, as per the third epigraph for this chapter and the image displayed directly below it (see Fig. 2.1 above), which utilizes (i) the phenomenology of multistable perception, (ii) the empirical psychology of multistable perception, (iii) a priori conceptual modal reasoning, and (iv) Kant’s famous “incongruent counterparts” argument for the essential

Fig. 2.1 The Necker Cube. (Wikimedia Commons, 2007)



non-conceptuality and synthetic aprioricity of geometry (Hanna, 2001, 2006a: ch. 2, 2015: ch. 2)—the two Necker Cube aspects are in fact topologically deformed mirror-reflected left handed \leftrightarrow right-handed configurations in egocentrically-centered orientable space, i.e., they're *enantiomorphs*, aka Kant's "incongruent counterparts"—in order to show that mental properties do not logically strongly globally supervene on fundamental physical properties.

More precisely, however, in *Embodied Minds in Action* we claim that the mental-physical relation in minded living organisms like us is nothing more and nothing less than (i) a *synthetic a priori two-way necessary complementarity relation*, and also (ii) a *neo-Aristotelian hylomorphic relation*, that is, a mental-to-physical and also physical-to-mental entangled necessary equivalence of "fused" inherently activating irreducible *formal* or morphetic mental properties on the one hand, and complex non-equilibrium thermodynamic *material* or hyletic biological physical properties on the other, such that, (iii) as *minded animals*, i.e., as conscious living organismic animal bodies, we're an indissoluble and physically irreducible form-matter composite, by virtue of which we're always "minding our bodies" (Hanna, 2011), that's (iv) *inherently poised for causally efficacious intentional action*, spontaneously initiated and creatively guided by our synchronous acts of desire-based *willing* (Hanna, 2020b). In short, *our minds are physically irreducible forms of animal life* and *we're essentially embodied minds in action*; and this is what Maiese and I call *the essential embodiment theory* of the mind-body relation and mental causation.

Correspondingly, the two spontaneously flipping enantiomorphic aspects of the Necker Cube provide an especially apt imagistic diagram of the relation between mental properties and organismic physical properties, by not only demonstrating the physical irreducibility of the mental, but also displaying an iconic metaphor for the necessary complementarity of causally efficacious physically irreducible mental properties and organismic physical properties, the hylomorphic *dual aspects* of rational human minded animals.

In this chapter, I'll do four things. **First**, I'll briefly and compactly re-present and re-motivate the essential embodiment theory (Sect. 2.2). **Second**, I'll equally briefly and compactly present and motivate three later significant elaborations and extensions of the essential embodiment theory: (i) an original and paradigm-shifting theory of free agency that I call *natural libertarianism*, (ii) a correspondingly original and paradigm-shifting conception of nature and the formal and natural sciences that I call *the neo-organicist worldview*, and, as directly entailed by the neo-organicist worldview, (iii) the metaphysical doctrine of *liberal naturalism* (Sect. 2.3). **Third**, I'll even more briefly and compactly critically compare-&-contrast the essential embodiment theory with an increasingly popular contemporary theory of the mind-body relation that's commonly known as *Analytic panpsychism* (Sect. 2.4). And **fourth** and finally, I'll conclude the chapter with something I call *a semi-autobiographical quasi-Whiteheadian postscript* (Sect. 2.5).

2.2 The Essential Embodiment Theory Briefly and Compactly Re-presented and Re-motivated

So that we're all on the same page, I'll begin this section with a quick critical synoptic sketch of recent and contemporary mainstream Analytic philosophy of mind (see, e.g., Chalmers, 1996; Kim, 2005, 2006).

As I see it, the two fundamental problems in recent and contemporary mainstream Analytic philosophy of mind are these:

The mind-body problem: what accounts for the existence and specific character of conscious, intentional minds like ours in a fundamentally physical world?

The problem of mental causation: what accounts for the causal efficacy and causal relevance of conscious, intentional minds like ours in a fundamentally physical world?

Correspondingly, there are two standard approaches to these problems: (i) *dualist* approaches and (ii) *materialist or physicalist* approaches. (I'll also briefly discuss *idealist* approaches at the end of this section and in Sect. 2.4.)

Now, *classical Cartesian interactionist substance dualism* in the philosophy of mind¹ holds that the human mind and the human body are essentially distinct substances: one of them fundamentally non-material or non-physical, and the other one fundamentally material or physical, hence fundamentally non-mental. These essentially distinct substances are held together by metaphysically mysterious contingent causal relations, including both mind-to-body or mind-to-mind causal relations (aka "mental causation") and body-to-mind causal relations. From a classical Cartesian interactionist substance dualist point of view, only body-to-body causal relations are non-mysterious, although of course Hume thoroughly "problematized" that kind of causal relations too in his "unfortunate" *Treatise* (Hume, 1776/2022: p. 6), thereby setting the philosophical stage for Kant's thrilling transcendental idealist modal-metaphysical rescuscitation of the very idea of manifestly real efficacious causation, via his conception of the synthetic a priori. In any case, there's also a more cautious twentieth and twenty-first century variant of classical Cartesian interactionist substance dualism, known as *property dualism*, which says that even though there aren't, at least in the actual world, any Cartesian mental substances per se, nevertheless there are essentially distinct fundamentally mental *properties* and fundamentally physical *properties*, each of which can be instantiated without the other in conceivably and logically possible worlds, for example, in *bodiless spiritual minds*, or in *mindless zombies* that are particle-for-particle and behavior-for-behavior *duplicates* of our actual-world minded bodies.

¹ There's also a twenty-first century variant on this, developed by E.J. Lowe, called "non-Cartesian substance dualism," which postulates a *person-body* substance dualism (Lowe, 1993, 2000), that I'll leave aside for the purposes of this chapter and this book, since it also entails *property dualism*, which I'll briefly critically discuss in this section, whose falsity entails the negation of Lowe's non-Cartesian version of substance dualism by *modus tollens*.

By sharp contrast, recent and contemporary mainstream Analytic philosophy of mind can be generally characterized by its official and orthodox *rejection* of classical Cartesian interactionist substance dualism, and correspondingly by its central, ongoing commitment to *materialism* or *physicalism* as regards the nature of the mind-body relation and mental causation. Materialism or physicalism, as such, says that all properties of or facts about the human mind are constitutively determined by fundamentally physical facts. But there are three interestingly different types of materialism or physicalism: (i) *reductive* materialism or physicalism, (ii) *eliminative* materialism or physicalism, and (iii) *non-reductive* materialism or physicalism. Reductive materialism or physicalism—a prime example of which is the mind-brain identity theory so famously criticized by Kripke in *Naming and Necessity*, as per the second epigraph of this essay (Kripke, 1972/1980: pp. 144–155)—says that all properties of or facts about the human mind are wholly constitutively determined by fundamentally physical properties or facts, or, as the technical terminology has it, mental properties or facts are *logically supervenient* on fundamentally physical properties or facts. That is: the human mind is really *nothing over and above* the fundamentally physical world. Eliminative materialism or physicalism, by contrast, says that, given the truth of reductive materialism, minds are really *nothing at all*: our belief in the existence of minds is a mere illusory folk belief and a conceptual myth. Non-reductive materialism or physicalism, by another contrast, says that some but not all properties of or facts about the human mind are wholly constitutively determined by fundamentally physical properties or facts. That is: certain causally inert or epiphenomenal properties or facts about the human mind—for example, properties or facts about the normative character of rational human intentionality, or about the qualitative specific character of consciousness—vary independently of fundamentally physical properties or facts, even though all of the human mind’s causally efficacious properties or facts are still wholly constitutively determined by fundamentally physical facts.

At the same time, however, even despite its official anti-Cartesianism, this recent and contemporary mainstream Analytic materialist or physicalist tradition remains entirely but (mostly only) implicitly and unself-consciously committed to a three-part metaphysical presupposition that Maiese and I call *Cartesian fundamentalism*, according to which (i) the mental (if it indeed exists at all) is *fundamentally* (that is, inherently, necessarily, and exclusively) *non-physical*, (ii) the physical is *fundamentally* (that is, inherently, necessarily, and exclusively) *non-mental*, and (iii) no actual or possible substance has or can have a *complementary dual essence* that’s inherently and necessarily *both* mental *and* physical. Of course, Descartes himself was a Cartesian fundamentalist. But it’s crucial to recognize that the presupposition of Cartesian fundamentalism is *also* held by twentieth and twenty-first century *property dualists*, like Kripke in *Naming and Necessity*, and Chalmers in *The Conscious Mind*, who both postulate the *conceivable and logically possible* existence of essentially distinct mental and physical substances—for example, bodiless spiritual minds in pain (“pains without brains”) and mindless, pain-lacking zombies (“brains without pains”)—even though neither of these exists in *the actual world*. Indeed, all classical Cartesian interactionist substance dualists, twentieth and twenty-first

century property dualists, and also all reductive, eliminative, or non-reductive materialists or physicalists, *alike*, are committed to Cartesian fundamentalism. They differ among themselves only as to whether, on the one hand, EITHER mental and physical *substances* or mental and physical *properties* possess equal but opposite ontological status—which captures classical Cartesian interactionist substance dualism and twentieth and twenty-first century property dualism—OR, on the other hand, the mental asymmetrically ontologically depends on the physical, or else is nothing but a folk-psychological illusion or conceptual myth—which captures reductive, eliminative, or non-reductive materialism or physicalism. Hence all reductive, eliminative, or non-reductive materialists or physicalists, at bottom, are *Cartesian materialists* or *Cartesian physicalists*, because they are fully committed to Cartesian fundamentalism, just like the classical Cartesian interactionist substance dualists and the twentieth and twenty-first century property dualists.

Although recent and contemporary mainstream Analytic philosophers of mind might well be “amazed” by this, the essential embodiment theory *completely rejects* Cartesian fundamentalism, and therefore it also *completely rejects* classical Cartesian interactionist substance dualism, twentieth and twenty-first century property dualism, and *also* reductive, eliminative, and non-reductive materialism or physicalism, *alike*. Or, to play a riff on a most excellent Shakespearian curse: *a philosophical plague on all their houses*.

More positively and specifically, however, the essential embodiment theory says (i) that the physically irreducible conscious, intentional minds of minded animals are *necessarily* and *completely* embodied in those animals, and, more specifically, (ii) that the physically irreducible conscious, intentional mind of a minded animal is the global dynamic immanent structure of the living organismic body of that very animal, a structure that synchronously activates and guides that animal’s causally efficacious biological powers—or as Aristotle puts it in his own terminology: “the soul (*anima*) is the first actuality of a natural body that has life potentially” (Aristotle, 1968: II.i.412a22). Hence, as I mentioned in Chap. 1, the essential embodiment theory is committed to a non-equilibrium-thermodynamics-inspired version of *neo-Aristotelian hylomorphism* about the mind-body relation.

According to the essential embodiment theory, consciousness is *subjective experience*, which is to say that it inherently involves a self that’s egocentrically-centered in orientable space and unidirectional time (= subjectivity), and also that this self enacts or engages in mental acts, states, or processes of various kinds (= experience), and furthermore consciousness has two basic modes: (i) *pre-reflective or non-self-conscious consciousness*, which, in being naturally directed towards cognitive or intentional targets *other than itself*, is *immanently reflexive*, or *aware of itself egocentrically and subjectively*, without implicitly or explicitly forming judgments or propositional thoughts about itself, and (ii) *reflective consciousness*, or *self-consciousness*, which, in being naturally directed towards, or about, *itself AS* a cognitive or intentional target, is *aware of itself allocentrically and objectively*, by implicitly or explicitly forming judgments or propositional thoughts about itself. More simply put, pre-reflective or non-self-consciousness consciousness is *just being* a conscious mind that’s directed towards other animals or things; whereas

reflective or self-conscious consciousness is *thinking about itself AS* a conscious mind that's *ALSO* directed towards other animals or things.

Against that theoretical backdrop, the essential embodiment theory is a specially restricted version of “dual-aspectism.” For other dual aspect theories, one can compare and contrast Spinoza's *theological* dual-aspect monism (in *The Ethics*), Bertrand Russell's *neutral* dual-aspect monism (in *The Analysis of Mind* and *The Analysis of Matter*), or A.N. Whitehead's *panexperientialist organicist* dual-aspect monism (in *Process and Reality*—and I'll briefly come back to that in the concluding Sect. 2.5). By contrast to those three kinds of dual-aspectism, the essential embodiment theory is committed to a dual-aspect monism of *complex dynamic systems*, and says that in all and only *appropriately complex kinds of organismic living systems*, causally efficacious physically irreducible mental properties and organismic physical properties are related by two-way necessary complementarity and neo-Aristotelian hylomorphism. Or in other and fewer words: *physically irreducible minds are forms of animal life, and nothing in nature that's not a form of animal life is minded.*

To summarize so far: the essential embodiment theory says (i) that physically irreducible minds like ours are necessarily and completely embodied, (ii) that physically irreducible minds like ours are complex dynamic global structures of our living organismic bodies, i.e., forms of life, (iii) that physically irreducible minds like ours are therefore inherently alive, (iv) that physically irreducible minds like ours are therefore inherently causally efficacious, just like all forms of organismic life, and (v) that physically irreducible minds like ours emerge over time and in space in all and only certain kinds of living organisms, i.e., minded animals.

Furthermore, if by *autonomy* we mean *a capacity for self-determination in the broadest possible sense*, then we can also distinguish between (v1) *the autonomy of proto-consciousness*, a minimal and relatively self-less endogenous sensibility possessed by all living organisms, all the way down to unicellular organisms, (v2) *the autonomy of pre-reflective consciousness*, an egocentric and immanently self-aware, self-locating sensibility possessed by all minded animals, and (v3) *the autonomy of self-consciousness*, a further and specifically rational conscious capacity to represent oneself by means of concepts and judgments, which requires and indeed presupposes that we're also able to think propositionally, speak richly-structured natural languages, and engage in logical reasoning (Hanna, 2006b: ch. 4).

Now in addition to self-consciousness, rational human minded animals are not only inherently capable of (i) consciousness, that is, subjective experience (as defined above), but also of (ii) *intentionality*, that is, *directedness to all kinds of things as their cognitive, desiderative, emotional, etc., targets*. More generally, consciousness and intentionality are *complementary*: they're distinct capacities, but also necessarily mutually connected capacities. More specifically, necessarily, all *conscious* acts, states, or processes are also *intentional* acts, states, or processes, a thesis that's also sometimes called “the intentionality of phenomenology,” and all *intentional* acts, states, and processes are also *conscious* acts, states, or processes, a converse thesis that's also sometimes called “the phenomenology of intentionality” (see also Horgan & Tienson, 2002). Our complementary capacities for consciousness and intentionality are also shared with minded animals in many other species,

but are *self-evidently* phenomenologically manifest in minds like ours, via our further capacity for specifically *rational* consciousness, intentionality, and self-consciousness, not only as per Descartes's *Cogito*, "I think, therefore I am," but also, and even more fundamentally, via our capacity for essentially embodied *affective or emotional* consciousness, intentionality, and self-consciousness, as per what Maiese and I call *The Essentially Embodied Cogito*, "I desire, therefore I am" (Hanna & Maiese, 2009: p. 21).

In view of all that, here are eight reasons why the essential embodiment theory not only *dissolves* the mind-body problem and the problem of mental causation, but also finally *solves* them.

First, the essential embodiment theory fully avoids *reducing* the mental to the physical, i.e., it fully avoids reductive materialism or physicalism. Reductive materialism or physicalism, as we've seen, ends up in eliminativism. But what could be more phenomenologically or epistemically primitive than our subjective experience of ourselves *as* conscious, intentional minds, and correspondingly, what then could be more metaphysically and ontologically primitive than the fact of the mental *quâ* mental?

Second, the essential embodiment theory also fully avoids non-reductive materialism or physicalism and solves the problem of mental causation. Non-reductive materialism or physicalism entails the causal inertness of the mental or epiphenomenalism, hence it robs the mental of all its efficacious causal power. By a diametric contrast, the essential embodiment theory identifies the causal efficacy of physically irreducible minds with the causally efficacious powers of appropriately complex dynamic organismic systems. It is no theoretical virtue of epiphenomenalism that the mental still has "causal relevance" even though it has no causal efficacy. On the contrary, for mental causation to be really possible, the mental has got to have *efficacious causal powers of its own*, not merely *an important informational bearing on causally efficacious fundamentally physical processes*. According to the essential embodiment theory, physically irreducible minds like ours have efficacious causal powers of their own *precisely insofar as they're forms of life, and therefore synchronous structuring guidance-causes of appropriately complex dynamic organismic systems, i.e., our "human, all-too-human" minded animal bodies*.

Third, by means of its solution to the problem of mental causation, the essential embodiment theory provides adequate metaphysical foundations for a robust metaphysics of *free agency* that I'll briefly present in Sect. 2.3 below.

Fourth, the essential embodiment theory also fully avoids reducing the physical to the mental, aka *subjective idealism*. Subjective idealism makes nature's existence radically dependent on the existence of individual minds. But it's highly implausible to hold that physical nature came into existence *only after* there were any minded animals. For, since animals are parts of physical nature, it would follow that animals came into existence only after there were minded animals. And it's equally highly implausible to hold that if all individual minds were to perish, nature would go out of existence too. For in that case, since all animals die, and in most cases after animals die, their corpses continue to exist for a while, it would follow that necessarily, the last minded animal would have no corpse.

Fifth, the essential embodiment theory also fully avoids making the mental and the physical either essentially or even logically independent of one another, as per either Cartesian interactionist substance dualism or twentieth and twenty-first century property dualism. Any form of dualism makes it impossible to explain how the mental and the physical causally interact without appealing to some sort of metaphysical mystery: for example, Descartes's God, Leibniz's divine pre-established harmony, an ectoplasmic medium, etc., etc. And any form of dualism also entails the synthetic a priori metaphysical impossibilities (i) that subjective experiences could ever exist without embodiment in living animal bodies like ours, (ii) that living animal bodies like ours could ever exist without subjective experiences. According to the essential embodiment theory, *spirits and zombies alike are synthetic a priori or strongly metaphysically impossible*, even though *they're also analytically or logically possible*.

Sixth, the essential embodiment theory also fully avoids over-restricting mentality to the brain, i.e., it fully avoids the error of "the brain-bounded mind" (Hanna, 2011).

Seventh, the essential embodiment theory also fully avoids *over*-extending the mental beyond living animal bodies like ours, i.e., it avoids the error of "the extended mind" (Clark & Chalmers, 1998; Clark, 2008; Gallagher, 2011).

Eighth, and perhaps most importantly, building on the sixth and seventh points, the essential embodiment theory is an approach to the mind-body relation and mental causation that's perfectly scaled to the nature, scope, and limits of our "human, all too human" existence in a thoroughly nonideal natural and social world. Brain-boundedness falls short of the human condition: it makes us much less than we manifestly are. The extended mind exceeds the human condition: it makes us more than we manifestly are. *Only* the essential embodiment theory adequately captures and reflects *the rational human condition*: it tells us exactly what we manifestly really are. For I just *am* my rational minded animal body and its "human, all too human" life, for better or worse. In short, of all the mind-body theories out there (in all the gin joints in all the towns in all the world), *only* the essential embodiment theory conforms to Socrates's Delphic-Oracle-inspired thesis that the ultimate aim of philosophy is to "know thyself."

So, *three cheers* for the essential embodiment theory.

2.3 Three Later Significant Elaborations and Extensions of the Essential Embodiment Theory: Natural Libertarianism, the Neo-Organicist Worldview, and the Metaphysics of Liberal Naturalism

But the story continues. As Maiese and I were writing the final three chapters of *Embodied Minds in Action*, I gradually or suddenly realized that our complete rejection of Cartesian fundamentalism also entailed our completely re-thinking the

conception of nature and the natural sciences that's presupposed by classical Cartesian interactionist substance dualism, twentieth and twenty-first century property dualism, reductive materialism or physicalism, and non-reductive materialism or physicalism, alike. Or in other words, in order to solve the mind-body problem and the problem of mental causation, instead of trying to fit minds like ours into the mechanistic and materialist or physicalist picture of nature and the natural sciences, like trying to jam a round peg into a square hole, *we have to revolutionize our picture of nature and the formal-&-natural sciences*. In *Embodied Minds in Action*, Maiese and I called this revolutionary idea *The Dynamic World Picture* (Hanna & Maiese, 2009: section 7.3).

After the publication of *Embodied Minds in Action* in 2009, in 2012, amazingly enough, the mainstream Analytic philosophers Thomas Nagel and Helen Steward also wrote some very similar things:

[R]ational intelligibility is at the root of the natural order. (Nagel, 2012: p. 17)

On a teleological account, the existence of value is not an accident, because that is part of the explanation of why there is such a thing as life, with all its possibilities of development and variation. In brief, value is not just an accidental side effect of life; rather, there is life because life is a necessary condition of value.

Even though natural selection partially determines the details of the forms of life and consciousness that exist, and the relations among them, the existence of the genetic material and the possible forms it makes available for selection have to be explained in some other way. The teleological hypothesis is that these things [are] determined not merely by value-free chemistry and physics but also by something else, namely a cosmic predisposition to the formation of life, consciousness, and the value that is inseparable from them. (Nagel, 2012: p. 123)

The task [of understanding free agency] requires some reflection on the organizational principles of living creatures, for it is only through such reflection ... that we can start to understand where the difference really lies between, on the one hand those things that are true agents, and, on the other, mere machines, entities that nothing will ever be up to, however impressive they may be.... I am exceedingly hopeful that the next few years will see the beginnings of a revolution in our conception of the human person, as philosophical and everyday conceptions of the scientific picture of the world are freed from outdated Newtonian ideas and begin to take more note, both of the complexities of science as it really is and of the undeniable fact of our animal nature. (Steward, 2012: pp. 198–199)

For the record, I'm absolutely certain that neither Nagel nor Steward has ever read a single word of *Embodied Minds in Action*. So it must have been the *Zeitgeist*. But in any case, my realization around 2009 about the profound need for a revolutionary turn to The Dynamic World Picture has led me to work out three significant elaborations and extensions of the essential embodiment theory since then: **first**, in a book called *Deep Freedom and Real Persons*, I presented and defended an original and paradigm-shifting theory of free agency called *natural libertarianism* (Hanna, 2018), and **second** and **third**, in *this* book, I'm going to present and defend an original and paradigm-shifting new conception of nature and the formal-&-natural sciences, called *the neo-organicist worldview*, which in turn directly entails the metaphysical doctrine of *liberal naturalism* (Hanna & Maiese, 2009: pp. 312–313;

Hanna & Paans, 2020; Torday et al., 2020; Hanna, 2021a). As a preliminary to that, in this section, I'll briefly and compactly present and motivate all three of these.

By *deep free agency* for rational human animals, I mean the conjunction of *real free will* and *real practical agency* in rational human animals, which in turn means (i) that you really can choose and do what you want to, or refrain from so choosing or doing, without being in any way compelled or prevented by irresistible inner or outer forces (i.e., free will), and (ii) that you really can self-consciously choose and do what you want to, for reasons, and with deep moral or non-moral responsibility (i.e., practical agency). And by *deep moral or non-moral responsibility for X*, I mean (i) that *X* is something you chose or did yourself, whose objective moral value flows from and directly attaches to your freely willed choice or action, and (ii) that deep moral responsibility requires free will—if you were not able to choose or do *X*, without being in any way compelled or prevented by irresistible inner or outer forces, then you could not be deeply morally or non-morally responsible for *X*. An example of choice and action with deep *moral* responsibility would be your deciding, right now, either to join, or to quit, The Democratic Socialists of America. And an example of choice and action with deep *non-moral* responsibility would be creating a work of art.

Now, the thesis of *natural determinism* says that everything that happens now and in the future is strictly fixed by the laws of nature together with all the actual facts about the past. And the thesis of *natural indeterminism* says that at least some things and perhaps all things that happen are *not* strictly fixed by the laws of nature together with all the actual facts about the past, but also happen more or less randomly, according to mathematical laws of probability. Most contemporary philosophers and scientists, and many non-philosophers too, hold that you are *not* really free, because they also believe that the truth of contemporary formal science and natural science entails *universal natural mechanism*. Universal natural mechanism says (i) that everything in the cosmos either just is or is a sub-part of natural or physical processes that are either deterministic, indeterministic, or some mixture of both (say, macroscopically deterministic but microscopically indeterministic at the quantum level), and (ii) that all the causal and quantitative characteristics of those happenings are not only (ii.a) strictly fixed by the general causal laws of nature and/or the mathematical laws of probability, especially those laws governing the conservation of quantities of matter or energy, together with all the settled facts about the past, especially including The Big Bang Singularity, but also (ii.b) calculable from those laws and facts on a real-world Turing machine, i.e. a digital computer.² If universal natural mechanism is true, then you're not really free, because, instead, no matter what you may believe about your own freedom, you're really only a deterministic or indeterministic natural automaton/natural machine, ultimately caused by The Big Bang Singularity.

I'll now briefly and compactly present and motivate a theory of deep free agency in rational human animals that, as I've mentioned already, I call *natural*

²For explicit definitions of *Turing machine* and *computability*, see Sect. 7.4 below.

libertarianism (Hanna, 2018),³ that's *neither* contrary to contemporary natural science *nor* committed to universal natural mechanism—indeed, it *completely rejects* universal natural mechanism—and, correspondingly, I'll also briefly and compactly present a new proof for the *real possibility* of deep free agency in rational human animals, by explaining and proving its *actual existence*.

Natural libertarianism flows from two simple but earth-shattering ideas proposed by Kant in the eighteenth century, and also from one slightly less simple but still earth-shattering idea proposed in the twentieth century by Nobel laureate Ilya Prigogine and his co-researchers (Nicolis & Prigogine, 1977; Prigogine & Stengers, 1984; Prigogine, 1997), that's fully in theoretical conformity and harmony with the essential embodiment theory. **First**, action that is perfectly in conformity with a law, is not necessarily entailed or otherwise necessitated by that law (Kant's earth-shattering idea #1). **Second**, real freedom presupposes, in rational human animals, the natural processes specifically characteristic of living organisms; but living organisms are not natural automata, whether deterministic or indeterministic, because they are self-organizing and purposive; hence real freedom is grounded in *biological anti-mechanism* (Kant's earth-shattering idea #2). And **third**, the correct physics is a *non-deterministic* (and also *non-indeterministic*, but for simplicity's sake in this section I'll highlight the non-determinism) *interpretation of non-equilibrium thermodynamics* (Prigogine's earth-shattering idea).

For simplicity's sake, I'll refer to Prigogine's earth-shattering idea by using the acronym "NDI-NET." And let us suppose, for the purposes of argument, that NDI-NET, as worked out, for example, by Prigogine in *The End of Certainty*, is true, and that all the general causal laws of nature and/or mathematical laws of probability, as formulated by modern science—with the *exception* of The Second Law of Thermodynamics, requiring that in the spontaneous evolution of a physical system, entropy never decreases (hence requiring that entropy is always either increasing, or else constant in an equilibrium, time-reversible state, in every physical system), which *isn't* universally true if non-equilibrium thermodynamics *is* universally true—are also true, under the NDI-NET interpretation. From these suppositions, taken together with Kant's two ideas, not only does it *not* follow that universal natural mechanism is true and that we are really natural automata, it also follows that universal natural mechanism *isn't* true—i.e., it's *false*—and that we all really *aren't* natural automata/natural machines.

To see this, suppose that everything we choose and do is at least consistent with those general causal natural laws and/or mathematical laws of probability (with the exception of The Second Law of Thermodynamics, which of course isn't universally true if NDI-NET is universally true), and that therefore we never violate any of them. And in particular, suppose that we never bring any new matter or energy into the natural world, hence we never violate any of the general causal natural laws and/

³It should be especially noted that natural libertarianism doesn't have anything to do with *political* libertarianism, which is a pernicious combination of psychological egoism, ethical or moral egoism, neoliberalism, and the self-serving self-delusion that it's a form of political anarchism. 'Nuff said.

or mathematical laws of probability governing the conservation of quantities of matter or energy. Nevertheless, it does *not* follow that whatever we choose and do is entailed or otherwise necessitated by those laws. This is because, as Kant pointed out, *mere conformity of action with laws* is not the same as *entailment or necessitation by laws*.

Indeed, for any general causal law of nature and/or mathematical law of probability whatsoever, no matter how specific it is, together with all the settled natural facts about the past, nevertheless, there is always some physical *open texture* that is neither entailed nor necessitated by that law, although it remains perfectly in conformity with the laws. More precisely, in the wake of The Big Bang Singularity, there is always and everywhere some physical open texture that, at various stages of far-from-equilibrium, temporally-unidirectional, complex, negentropic, self-organizing thermodynamic activity, as studied in NDI-NET, creates targets for ultra-specific, context-sensitive natural activity, for example: (i) the roiling surface-structures of boiling water, (ii) the Belousov-Zhabotinsky chemical reaction, plus light excitation (Prigogine, 1997: pp. 66–67⁴), (iii) the unfolding of weather systems, (iv) the development of viruses, (v) organismic activity including the purposive lives of simple organisms, plants, and animals, (vi) the desires, feelings, passions, perceptions, and thoughts of conscious animals, and above all, (vii) really free choice and action by conscious animals, including rational human animals. I'll call these thermodynamic targets *live options*, and this physical open texture *natural open space*. Given some live options in natural open space, then, even though you never violate any general causal laws of nature and/or mathematical laws of probability and never bring any new matter or energy into the natural world, it remains really possible for you, in context, to choose and do some things you want to, in purposive, creative, and morally-empowered ways, by spontaneously locally re-organizing and re-structuring the total quantity of matter or energy that's always already available then and there. For example, imagine Nietzsche writing *The Birth of Tragedy Out of The Spirit of Music*. Needless to say, that amazing book had never been produced before in the actual history of the cosmos. Correspondingly, I'll call this sort of activity, *natural creativity*.

Now, inspired by Nietzsche's example, I am now going to do a little spontaneous Dionysian dance by flapping my arms and legs, bobbing my head, and hopping up and down a bit, like this → [RH does the dance]: I call this *The Freedom Dance*.⁵ The Freedom Dance, as an act of natural creativity, is just like an artistic genius who creates an original work of art by spontaneously locally re-organizing and re-structuring whatever already-existing materials are given to them: in that sense, it's just like Nietzsche creating *The Birth of Tragedy*. As naturally creative animals,

⁴The Belousov-Zhabotinsky reaction can be excited into self-organizing activity by means of the influence of light, using tris(bipyridine)ruthenium(II) chloride as a catalyst. But even this still falls short of organismic life.

⁵Actually, I first saw a freedom dance performed in a graduate seminar at Yale, in the mid-1980s, by Stephan Körner. It was amusing. But, sadly, he used it as part of a fallacious argument for compatibilism and soft determinism, which I reject. Hence I call mine *The Freedom Dance*.

we're all small-scale natural artistic geniuses, *little singularities and little bangs*, who purposively bring new energy-structures into the world, and thereby actualize potential energy. As we've seen, The Big Bang Singularity has done many things. But it did not, on its own, write *The Birth of Tragedy*, nor did it do *The Freedom Dance*. On the contrary, *Nietzsche* wrote *The Birth of Tragedy*, and I did *The Freedom Dance*, with actual free agency in both cases. Therefore, neither Nietzsche, I, nor anyone else, is a natural automaton or natural machine; instead we are all naturally creative animals fully capable of free agency.

Notice that I'm *not* saying that it's impossible to design and build a natural automaton/natural machine that, when it's turned on, makes various motions that might effectively fool someone, or even many people, into believing that it was I or you doing *The Freedom Dance*. On the contrary, it's logically, really, naturally, and perhaps even technologically possible that there is such a machine. What I'm saying is that, synthetic a priori necessarily, the deceptive naturally mechanical motions of such a natural mechanism *could not be The Freedom Dance*, since *that and only that* was *actually* freely performed by *me*, or for that matter by *you*, and *not* by any natural automaton/natural machine designed and built to resemble us in various ways.

So, self-evidently, natural libertarianism is true, given my original assumptions.

Now, if the essential embodiment theory and natural libertarianism are both *true*, then the thesis of universal natural mechanism is *false*. In turn, the false thesis of universal natural mechanism properly belongs to even larger yet equally false conception I call *the mechanistic worldview*, centered on the root metaphor of *the machine* (for example, in the seventeenth and eighteenth centuries, a *clock*, in the nineteenth century, a *steam engine*, and paradigmatically since the full emergence in the 1920s and 30s of what James C. Scott very aptly calls "high modernism,"⁶ a *Turing machine*, i.e., a *digital computer*⁷), which says that

everything in the world is fundamentally either a formal automaton or a natural automaton, operating strictly according to Turing-computable algorithms and/or time-reversible or time-symmetric deterministic or indeterministic laws of nature, especially the Conservation Laws (including the First Law of Thermodynamics) and the Second Law of Thermodynamics, which also imposes always-increasing entropy—i.e., the always-increasing unavailability of any system's thermal energy for conversion into causal (aka "mechanical") action or work—on all natural mechanisms, until a total equilibrium state of the natural universe is finally reached. (see also Hanna & Paans, 2020).

Furthermore, if the essential embodiment theory and natural libertarianism are both true, and if the thesis of universal natural mechanism and the mechanistic

⁶See (Scott, 1998: p. 4):

[High modernism] is best conceived as a strong, one might even say muscle-bound, version of the self-confidence about scientific and technical progress, the expansion of production, the growing satisfaction of human needs, the mastery of nature (including human nature), and, above all, the rational design of social order commensurate with the scientific understanding of natural laws. And now, a century later, high modernism has hit a brick wall. Indeed, it's not implausible to see the 2020s as the decade of *the mega-crisis of high modernism, the formal and natural sciences, and the mechanistic worldview, alike*. See (Hanna & Paans, 2020; Torday et al., 2020).

⁷Again, for explicit definitions of Turing machine and computability, see Sect. 8.4 below.

worldview are both false, then what conception of nature and the natural sciences must correspond to these facts?

My answer is—the *neo-organicist worldview*, centered on the root metaphor of *the living organism* (for example, a plant, an animal, and above all, rational, self-conscious minded animals like us), which says: (i) that everything in the world is essentially or fundamentally uncomputable, negentropic, processual, purposive, self-organizing, time-irreversible or time-asymmetric, and non-equilibrium thermodynamic, (ii) that there is a basic metaphysical and ontological continuity, running from the Big Bang singularity to uncomputable, negentropic, time-asymmetric, non-equilibrium thermodynamic energy flows, to living organisms, to conscious minded animals, to rational, self-conscious minded animals with free will and practical agency, and finally to social institutions of all kinds (see also Torday et al., 2020), and (iii) that all mechanical systems whatsoever, whether formal or natural, are *nothing but systematic abstractions from*—that is, degenerate cases of, fragments of, or limiting cases of—fundamentally organic systems, and therefore all mechanical systems whatsoever are *logically or nomologically strongly supervenient* on organic systems. In turn, the neo-organicist worldview directly entails the metaphysical doctrine of *liberal naturalism* (Hanna & Maiese, 2009; Nagel, 2012; Hanna, 2018). Liberal naturalism says that the physically irreducible but also non-dualistic mental properties of rational human minded animals are at least as basic in nature as *biological* properties and any other *physical* properties, and metaphysically continuous with them. More precisely, according to liberal naturalism, rational human free agency is an immanent structure of essentially embodied, conscious (i.e., subjectively experiencing), self-conscious (i.e., conscious of its own consciousness, second-order conscious), caring (i.e., desiring, emoting, and feeling), sensibly cognitive (i.e., perceiving, remembering, and imagining), intellectually cognitive (i.e., conceptualizing, believing, judging, and inferring), volitional (i.e., deciding, choosing, and willing), intentional more generally (i.e., object-directed or act-directed), human animal mind; essentially embodied conscious, self-conscious, caring, sensibly cognitive, intellectually cognitive, volitional, intentional more generally, free-agential human animal mind is an immanent structure of organismic life; and organismic life is an immanent structure of spatiotemporally asymmetric, uncomputable, negentropic, non-equilibrium thermodynamic matter/energy flows. Each more complex structure is metaphysically continuous with, and embeds, all of the less complex structures.

Again, and now put in terms of dynamic emergence, according to neo-organicism and its liberal naturalism, human free will and practical agency are dynamically inherent in and dynamically emerge from essentially embodied, conscious, self-conscious, caring, sensibly cognitive, intellectually cognitive, volitional, and more generally intentional human animal mind. And essentially embodied conscious, self-conscious, caring, sensibly cognitive, intellectually cognitive, volitional, and more generally intentional, human animal mind is dynamically inherent in and dynamically emerges from life. Therefore, human free will and practical agency are dynamically inherent in and dynamically emerge from life. Moreover, life is dynamically inherent in and dynamically emerges from spatiotemporally asymmetric,

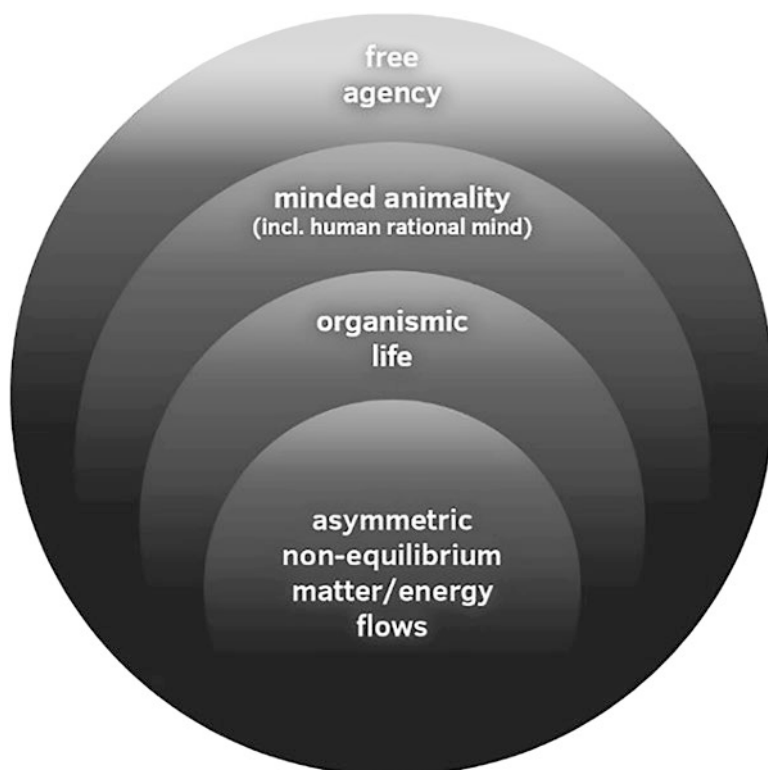


Fig. 2.2 Neo-organicism. (Hanna & Paans, 2020: p. 35; diagram created by Otto Paans)

uncomputable, negentropic, non-equilibrium thermodynamic matter/energy flows. Therefore, human free will and practical agency, human mind, and life are all dynamically inherent in and dynamically emerge from spatiotemporally asymmetric, uncomputable, negentropic, non-equilibrium thermodynamic matter/energy flows. By way of a quick summary, here's a diagram of the basic metaphysical continuities and structural embeddings according to the neo-organicist, liberal naturalist conception (Fig. 2.2):

2.4 One Cheer, But Only One, for Analytic Panpsychism

Where are we now? I've briefly and compactly presented and motivated four original and paradigm-shifting theories or conceptions, the latter three of which are all elaborations and extensions of the first: (i) the essential embodiment theory of the mind-body relation and mental causation, (ii) the natural libertarianism theory of free agency for rational human animals, (iii) the neo-organicist worldview's

conception of nature and the natural sciences, and (iv) the metaphysics of liberal naturalism. In this section, I'll even more briefly and compactly critically discuss an increasingly popular contemporary theory of the mind-body relation commonly known as *Analytic panpsychism*. For the sake of convenience and precision, I'll present this critical discussion as a twelve-step argument.

1. *Panpsychism* is the two-part metaphysical thesis which says (Pi) that mental properties are *at least as basic in the natural universe* in its total spatiotemporal extent and all its parts, aka the cosmos, *as physical properties* (aka, *liberal naturalism*), and (Pii) that at least some mental properties are *universally actually instantiated* in the cosmos (aka, *the ubiquity of the mental*) (Nagel, 1979; Chalmers, 1996; Strawson, 2006a, b; Goff, 2017, 2023; Goff et al., 2021; Murphy, 2022). [Premise]
2. *Idealism* is the metaphysical thesis which says that there are necessary and possibly also essential connections—including identity-relations—between minds and the cosmos (Hanna, 2001: ch. 2, 2006a, b: section 6.1). [Premise]
3. Necessarily, all minds, precisely because they're *mental entities*, and because, necessarily, all entities of any given kind, *have properties of that kind*, have mental properties. [From 2]
4. Therefore, idealism also says that there are necessary and perhaps also essential connections between mental properties and the cosmos. [From 2 & 3]
5. Now, panpsychism directly entails that there are necessary and possibly also essential connections between mental properties and the cosmos. [From 1]
6. Therefore, panpsychism is a form of idealism. [From 4 & 5]
7. It's plausibly arguable that liberal naturalism (i.e., sub-thesis Pi above) is *true*, but the ubiquity of the mental (i.e., sub-thesis Pii above) is *false*, for two reasons: **first**, the ubiquity thesis is *much too strong a thesis*, because it's highly implausible *that literally everything in the cosmos*, including, for example, beer cans, rocks, clouds, random specks of dust, etc., etc., is *actually* sentient or proto-sentient, and **second**, the ubiquity thesis *mistakenly attributes consciousness to mechanical systems*; correspondingly, *it's a far more plausible thesis* (i) that *all and only living organisms* are actually sentient or proto-sentient, aka *the mind-in-life thesis* (Thompson, 2007; Hanna & Maiese, 2009; Torday et al., 2020; Kauffman & Roli, 2023), and *also* (ii) that an explicitly non-panpsychist idealist metaphysical thesis, which *affirms* liberal naturalism and also *rejects* the ubiquity of the mental, called *weak transcendental idealism*,⁸ are indeed

⁸For the record, weak transcendental idealism says that (i) necessarily, the basic metaphysical and ontological structures of the manifestly real world conform to the basic innate structures of our rational human cognitive and practical capacities, especially including our *sensible* capacities for first-order consciousness, affect or emotion (including desire, feeling, and passion), sense-perception, memory, and imagination, and also our *discursive* capacities for conceptualization, thinking, self-consciousness, and rationality, (ii) necessarily, if the manifestly real world exists, then if sensible, discursive, conscious, and self-conscious rational human cognizers *were* to exist, they *would* be able to cognize that world veridically to some salient extent, which in turn is fully consistent with sensible, discursive, conscious, and self-conscious rational human cognizers *not* actually

- both true (Hanna & Maiese, 2009: chs. 6–8, esp. pp. 300–301, 321–323; Hanna, 2015: section 7.3). [Premise]
8. Therefore, one cheer for panpsychism. [From 7]
 9. Now, one of the core beliefs of the Analytic tradition is the rejection of any form of idealism (Hanna, 2001: section 2.3, 2021b: chs. I–IV). [Premise]
 10. Nevertheless, some recent and contemporary Analytic philosophers not only *are* panpsychists but also either explicitly affirm or implicitly accept that their views fall under the label of “Analytic panpsychism” (Nagel, 1979; Chalmers, 1996; Strawson, 2006a, b; Goff, 2017, 2023; Goff et al., 2021; Murphy, 2022). [Premise]
 11. Therefore, *either* (i) “Analytic panpsychism” is an oxymoron and Analytic panpsychists are explicitly or implicitly contradicting themselves, *or else* (ii) Analytic panpsychists are *crypto-idealists* who explicitly or implicitly, and deceptively, *call* themselves “Analytic panpsychists,” so that they won’t be *labelled* “idealists” by their fellow Analytic philosophers and therefore banished to the pejorative pseudo-category of so-called “Continental philosophy”—the undiscovered country from whose bourne no Analytic philosophical traveler ever returns professionally unscathed (Hanna, 2021b: chs. XVII–XVII), and *neither* option (i) *nor* option (ii) is philosophically acceptable.⁹ [From 6, 9, & 10]
 12. Therefore, as per step 8, and also as per the destructive dilemma in step 11, *one* cheer for Analytic panpsychism, but *only* one cheer. [From 8 and 11] **QED**

2.5 Concluding Semi-autobiographical Quasi-Whiteheadian Postscript

By virtue of its commitment to the neo-organicist worldview and the metaphysics of liberal naturalism, the essential embodiment theory bears certain important similarities to A.N. Whitehead’s panexperientialist organicism in his 1929 masterpiece of speculative cosmology, *Process and Reality* (Whitehead, 1929/1978). According to Whitehead, everything in the cosmos is essentially, systematically, and organically composed of micro-level, living atomic processual events he calls *actual entities*, each of which necessarily and complementarily possesses a “mental pole” and a “physical pole,” and also enacts special kind of subjective experience and relational intentionality that he calls *prehensions*. But it seems to me that filling the

existing at any given time, and (iii) the existence of the manifestly real world necessitates *the real possibility* of sensible, discursive, conscious, and self-conscious rational human cognizers, but *not* their actual existence at any given time. See also Chap. 7 below.

⁹It should especially be noted that this dilemma *doesn’t* apply to Thomas Nagel, an early Analytic panpsychist (Nagel, 1979) who officially “confessed” to idealism in *Mind and Cosmos* (Nagel, 2012: p. 17), thereby implicitly opting out of Analytic philosophy; as a consequence, he paid a significant price in damaged professional academic reputation and status (Hanna, 2021a).

cosmos, all the way down, with micro-level living atomic mental/physical experiential processual events, is an excessively and implausibly strong theory, when it's *also* fully feasible to be committed to the essential embodiment theory, natural libertarianism, the neo-organicist worldview, and the metaphysics of liberal naturalism. Nevertheless, the essential embodiment theory and its presuppositions or implications do, in a *specialty restricted* way, share some of the metaphysical benefits of Whitehead's panexperientialist organicism: namely, that creatures like us—i.e., appropriately dynamically complex kinds of organismic living creatures—are indeed *minded all the way down*. But, in salient contrast to Whitehead's panexperientialist organicism, the essential embodiment theory says that *all and only* those creatures are minded in this way.

One last thing about Whitehead & me. More precisely, I'll now conclude this chapter with a semi-autobiographical quasi-Whiteheadian comment that might throw some further light on the philosophical provenance of the essential embodiment theory and its later elaborations and extensions, especially including this book. As an upper-level undergraduate student and a beginning graduate student, I was a Whiteheadian True Believer for several years, and even travelled all the way to Washington, DC to write my MA thesis on Whitehead's metaphysics under the direction of Paul Weiss, who had been a PhD student of Whitehead's at Harvard. During my Whiteheadian True Believer phase, I even bought myself a 1929 first edition copy of *Process and Reality* for more money than I had that month for groceries. And then, a year or so after that, when I'd moved on from Whitehead's process philosophy and was a recovering Whiteheadian, I read and closely studied Merleau-Ponty's *Phenomenology of Perception*, and I thought to myself (roughly): "This is amazingly amazing! Conscious, intentional human perceivers like us, who, by means of 'our body, as the potentiality of this or that part of the world, surges towards objects to be grasped and perceives them' (Merleau-Ponty, 1945/1962: p. 106), are just *macro-level* versions of Whitehead's actual entities!" And I fantasized about actually working out an adequate solution to the mind-body problem along those very lines, when I finally grew up to be a real philosopher. So I think that, to this extent, *Embodied Minds in Action* could also be accurately microsynopsized as

Merleau-Ponty Meets The Whiteheaded Kripke Monster

—which sounds like some amusingly off-the-wall horror/science-fiction movie from the 1950s or 1960s, directed by Jack Arnold (see also Sect. 15.4 below), Roger Corman, or Ishiro Honda. I like that too.

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Chapter 3

Physics for Humans: Kant, Physics, and the Neo-Aristotelian Natural Power Grid



Abstract In this chapter, I argue that there is a distinctively different, arguably true, and above all thoroughly anti-skeptical, contemporary Kantian third alternative, between (i) the Scylla of failed noumenalistic and classical Rationalist-style, God’s-eye-view metaphysical scientific realism and (ii) the Charybdis of failed phenomenistic and classical Empiricist-style, anti-realist communitarian scientific relativism. In *Kant, Science, and Human Nature*, I argued that for Kant and for contemporary Kantians, *mathematics* is not only an objectively true a priori science (*Wissenschaft*), but also an irreducibly human or moral science (*Geisteswissenschaft*): I called that thesis *mathematics for humans* (Hanna R, Kant, science, and human nature. Clarendon/Oxford University Press, Oxford, 2006: ch. 6). In this chapter, I argue the same thing, mutatis mutandis, for *physics*: for Kant and for contemporary philosophers inspired by Kant’s work, physics is not only an objectively true a priori science, but also an irreducibly human or moral science: I call this thesis *physics for humans*.

3.1 Introduction

As I’ve already indicated in Chaps. 1 and 2, the main themes of this book have been importantly inspired and primed by aspects of Kant’s eighteenth century metaphysics of nature and free will, and also by Whitehead’s, Merleau-Ponty’s, and Prigogine’s philosophical and scientific work in the twentieth century. In this chapter, I’ll explore the Kantian connection further by taking a deep dive into Kant’s philosophy of science.

In his book, *Science Wars: The Battle Over Knowledge and Reality* (Goldman, 2022), Steven L. Goldman compellingly argues that modern natural science, especially including physics, in its various attempts to ground itself philosophically, has tragically driven itself into a seemingly irresolvable Scylla-&-Charybdis-style dilemma:

1. *on the one hand* (the Scylla side of the dilemma), ever since the seventeenth century and the rise of modern natural science, the philosophy of physics has postulated *a noumenal and inherently mind-independent physical world* as the object of natural science's truth-claims and true theories, which, however, makes it impossible for human beings ever to cognize or know that object, thereby becoming an eminently easy, slow-moving target for radical skepticism; but then
2. *on the other hand* (the Charybdis side of the dilemma), ever since Thomas Kuhn's *Structure of Scientific Revolutions* (Kuhn, 1970), the philosophy of physics has postulated that scientific theories, their truth-claims, and the physical world they purport to describe, are one and all *phenomenal, socially-constructed, and wholly relativistically mind-dependent*, thereby becoming yet again, although by a seemingly diametrically opposed route, an eminently easy, slow-moving target for radical skepticism.

Of course, the dialectical structure of this two-horned dilemma is thoroughly Kantian in nature: on the first horn of the dilemma, there is failed *noumenalistic and classical Rationalist-style, God's-eye-view metaphysical scientific realism*; and on the second horn of the dilemma, there is failed *phenomenalistic and classical Empiricist-style, anti-realist communitarian scientific relativism*. And in this way, modern natural science, especially including physics, like a hapless matador, has tragically impaled itself on both horns of the philosophical bull. Hence the interminable and unresolvable "science wars."

But in my opinion, *all is not lost*, because there is a distinctively different, arguably true, and above all thoroughly anti-skeptical, *contemporary Kantian third alternative*.

In *Kant, Science, and Human Nature*, I argued that for Kant and for contemporary Kantians, *mathematics* is not only an objectively true a priori science (*Wissenschaft*), but also an irreducibly human or moral science (*Geisteswissenschaft*): I called that thesis *mathematics for humans* (Hanna, 2006: ch. 6). In this chapter, I argue the same thing, mutatis mutandis, for *physics*: for Kant and for contemporary philosophers inspired by Kant's work, physics is not only an objectively true a priori science, but also an irreducibly human or moral science: I call this thesis *physics for humans*.

3.2 Kant's Theory of Physics Revisited

Here is what Kant says about physics (which he calls "natural science") in the B edition Preface to the *Critique of Pure Reason*:

It took natural science much longer [than mathematics] to find the highway of science; for it is only about one and a half centuries since the suggestion of the ingenious Francis Bacon partly occasioned this discovery and partly further stimulated it, since one was already on its tracks—which discovery, therefore, can just as much be explained by a sudden revolution in the way of thinking. Here I will consider natural science only insofar as it is grounded on **empirical** principles. When Galileo rolled balls of a weight chosen by himself down an

inclined plane, or when Torricelli made the air bear a weight that he had previously thought to be equal to that of a known column of water, or when in a later time Stahl changed metals into calx and then changed the latter back into metal by first removing something and then putting it back again, a light dawned on all those who study nature. They comprehended that reason has insight only into what it itself produces according to its own design; that it must take the lead with principles for its judgments according to constant laws and compel nature to answer its questions, rather than letting nature guide its movements by keeping reason, as it were, in leading-strings; for otherwise accidental observations, made according to no previously designed plan, can never connect up into a necessary law, which is yet what reason seeks and requires. Reason, in order to be taught nature, must approach nature with its principles in one hand, according to which alone the agreement among appearances can count as laws, and, in the other hand, the experiments thought out in accordance these principles—yet in order to be instructed by nature not like a pupil, who has recited to him whatever the teacher wants to say, but like an appointed judge who compels witnesses to answer the questions he puts to them. Thus even physics owes the advantageous revolution in its way of thinking to the inspiration that what reason would not be able to of itself and has to learn from nature, it has to seek in the latter (though not merely ascribe to it) in accordance with what reason itself puts into nature. This is how natural science was first brought to the secure course of a science after groping about for so many centuries. Here I am following exactly the thread of the history of the experimental method, whose first beginnings are not precisely known. (*CPR* Bxii-xiv and n.)

According to Kant, then, physics, like mathematics, entered the “highway of science” (*Heeresweg der Wissenschaft*), by virtue of a “sudden revolution in the way of thought” (*CPR* Bxii). This thought-revolution, again like mathematics, consisted in shifting from the idea that our rational human a priori knowledge of necessary or essential properties of objects is derived by induction from individual or collective samples, to the idea that a priori knowledge is generated by *self-knowledge* of the spontaneous cognitive activity of human theoretical reason in non-empirically introducing formal features into its mental representations of objects.

This is an absolutely fundamental epistemic point that needs to be re-emphasized, because it attaches to *all* kinds of a priori knowledge, whether in logic, mathematics, physics, or metaphysics:

[R]eason has insight (*Einsicht*) only into what it itself produces (*hervorbringt*) according to its own design (*Entwurfe*). (*CPR* Bxiii)

Crucially, rational insight has its own characteristic *cognitive phenomenology* (see, e.g., Hanna, 2006: ch. 7, 2015: chs. 6–8): that is, rational insight has its own consciously-experienced *specific character*. So a priori knowledge for Kant is how human reason consciously experiences and self-consciously recognizes the results of its own cognitive activity in the structured non-empirical products of that very activity, in such a way that the apparent, phenomenal, or manifestly real natural world also necessarily conforms to those very non-empirical structures. That, in turn, is the essence of Kant's and contemporary Kantian *weak transcendental idealism* (Hanna, 2001: esp. ch. 2, 2006, 2015: esp. section 7.3, 2016; see also ch. 7 below).

Insofar as this relationship obtains, then not only are the necessity and non-empirical character of human rationality exported from the cognizing subject to the form of the manifestly real natural universe, but also the *purposiveness* and

categorical normativity of human rationality are correspondingly exported from the cognizing subject to the form of the manifestly real natural universe. Via this subject-to-world exporting, the manifestly real natural universe is thereby also constituted as *a meaningful universe* in all the relevant senses of that phrase. By that I mean that the manifestly real natural universe, for Kant and contemporary Kantians, is an “enchanted” universe shot through with logical form, mathematical structure, informative modes-of-presentation, truth-value, logical consequence, synthetic a priori consequence, counterfactuals and other subjunctive conditionals, especially those relating to: (i) choice and free will (for example, “If Lincoln had not finally resolved to end American slavery by means of The Emancipation Proclamation, then he would not have been assassinated by Wilkes Booth”), (ii) law-governed natural causal necessitation, (iii) organismic life, (iv) purposiveness of all kinds, (v) aesthetic value, and (v) moral value. Hence the manifestly real natural universe, for Kant and for contemporary Kantians, *is a fully human-mind-apt and human-rationality-apt universe*, for better or worse, and NOT a “*fundamentally physical*” and *naturally mechanistic universe* that inherently excludes life, consciousness, beauty/sublimity, freedom, and absolute, objective, non-denumberably infinite, irreducibly non-instrumental value (Hanna, 2014; see also ch. 15 below).

Of course the necessary-conformity component is precisely what mediates this exporting, and is also precisely what smoothly carries over our cognitive phenomenology and self-knowledge into our non-empirical knowledge of the manifestly real natural universe. The built-in limitation of human cognition to manifestly real natural objects alone, together with the necessary conformity component, jointly constitute transcendental idealism. So this Kantian theory of a priori knowledge works *if and only if* weak transcendental idealism is true.

But a second crucial feature of Kant’s theory of physics is not so very clear and distinct, and needs to be teased out. Kant says explicitly that “here I will consider natural science only insofar as it is grounded on **empirical** principles” (CPR Bxii, boldfacing in the original). This is *prima facie* puzzling, for two reasons.

First, by his own explicit admission, Kant is attempting to show how logic, mathematics, and physics are all authentic a priori sciences, in order to compare and contrast them with metaphysics. But how could this be consistent with focusing on how physics is grounded on *empirical*—and thereby *a posteriori*—factors?

Second, the very notion of a “principle” (*Grundsatz, Prinzip*) for Kant carries the *prima facie* sense of apriority (hence also the *prima facie* senses of necessity, non-sensory character, purposiveness, and categorical normativity). But how could there then be anything like an *empirical* principle? The very phrase “empirical principles” (*empirische Prinzipien*) seems to be an oxymoron.

Sorting out and then explaining these two *prima facie* puzzling features will take us to the very heart of Kant’s theory of physics. More precisely, we need to understand the texts surrounding the crucial “reason has insight...” text at Bxiii. Here is Kant’s basic line of argument, as I understand it.

Manifestly real material or physical nature is rationally comprehensible via natural scientific investigation, and thereby knowable a posteriori, only to the extent that it is governed according to principles or laws that have the epistemic, modal,

non-sensory, purposive, and normative properties of necessary a priori truths, but are nevertheless also *empirical*, in that these principles and laws bind together apparent, phenomenal, or manifest material or physical objects and states-of-affairs that are themselves actual-world bound, and contingent. Indeed, it's precisely the principle-governedness or causal-law-governedness of manifestly real actual-world bound, contingent material or physical nature that makes it *objective*, and therefore a proper subject for the authentic objectual a priori science of physics. So, odd as it might at first seem, even an *empirical* science like physics is an authentic science only and precisely to the extent that it has a *non-empirical* foundation that of course includes both logic and mathematics, but also extends *beyond* the purely logico-mathematical part of its foundation into the necessary and objectual a priori law-governed *causal* connections between actual-world bound, contingent manifestly real material things and states-of-affairs. Otherwise put, according to Kant, natural science/physics is on the secure path of science only and precisely to the extent that it tracks the penetration of the necessary, non-sensory, purposive, and categorically normative structures of human rationality into the actual-world bound, contingent manifestly real material or physical natural universe, *all the way down*. Kantian naturalism is therefore a *liberal naturalism* in these three senses: (i) nothing in the manifestly real natural universe exists outside of space and time, (ii) everything in the manifestly real natural universe has efficacious causal powers in spacetime, and (iii) mental properties are as essential to the basic architecture of the manifestly real natural universe as physical properties are.

Now, the causal natures of these manifestly real material or physical objects and states-of-affairs are knowable a posteriori in all their specificity by means of experimental investigations that involve not only Baconian (that is, simple colligative, descriptive, and generalizing) induction, but also another method only partially anticipated by Bacon, namely, what I call *Kantian abduction*, aka *Kantian inference-to-the-best-explanation*. What Kant calls *reflecting judgment* in the third *Critique*, what Charles Sanders Peirce later calls *abduction*, and what is nowadays also called "inference to the best explanation," all describe a non-monotonic¹ inference from given particulars to a newly-created general conception or theory that adequately comprehends those particulars (Lipton, 1991; Douven, 2017). The theory of Kantian abduction was worked out both the Critical period and also the post-Critical period, via Kant's scattered and all-too-brief remarks on "the method of those who study nature" (*CPR* Bxviii-Bxix n.), "the empirical affinity of the manifold" (*CPR* A113–114), "empirical laws" or "particular laws" (*CPR* A127–128 and B163–165) (*Prol* 4: 318–322), and also under the rubrics of what he calls the "regulative use of the ideas of pure reason," the "hypothetical use of reason" and above all, "reflecting judgment" (*CPR* A642–668/B670–696) (*CPJFI* 20: 211–217, *CPJ* 5: 179–181).

¹An argument or inference is *monotonic* if and only if adding new premises to the original set of premises of that argument or inference does *not* change the set of logical consequences of those premises; and an argument or inference is *non-monotonic* if and only if adding new premises to the original set of premises of that argument or inference *does* change the set of logical consequences of those premises.

Kantian abduction, as exemplified by Galileo, Torricelli, and Stahl—Kant’s own cases-in-point—is not itself *merely* an empirical or a posteriori method, but in fact systematically closes the epistemic and semantic gap between empirical/a posteriori generalizations and non-empirical/a priori principles and causal natural laws. It *doesn’t* do so, however, by what classical Logical Empiricist philosophy of science calls *the hypothetico-deductive method*, according to which general propositions about the material or physical world, originally derived by induction, are laid down, more or less arbitrarily, like extra axioms added to first-order classical logic, and then particular propositions about empirical consequences deduced from these axioms, which in turn are tested by observations. For such a procedure would be unable to distinguish between, on the one hand, inductive hypotheses that are *noumenal*, and therefore humanly unknowable and anthropocentrically meaningless, and, on the other hand, humanly knowable *empirically meaningful* hypotheses that are specifically grounded on the objectively valid and objectively real transcendental idealism-based real metaphysics of rational human experience. By sharp contrast to the hypothetico-deductive method, Kantian abduction doesn’t operate by induction + analytic stipulation + deduction + observation, but instead it operates by *synthetic a priori* “*counterfactual*” or *subjunctive conditional reasoning*.

More precisely, according to the contemporary Kantian modal semantics of subjunctive conditionals that I am using, a Kantian abduction is a conditional proposition of this form,

$$\Gamma(X_1, X_2, X_3, \dots, X_n) \rightarrow Y$$

which in English says:

Necessarily, if Γ , a set of propositions $X_1, X_2, X_3, \dots, X_n$, jointly constituting a general conception or theory, *were to be true*, then Y , another proposition that describes an actual fact, *would also be true*.

This subjunctive conditional, in turn, is true if and only if

given the smallest restricted class of logically possible worlds, each member of which has the same basic transcendental structure as the manifestly real actual natural universe, namely, *the class of experienceable worlds*, and is also consistent with the truth of all the propositions in Γ , then, in every member of this class of worlds, the truth of Γ synthetically necessitates the truth of Y .

Granting this truth-definition, then according to Kantian abduction, natural science advances inferentially.

FROM

- (i) the complete set of schematized synthetic a priori Principles of the Pure Understanding, which, in turn, collectively specify the basic transcendental structure of the apparent, phenomenal, or manifestly real actual natural universe, and thereby determine the smallest restricted class of logically possible worlds—namely, *the class of experienceable worlds*, each member of which has the same basic transcendental structure as the manifestly real actual natural universe, and is also consistent with the truth of some general empirical *natural causal law* proposition NCL,

TOGETHER WITH

- (ii) NCL, which is partially derived by induction, but which also specifically reflects the creative and imaginative capacity for insight (aka the capacity for “genius”) of the individual natural scientist who formulates NCL, in whom “[genius] gives the rule to **nature**” (*CPJ* 5: 308), and which is postulated as the hypothetically antecedent of a subjunctive conditional of the form

If, given the schematized Principles of Pure Understanding, NCL *were* true in the experienceable worlds $W_1, W_2, W_3, \dots W_n$,

TO

- (iii) a synthetically a priori entailed factual proposition Y in all those experienceable worlds, as the consequent of that same subjunctive conditional, of the form

... then Y *would be* true in the experienceable worlds $W_1, W_2, W_3, \dots W_n$,

THEN

- (iv) compares and contrasts that synthetic a priori subjunctive conditional implication Y with what is supplied by direct observational evidence in the manifestly real actual natural universe,

AND THEN

- (v) also compares and contrasts the physical explanation provided by the subjunctive conditional proposition $\Gamma[X_1, X_2, X_3, \dots \text{NCL}, \dots X_n] \rightarrow Y$ with all the other relevant possible sufficiently good physical explanations of the same actual apparent, phenomenal, or manifestly real natural facts, thus ruling out the worry that the explanation provided by $\Gamma[X_1, X_2, X_3, \dots \text{NCL}, \dots X_n] \rightarrow Y$ is only “the best of a bad lot,” and not the best *overall* explanation,

AND THEN FINALLY

- (vi) asserts the general conception or theory Γ , constituted by the propositions $X_1, X_2, X_3, \dots X_n$, *including* the general empirical natural causal law proposition NCL, as the true synthetic a priori representation of how a given natural causal law governs dynamic interactions and processes in the manifestly real actual natural universe,

by Kantian inference-to-the-best-explanation.

3.3 Kant's Neo-Aristotelian Natural Power Grid

Kant and the Laws of Nature, edited and with an Introduction by Michela Massimi and Angela Breitenbach, is a collection of thirteen uniformly excellent essays on Kant's philosophical views on the nature and (metaphysical or epistemic) status of laws of nature, produced under the aegis of a three-year international research network running from 2012 to 2015 (Massimi & Breitenbach, 2017). But as *contemporary philosophers of nature and science inspired by Kant's philosophy of science*, and not merely as *Kant-scholars*, why should we care about Kant's theory of the laws of nature? In my opinion, there are at least four good reasons.

First, from the standpoint of an alethic or truth-based contemporary Kant-inspired philosophy of nature and science, natural laws reveal to us *the necessary theoretical rules and basic factual structures* of a causally efficacious, manifestly real material or physical natural universe.

Second, from the standpoint of a *pro-scientific* yet also *anti-scientistic* contemporary Kant-inspired philosophy of nature and science, natural laws fix the inherent metaphysical and epistemic *limits* of the natural sciences.

Third, from the standpoint of a contemporary Kant-inspired philosophy of nature and science that operates *beyond* the limits of the natural sciences, natural laws also reveal, by negation and categorical contrast, *the necessary teleological or practical rules and basic normative structures* of a causally efficacious, manifestly real material or physical natural universe that's fundamentally enchanted and transformed by organismic life and goal-directed natural processes, consciousness, feeling and desire, cognition, rationality, agency, freedom, personhood, and dignity.

And **fourth**, from the standpoint of a contemporary Kant-inspired philosophy of nature and science that operates *within* the realm of that fundamental enchantment and transformation, it's further revealed to us that natural laws have their own special kind of *alethic or truth-based normativity, operating by means of a set of necessary, enabling constraints on animal life and agential activity*, an alethic normativity that's inherently constrained by, although not entailed by, the normative laws of pure logic.

What however, according to Kant himself, are laws of nature?

There are various classical, orthodox Kant-scholarly accounts all saying that for Kant, natural laws are fundamentally *epistemological* in nature. Generally characterized, according to these classical, orthodox, epistemologically-driven Kant-scholarly accounts, natural laws are synthetic *a priori* transcendental principles imposed on subjective appearances by our cognitive faculties, by means of the absolutely spontaneous power of *prescription* contained in the faculty of pure reason, together with the egocentric, synthesizing, and unifying power of pure or transcendental apperception, inherently under the Categories and also inherently guided by the rational Idea(s) of the systematic unity of nature. So, for these accounts, Kantian natural laws are nothing more and nothing less than subjectively-idealistic general laws of phenomena that are prescribed-a-priori-by-the-rational-transcendental-ego-precisely-in-order-to-be-known-in-phenomenal-nature-by-its-very-own-cognitive-faculties-operating-under-its-very-own-Categories-and-Ideas, as per the famous remark in the B Preface, that I've discussed in section 3.2 above, "reason has insight only into what it itself produces according to its own design" (*CPR* Bxiii), and as per the only slightly-less-famous remark in the *Prolegomena*, that "*the understanding does not draw its (a priori) laws from nature, but prescribes them to it*" (*Proleg* 4: 320, italics in the original).

In turn, however, there are at least five important problems for those classical, orthodox accounts.

First, exegetically speaking, a subjective-idealist reading of Kant's theory of natural laws cannot be smoothly combined with Kant's own empirical (or "manifest") realism, because in that case, the very idea of "empirical laws," discovered a posteriori via empirical scientific investigation, then seems modally *self-contradictory*, since, other things being equal, "empirical" entails *contingency*, whereas "laws" entails *necessity*.

Second, in a closely-related way, assuming that empirical natural laws *are* in some sense genuinely universal and necessary, then how can Kant *explain* their universality and necessity? On the subjective-idealist reading, the way in which particular empirical laws *inherit* their restricted kind of universality-and-necessity from strictly universal and unconditionally necessary a priori laws seems metaphysically mysterious.

Third, extra-exegetically speaking, any form of subjective idealism applied to natural laws seems philosophically implausible, since it entails that, *necessarily, if all actual minds go out of existence, then the nomologically-governed natural universe goes out of existence too*.

Fourth, epistemically-speaking, as Kant himself noted in the First Introduction to the third *Critique*, a subjective-idealist approach to natural laws is *prima facie* consistent with a *global skepticism* not only about our ability to know particular, specific natural laws by means of judgment and concepts, but also, as a consequence, about the very existence of such particular, specific natural laws.

And **fifth** and finally, metaphysically speaking, even allowing for the radical philosophical *Gestalt*-shift implied by Kant's Copernican Revolution in metaphysics, the subjective-idealist approach to Kant's theory of natural laws overlooks various essentialist, organicist or processual, non-reductively naturalistic, *broadly Aristotelian* elements in Kant's and/or Kantian metaphysics.

Correspondingly, in view of these five important problems, it seems to me that a new, exciting, and philosophically important post-classical and post-orthodox contemporary Kantian *metaphysical* and *non-epistemic* conception of the laws of nature has begun to emerge, and also that it's nicely supported by the several essays in *Kant and the Laws of Nature*. Bounded in a nutshell, this nomological conception is all about how, according to Kant, natural laws are nothing more and nothing less than essential immanent structures (as per classical Aristotelian essentialism and hylomorphism) of a totality of manifestly real causal-dynamic processes that, in turn, are individuated as objects of experience by virtue of a multitude of many-termed temporally asymmetric (cause → effect, as per the Second Analogy of Experience) or simultaneous (causal reciprocity, as per the Third Analogy of experience) efficacious natural relations in space and time, specified as sets of active causal powers (to bring about effects or trigger causal reciprocity networks) and receptive causal powers (to be brought about as effects or to be triggered as causal reciprocity networks). Natural laws in this sense are ontologically defined and modally-constituted solely by their positions in the manifestly real, systematically unified, total natural power grid consisting of all these essential immanent structures, real causal-dynamic processes, objects of experience, and causal-power-relations, namely, "Nature in general" (*CPJ* 5: 183), so they are not independently given apart from the whole—and holistic—grid. And in turn, the whole and holistic natural power grid is non-reductively mind-dependent on the innately-specified non-empirical capacities of the human mind, and, in a necessarily complementary way, also non-reductively world-dependent on the specific essential constitution of physical matter—whether it be (i) inert, mechanical, purposeless matter, or (ii) living, organismic, purposive material processes—as an independently-given fact. Just

to give this new, exciting, and philosophically important post-classical and post-orthodox contemporary Kantian conception of the laws of nature the sort of jazzy name you could put on a T-shirt or use as a bumper-sticker slogan, thereby at once impressing your philosophical friends and confounding your philosophical enemies, I'll call it *Kant's Neo-Aristotelian Natural Power Grid* (see also Hanna, 2006: esp. part 1 and ch. 8).

But there is much, much more to Kant's Neo-Aristotelian Natural Power Grid than even that. Indeed, the fully-elaborated version of it can be formulated as a set of no less than fourteen theses, the first three of which I've already mentioned, but will include again for the sake of clarity, distinctness, and completeness, as follows.

3.3.1 *Kant's Neo-Aristotelian Natural Power Grid*

(Thesis 1) Natural laws are nothing more and nothing less than essential immanent structures of a totality of manifestly real causal-dynamic processes that, in turn, are individuated as objects of experience by virtue of a multitude of many-termed temporally asymmetric (cause → effect, as per the Second Analogy of Experience) or simultaneous (causal reciprocity, as per the Third Analogy of experience) efficacious natural relations in space and time, specified as sets of active powers (to bring about effects or trigger causal reciprocity networks) and receptive powers (to be brought about as effects or be triggered as causal reciprocity networks).

(Thesis 2) Natural laws in this sense are ontologically defined and modally constituted solely by their positions in the manifestly real, systematically unified, total natural power grid consisting of all these immanent essential structures, real causal-dynamic processes, objects of experience, and causal-power-relations, namely Nature in general, so they aren't independently given apart from the whole—and holistic—grid.

(Thesis 3) The whole and holistic natural power grid is non-reductively mind-dependent on the innately-specified non-empirical capacities of the human mind, and, in a necessarily complementary way, also non-reductively world-dependent on the specific essential constitution of physical matter—whether it be (i) inert, mechanical, purposeless matter, or (ii) living, organismic, purposive matter—as an independently-given fact.

(Thesis 4) Laws of nature have weak or counterfactual transcendental ideality, in that they necessarily conform to the innately-specified, non-empirical structures of our basic cognitive capacities or powers, and are thereby such that, necessarily, if the natural laws exist, then if rational human animals were to exist, they would be able to know those laws objectively via the world-enabled operations of their cognitive capacities, at least to some significant extent; and not only are those laws *not* imposed by the operations of those cognitive capacities, but also those laws did exist, do exist, and will continue to exist in the manifestly real natural world of objects of experience, even if no rational human animals ever actually existed, do

exist, or will exist, provided that, necessarily, at any time, it's really possible for that specific kind of animals to exist.

(Thesis 5) Moreover, laws of nature in this sense correspond, one-to-one, to sets of synthetic a priori truths, which, in turn, are progressively narrowed in their modal scope by increasingly strong (that is, richly specific) existential assumptions about the specific essential constitution of physical matter—whether it be (i) inert, mechanical matter or (ii) living, organismic matter—as an independently-given fact, and thereby, insofar as they apply to the manifestly real world of causal-dynamic processes and objects of experience, give rise to distinctively different grades and types of natural universality-and-necessity.

(Thesis 6) In direct proportion as laws of nature correspond to increasingly strong material existential assumptions about the specific essential constitution of physical matter—whether it be (i) inert, mechanical, purposeless, matter, or (ii) living, organismic, purposive matter—as an independently-given fact, and incorporate distinctively different grades of natural universality-and-necessity, then the more empirically-grounded they are, and the more correctly they are to be called specifically *empirical* laws of nature, even though they remain irreducibly universal, necessary, and a priori, although in a specially restricted way.

(Thesis 7) Manifestly real physical matter is essentially constituted by attractive and repulsive dynamic forces, hence manifestly real physical matter is essentially processual and active, hence phenomenally substantial, mechanical, and static only in an ontologically derivative, relative, and strongly supervenient sense (see also Chap. 14 below) under the First Analogy of Experience, and not noumenally substantial and static in the absolute Cartesian or Leibnizian senses.

(Thesis 8) Furthermore, there's a fundamental difference between (i) laws of nature that are grounded on the strong material existential assumption that the attractive and repulsive forces constitute processual matter as passive and inert, mechanical, and inherently Turing-computable (Turing, 1936/1937), as regards its quantitative properties, and are, thereby, deterministic—or for that matter, indeterministic and probabilistic/statistical/stochastic, although Kant himself wouldn't have been in a good historical-theoretical position to recognize that, since the very idea of indeterminism and probabilistic/statistical/stochastic laws was a nineteenth century discovery or invention (Hacking, 1990)—mechanistic, non-teleological laws of physical nature, aka *laws of mechanistic physics*, and (ii) laws of nature that are grounded on the strong material existential assumption that the attractive and repulsive forces constitute processual matter as spontaneous, purposive, and self-organizing, inherently uncomputable as regards their quantitative properties, and purposive, hence not passive and inert, and inherently non-mechanical, and are, thereby, non-deterministic (and for that matter, inherently non-indeterministic and non-probabilistic/statistical/stochastic), organismic, teleological laws of nature, aka *laws of biology*.

(Thesis 9) Spontaneous and vital, self-organizing, purposive, processual matter is every bit as manifestly real as passive and inert, mechanical, computable, non-purposive, processual matter, hence the manifestly real, systematically unified, total natural power grid, aka Nature in general, *globally* contains *both* kinds of causal

processes, even despite their being *locally incompatible*—for example, in non-animal organisms, in minded animals, and at the source of rational human agency.

(Thesis 10) Rational human animals, like all minded animals, are made out of manifestly real spontaneous, purposive, self-organizing, organismic processual matter, and immanently governed by its biological laws of self-organization, hence their agency is locally incompatible with the causal processes of passive and inert, mechanical, computable, non-purposive, non-processual matter.

(Thesis 11) Therefore, as transcendently free, practically free, autonomous, self-determining animals, rational human animals are immanently self-governed by moral laws that are themselves *also* a special kind of biological laws.

(Thesis 12) Natural laws are in-principle knowable (even if not actually known) by us, by means of transcendental counterfactual arguments that employ abductive reasoning, aka inference-to-the-best-explanation, aka reflective judgment, as per Sect. 3.2 above.

(Thesis 13) Such reasoning is inherently guided by the rational Idea(s) of a systematic unity of nature.

(Thesis 14) And this reasoning, in turn, transcendently presupposes both the subjective and also objective purposiveness of manifestly real nature for our cognitive faculties, in order to ward off the global skeptical possibility that nature might have presented an anarchic, chaotic mass of particular appearances to our faculties, thereby making it in-principle impossible to apply empirical judgments to nature.

The thirteen essays in *Kant and the Laws of Nature* are helpfully organized by the editors into five groups of two or three, under the following general headings, the names of their authors, and the titles of their essays:

Part I THE LAWFULNESS OF NATURE

1. Eric Watkins, “Kant on the Unity and Diversity of Laws”
2. Karl Ameriks, “On Universality, Necessity, and Law in General in Kant”
3. Paul Guyer, “Imperfect Knowledge of Nature: Kant, Hume, and Laws of Nature”

Part II THE SYSTEMATICITY OF NATURE

4. Hannah Ginsborg, “Why Must We Presuppose the Systematicity of Nature?”
5. Rachel Zuckert, “Empirical Scientific Investigation and the Ideas of Reason”
6. Thomas Teufel, “Kant’s Transcendental Principle of Purposiveness and the ‘Maxim of the Lawfulness of Empirical Laws’”

Part III NOMIC NECESSITY AND THE METAPHYSICS OF NATURE

7. James Messina, “Kant’s Necessitation Account of Laws and the Nature of Natures”
8. Michela Massimi, “Grounds, Modality, and Nomic Necessity in the Critical Kant”
9. Daniel Warren, “Kant on Mathematical Force Laws”

Part IV LAWS IN PHYSICS

10. Michael Friedman, "Kant's Conception of Causal Necessity and Its Legacy"
11. Marius Stan, "Metaphysical Foundations of Neoclassical Mechanics"

Part V LAWS IN BIOLOGY

12. Angela Breitenbach, "Laws in Biology and the Unity of Nature"
13. Catherine Wilson, "The Building Forces of Nature and Kant's Teleology of the Living"

In the rest of this section, I'll refer to any of the essays in the collection by using the relevant author's last name and page numbers only.

To be sure, the several essays in *Kant and the Laws of Nature* do philosophically differ from one another somewhat, sometimes even to the point of substantive disagreement or local incompatibility; and, correspondingly, they also each contribute to Kant's Neo-Aristotelian Natural Grid in somewhat differing or sometimes even locally incompatible ways. Still, the essential thing for my constructive philosophical purposes in this chapter and this book, is my overarching thesis that the several essays in the volume, taken all-in-all, do indeed philosophically interact in complex, original, and productive ways so as to yield one and the same philosophically important global doctrine, namely, Kant's Neo-Aristotelian Natural Power Grid.

As we've seen above, **Thesis 1** says that natural laws are neither directly derived from, nor instantiations of, a priori principles about causality, and in particular from the Second Analogy of Experience. Instead, they have a weakly mind-independent grounding in the manifestly real natural universe, and express causal powers that are globally determined and individuated, and also modally-constituted, as **Thesis 2** specifies, by an equally weakly mind-independent, but also formal and unified, global *structuralist* network or system of universal-and-necessary causal relations. We can find significant support for both of these theses in Messina's and Massimi's essays, each of which defends a slightly different version of what Messina calls "the Necessitation Account" (p. 132, following James Kreines's terminology), according to which, for Kant, particular natural laws, aka "empirical laws," are grounded in relatively mind-independent *real essences or natures*:

[The Necessitation Account's] core metaphysical thesis is that Kant conceives of particular laws in terms of particular empirical natures, the positing of which necessitates certain regular behaviors.... [T]ranscendental laws of nature ... are similarly associated with natures. In the case of transcendental laws, the nature in question is Nature in general, which might be thought of as a completely general nature common to and contained in all particular empirical natures. The positing of this nature brings with it the transcendental laws and indeterminate causal power associated with it. In this respect, Kant has a uniform metaphysics of nature.... Kant holds that natures cannot exist apart from their associated laws, and those laws cannot exist apart from (must be realized within) their associated natures. This is the sense in which laws are inherent in natures and Kant's model of laws is bottom-up.... Laws do not reduce to the causal powers that define a given nature [or essence] but are a separate aspect of that nature, albeit one no more detachable from the nature than the causal power is. The law of a given nature ... acquires its content from the a priori grounds of the possibility of that nature. (pp. 147–148)

Given this grounding, the Necessitation Account is a “bottom-up” account, as opposed to a priori entailment/instantiation accounts like Friedman’s, which are “top-down.” As Massimi points out (pp. 157–160), in his *Metaphysics* lectures from the early 1790s, Kant carefully distinguishes between “essences” which are either (i) *logical* essences (of concepts) or (ii) metaphysical, *real* essences (of things, and (iii) “natures,” which presuppose metaphysical, real essences, yet are also spatio-temporally embedded and thus *causal*; but for my purposes here I won’t heed that special refinement. In any case, both Messina and Massimi construe Kant’s account as versions of *dispositional* essentialism, which locates the determining and individuating features of nomological causal powers *internally to things*. But as Messina rightly points out (pp. 133 and 144–146), following Stephen Mumford, this yields a worry, especially for reductive versions of dispositional essentialism like Brian Ellis’s, about the ontological status of natural laws over and above the dispositions of things. The worry is that, given a reductive dispositional grounding, arguably, it follows that laws are ontologically *superfluous*. Messina’s promising solution to this nomological-ontological-superfluity problem is to appeal to Kant’s notion of “Nature in general” as a global system of causal natural laws grounded in a global system of manifestly real natures; and this is further strengthened by Guyer’s important observation that the transcendental principle of the systematic unity of nature guarantees that “[a particular natural law’s] position in a system is what makes any particular law of nature necessarily true” (p. 61).

So in view of the nomological-ontological-superfluity problem and Guyer’s observation, I think that Messina’s and Massimi’s arguments for a Kantian *dispositional* essentialism about natural laws are in fact better accommodated by a Kantian *structural* essentialism about natural laws, according to which the manifestly real natures and causal laws are all metaphysically *constituted* by their positions or roles in the global system. This in turn makes possible an elegant explanation of the various distinct kinds of universality-and-necessity of all laws for Kant—nicely sorted and catalogued by Ameriks (p. 37), obviously including natural laws, but also logical laws, synthetic a priori metaphysical principles, moral principles, and even political principles—in terms of *structure-based relationships of various kinds*. This in turn entails that the explanation of the universality-and-necessity of laws is *not* explained in terms of what Watkins calls the “no law without a lawmaker” slogan, according to which “Kant requires that a law be established by a spontaneous act” (p. 16). On the contrary, although it’s true that there are *no laws without the necessary and real possibility of minds like ours, endowed and pre-equipped with the unified system of innately-specified cognitive and practical capacities that jointly constitute our minds*—which in turn, when appropriately primed and triggered, are indeed capable of carrying out various kinds of absolutely or relatively spontaneous acts—nevertheless, *most laws and most kinds of laws do not require occurrent law-makers*, and therefore *most laws and most kinds of laws do not require spontaneous acts*. At the same time, as both Messina and Massimi rightly point out, an appropriately modified version of the a priori derivation/instantiation view, as represented by Friedman, is also available to the Neo-Aristotelian Natural Power-Grid conception, if we assume that every particular natural law, even though it is weakly

mind-independently grounded in a global structuralist network of laws, *also necessarily conforms to the Second Analogy*, even though it is neither directly derived from it or entailed by it, nor merely an instance of it.

This point, in turn, provides a smooth segue to **Thesis 3** and **Thesis 4**, which together spell out the way in which natural laws are only *weakly* transcendentially ideal, not *strongly* transcendentially ideal. In view of the structural essentialist version of the Necessitation Account that I've just sketched, with the help of Messina's, Massimi's, and Guyer's essays, then it follows that, just as, on the worldly side, natural laws are partially grounded in a universal network of manifestly real essences or natures with relational causal powers, so too they are *also* partially grounded, by virtue of a priori principles flowing from the Categories, in the necessary real possibility of minds like ours, endowed and pre-equipped with the unified system of innately-specified cognitive and practical capacities that jointly constitute our minds.

Thesis 5 and **Thesis 6** address the **first** and **second** problems noted above for the classical, orthodox, accounts of Kant's theory of natural laws, about the very idea of an "empirical law," and how its necessity can be explained. As Ginsborg, Zuckert, and Teufel all recognize, the solution to these problems is intimately bound up with the nature and status of Kant's a priori principles of the systematicity of nature and its *as-if* purposiveness for our cognitive faculties, which are also directly addressed in **Thesis 12**, **Thesis 13**, and **Thesis 14**. In my opinion, everything here turns on how we think about natural laws in relation to Kant's *theory of judgment*, whether analytic or synthetic judgments, and whether synthetic a priori or synthetic a posteriori judgments (Hanna, 2017). Correspondingly, a sharp distinction is needed between (i) *the logico-semantic and metaphysical dimension* of judgments, on the one hand (i.e., their truth, consequence or validity, meaning, and modality), and (ii) *the cognitive-semantic and epistemic dimension* of judgments, on the other (their intentionality, cognitive phenomenology, and justification or warrant). Natural laws correspond to synthetic a priori judgments, all of which are necessary and strictly underdetermined by contingent facts and sensory experiences, which is the same as their apriority or "experience-independence." In my opinion, the correct account of the modal semantics of synthetic a priori judgments specifies their truth-conditions in terms of increasingly restricted classes (or "spaces") of possible worlds (Hanna, 2001: ch. 5). And the corresponding restrictions on classes or spaces of worlds for the purposes of the semantics of the "material necessity" of synthetic a priori judgments about natural laws, as spelled out in the Postulates of Empirical Thought, are various more-or-less richly specific (aka strong) existential assumptions about the specific character of matter and its causal powers: let's call these *material existential assumptions*.

For example, as Stan correctly and ingeniously points out, if we formulate our material existential assumptions carefully enough, and "ascribe... to Kant mass-points as the best ontological explanation of all determinate phenomena of motion in a Galilean regime," then there's a promising case that Kant's "'special metaphysics of material nature' remains viable and relevant" for the "vast swath of determinate experience [that] still unfolds at speeds and scales for which classical [physical] theory remains indispensable" (p. 233), namely, "the 'classical belt' of the world,

where masses and speeds are slow enough that relativistic theory is not needed” (p. 214). Synthetic a priori judgments about natural laws are then necessary, precisely because they *hold for all and only the possible worlds in the relevant class or space of worlds corresponding to the relevant material existential assumptions of varying degrees of strength*. Hence no matter how *strong* the material existential assumptions are, and therefore no matter how *small* the corresponding class or space of worlds is, then the modal character of the judgments is exactly the same, i.e., they’re all genuinely *necessary*. Moreover, all necessary truths, no matter how small their modal scope, are a priori precisely because their meaning and truth are strictly underdetermined by all actual and possible contingent facts and sensory experiences.

In this way, the problem about the prima facie contingency of so-called “empirical laws” disappears. What makes them “empirical” laws is just *their dependency on material existential assumptions*, and *not* their dependency on contingent facts or sensory experiences. Indeed, Kant should have called them *material* laws, not *empirical* laws, and then the confusion about the nature and status of these natural laws would have been avoided. This recognition, in turn, adequately captures Warren’s otherwise very well-argued points about Kant’s theory of attractive and repulsive forces in *Metaphysical Foundations of Natural Science (MFNS)* simply by substituting the term “material existential assumptions” for the terms “experience” and “data of experience” in the following quotation:

The argument of the Dynamics chapter is that if matter is endowed with repulsive force, then it must also be endowed with an attractive force. And this attractive force must act immediately at a distance, and on all bodies, no matter how distant. The reality of the repulsive can be given only through [material existential assumptions]. But once that is given, the reality of this attractive force is guaranteed as well. What I am suggesting here is that in the case of attractive force, unlike repulsive force, there is a further role for [material existential assumptions] in establishing the specific mathematical form (the inverse-square character) of the relevant force law. (pp. 191–192)

Now what about the transcendental principles of the systematicity of nature and its as-if purposiveness for our cognitive faculties? Here, the issue is how correctly to construe the *cognitive semantics* and *epistemology* of empirical conceptualization and empirical or synthetic a posteriori “judgments of experience” (see Hanna, 2021) about nature, including empirical generalizations following from inductive inferences, and general hypotheses following from abductive inference-to-the-best-explanation. Ginsborg, Zuckert, and Teufel are undoubtedly correct that the transcendental principles of the systematicity of nature and of its as-if purposiveness for our cognitive faculties are *regulative*, not *constitutive*, and thereby function as necessary epistemic presuppositions for the purposes of guiding empirical scientific investigation and theorizing, and also warding off global epistemic skepticism both about knowing particular natural laws and also about the existence of particular natural laws. But it also seems to me that there’s something deeper going on here, not at the level of *concepts* and *determining judgments*, but instead at the level of essentially non-conceptual *intuitions* about systematic unity and essentially non-conceptual *feelings* about the beautiful in nature, especially as these have a bearing

on reflective judgments. What I mean is that it's perfectly consistent to hold that a transcendental principle can at once have a *regulative use for concepts and judgments*, and also a *constitutive use for essentially non-conceptual intuitions and feelings*.

This point plays out in two especially important ways.

The **first** way is that empirical conceptualization and empirical or synthetic a posteriori "judgments of experience" about nature, including empirical generalizations following from inductive inferences, and general hypotheses following from abductive inference-to-the-best-explanation, receive a relatively *weak* epistemic justification or warrant via the regulative use of the transcendental principles of the systematicity of nature and its as-if purposiveness for our cognitive faculties, because regulative principles do not entail truth or existence. But at the same time, these principles can also be *epistemically super-charged* via the constitutive use of these transcendental principles in an essentially non-conceptual *cognitive faith* in systematicity and *feelings of anti-skeptical confidence*, both of which flow directly from the disinterested pleasure we experience in the harmonious free play of our cognitive faculties of imagination and understanding in representing beautiful forms in nature (*CPJFI* 20: 208–216). Here the principles are constitutive because the intuitions and feelings falling under them entail *the real or actual existence* of that which is intuited and felt.

And the **second** way is collectively captured by **Thesis 7**, **Thesis 8**, **Thesis 9**, **Thesis 10**, and **Thesis 11**, all of which bring out various aspects and implications of Kant's anti-mechanism or organicism. As Breitenbach correctly points out, the standard reading of Kant's views on teleological natural laws in biology says that such laws are strictly regulative, for the purposes of forming teleological concepts and teleological judgments with relatively weak epistemic justification or warrant, in order to supplement the constitutive natural-scientific enterprise of discovering deterministic, mechanistic laws of empirical nature. But she also argues that

the teleological conception of the organism would guide the study of living beings even if we had a fully naturalistic organism concept. It carves out a part of nature as an object of study in its own right. It highlights a level of organization in the hierarchy of kinds on which to focus scientific investigations. (p. 254)

In other words, there's at least *theoretical space* in Kant's philosophy of nature for a constitutive reading of teleological natural laws in biology.

And here's how we can begin to *populate that theoretical space*, as per Kant's Neo-Aristotelian Natural Power Grid. If we sharply distinguish between teleological natural laws in biology as they're (i) used *regulatively* for empirical conceptualization and empirical judgments, and also (ii) used *constitutively* for essentially non-conceptual intuitions and feelings, then it is easy to see how Kant's anti-mechanism or organicism is not *merely epistemic*, but also *robustly metaphysical*, as Wilson correctly points out:

It is commonly held that Kant maintained a strict and productive distinction between a "constitutive" mechanical science based on the Newtonian forces of nature and a "regulative" teleological account.... [T]his is not quite right. Kant maintained a "constitutive" belief in active, organizing forces resident in matter throughout his career. (p. 257)

Where I would disagree slightly although also substantively with Wilson's otherwise well-supported account, is only with respect to her further claim that organisms and organismic processes can be real only *noumenally*, not *phenomenally* (p. 270). Yet this cannot be right, since Kant says explicitly (i) that we essentially non-conceptually intuit ourselves as living organisms, aka "natural purposes," via "the feeling of life" (*CPJ* 5: 204) and (ii) that "mind for itself is entirely life," hence we have a fully constitutive cognitive awareness of natural purposes or organisms *really or actually existing in the manifest or phenomenal material or physical world*, by subjectively experiencing our own living animal bodies from the inside:

[L]ife without the feeling of the corporeal organ is merely consciousness of one's existence, but not a feeling of well- or ill-being, i.e., the promotion or inhibition of the powers of life; because the mind for itself is entirely life (the principle of life), and hindrances or promotions must be sought outside it, though in the human being himself, hence in combination with his body. (*CPJ* 5: 278)

Kant famously and explicitly pointed out that there could never be "a Newton who could make comprehensible even the generation of a blade of grass according to natural laws that no intention has ordered" (*CPJ* 5: 400). But even more to the point, in view of Kant's anti-mechanism or organicism, there could never be a Newton *of Newton himself*, the rational human animal. And it's only one short step from that insight, via the constitutive use of teleological natural laws in biology for essentially non-conceptual intuitions and feelings, to a fully realistic non-reductive, anti-mechanistic approach to organismic biology, such as Francisco Varela's theory of *autopoiesis* (Varela et al., 1974; Varela, 1979). Add to this the weak or counterfactual transcendental idealist Kantian structural essentialism spelled out above in Theses 1, 2, 3, and the philosophical result is recorded in **Theses 7, 8, 9, 10, and 11**.

Kant's Neo-Aristotelian Natural Power Grid is not only an exciting, original, independently defensible, and arguably true *contemporary Kant-inspired theory of causal natural laws*, but also it's well-supported and arguably true as an interpretation of *Kant's own theory of causal natural laws* by the thirteen excellent essays in *Kant and the Laws of Nature*, although each of them in somewhat different and sometimes locally incompatible ways.

3.4 Conclusion

In this chapter, I've been arguing for the thesis I call *physics for humans*: for Kant, and for contemporary philosophers inspired by Kant, physics is not only an objectively true a priori science, but also an irreducibly human or moral science. In my opinion, for the reasons I've provided, the physics for humans thesis is true. If the physics for humans thesis is indeed true, then, riffing on Goldman's evocative "science wars" trope in a Kantian key, *we've successfully negotiated a philosophical treaty for perpetual peace in science* (cf. *TPP*).

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Chapter 4

The Incompleteness of Logic, The Incompleteness of Physics, and The Primitive Sourcehood of Rational Human Animals



Abstract In this short chapter, I argue that just as the inherent logico-mechanical Gödel-incompleteness of *Principia Mathematica*-style systems of mathematical logic needs to be completed by the capacity for mathematical intuition possessed by rational human animals, so too contemporary physics, according to the Standard Models of cosmology and particle physics, is itself inherently *physico-mechanically incomplete* and needs to be completed by a robust neo-organicist metaphysics of rational human animal free agency in particular and a neo-organicist worldview more generally.

4.1 Introduction

In the 1990s and again in the 2010s, Steven Weinberg, Stephen Hawking, and other leading physicists asserted that late twentieth and early twenty-first century philosophy is “dead” (Weinberg, 1994: ch. VII; Hawking & Mlodinow, 2010: p. 5). And it’s certainly true that recent and contemporary mainstream professional academic philosophy, which is hegemonically dominated by post-classical (i.e., since 1950) *Analytic philosophy*, is largely and pervasively (i) irrelevant to the larger sociocultural and sociopolitical world, (ii) ideologically enslaved to what I call *the military-industrial-university-digital complex*, and hyper-Scholastic, and therefore (iii) capable of at most “playpen” creativity and scholarship, and bereft of any truly original, life-changing, world-shaping ideas (Hanna, 2021: chs. XVII–XVIII). But by an ironic twist, this is principally because science *itself* killed post-classical Analytic philosophy in a substantive philosophical sense, by fatally chaining it to *scientism*, i.e., the dogmatic, uncritical epistemic and metaphysical valorization of formal science and natural science alike, including biology, chemistry, and physics, but in the context of this book, especially biology and physics (Haack, 2017; Hanna, 2021: ch XVII).

Let’s assume that post-classical Analytic philosophy is indeed dead in a substantive philosophical sense, even if not in a social-institutional sense—indeed, in *that* sense, post-classical Analytic philosophy remains hegemonically dominant in contemporary professional academic philosophy—and that science killed it. Nevertheless, as Carlo

Rovelli has correctly pointed out, “physics needs philosophy [and] philosophy needs physics” (Rovelli, 2018). Rovelli’s insight, which is of-a-piece with Whitehead’s similar first-wave organicist insight a century ago, philosophically outruns Weinberg’s and Hawking’s blithe and uncritical neo-Vienna-Circle-style scientism by a country mile. Correspondingly, I’ll argue in this short chapter that contemporary physics, according to the Standard Models of cosmology and particle physics, is itself inherently *incomplete* and needs to be completed by a robust neo-organicist metaphysics of free agency in particular and a neo-organicist worldview more generally. And if that’s the case, then not only are Weinberg and Hawking scandalously wrong that philosophy is dead, but also it’s profoundly true that *without* neo-organicism, then *contemporary physics is dead* in the substantive philosophical sense.

4.2 From Gödel to Physics 1: Definitions

What follows in this section and the next, is my attempt to provide a compact, clear, distinct, and philosophically defensible reformulation and extension of an important line of argument that has been developed since the early 1960s, in various ways, by J.R. Lucas, Roger Penrose, and others (Lucas, 1961; Penrose, 1990; Deacon, 2011; Smolin, 2013, 2014). To be sure, these various developments of this important line of argument are all somewhat controversial; so my aspiration in this chapter is simply to build on their pioneering work, and improve on it if I can. It’s an argument by formal analogy. The formal analogy is between (i) the incompleteness of *Principia Mathematica*-style systems of mathematical logic (Whitehead and Russell, 1962) that are rich enough to contain the Peano axioms for arithmetic and the primitive recursive functions over the natural numbers, and (ii) the incompleteness of the Standard Models in contemporary physics.

For clarity’s sake, I’ll start with some definitions.

By *the Peano axioms for arithmetic* I mean: (i) 0 is a number, (ii) the successor of any number is a number, (iii) no two numbers have the same successor, (iv) 0 is not the successor of any number, and (v) any property which belongs to 0, and also to the successor of every number which has the property, belongs to all the numbers.

By *the primitive recursive functions over the natural numbers* I mean: the successor function, addition, multiplication, exponentiation, and so-on.

And by *the Standard Models in contemporary physics* I mean the current Standard Model of Cosmology (SMC), together with a proper sub-part of SMC, the current Standard Model of Particle Physics (SMPP), as per the following non-technical gloss by B.A. Robson:

The current Standard Model of Cosmology (SMC), also called the “Concordance Cosmological Model” or the “ Λ CDM Model,” assumes that the universe was created in the “Big Bang” from pure energy, and is now composed of about 5% ordinary matter, 27% dark matter, and 68% dark energy.¹

¹Ade PAR et al. (Planck Collaboration). Planck 2013 results. I Overview of products and scientific results. Astronomy and Astrophysics. 2014;571:A1, 48 pp. (Robson, 2019: footnote 1).

[T]he SMC is based primarily upon two theoretical models: (1) the Standard Model of Particle Physics (SMPP),² which describes the physics of the very small in terms of quantum mechanics and (2) the General Theory of Relativity (GTR),³ which describes the physics of the very large in terms of classical mechanics; it also depends upon several additional assumptions.

The main additional assumptions of the SMC are: (1) the universe was created in the Big Bang from pure energy; (2) the mass energy content of the universe is given by 5% ordinary matter, 27% dark matter, and 68% dark energy; (3) the gravitational interactions between the above three components of the mass energy content of the universe are described by the GTR; and (4) the universe is homogeneous and isotropic on sufficiently large (cosmic) scales.

Unfortunately, both the SMPP and the GTR are considered to be *incomplete* in the sense that they do not provide any understanding of several empirical observations. The SMPP does not provide any understanding of the existence of three families or generations of leptons and quarks, the mass hierarchy of these elementary particles, the nature of gravity, the nature of dark matter, etc.⁴ The GTR does not provide any understanding of the Big Bang cosmology, inflation, the matter-antimatter asymmetry in the universe, the nature of dark energy, etc.

Furthermore, the latest version of the SMC, the Λ CDM Model is essentially a parameterization of the Big Bang cosmological model in which the GTR contains a cosmological constant, Λ , which is associated with dark energy, and the universe contains sufficiently massive dark matter particles, i.e., “cold dark matter.” However, both dark energy and dark matter are simply names describing unknown entities. (Robson, 2019)

By the *completeness of a logical system* I mean the systemic property such that all the logical truths of the system (i.e., tautologies or valid sentences) are *provable* (i.e., theorems), hence the *incompleteness of a logical system* is the systemic property such that *not all* of its logical truths are provable, i.e., that *some* of its logically true sentences are *unprovable* sentences.

By the *completeness of a physical theory* I mean the systemic property such that all its true empirical sentences are *predictable*, hence the *incompleteness of a physical theory* is the systemic property such that *not all* of its true empirical sentences are predictable, i.e., that *some* of its true empirical sentences are *unpredictable* sentences.

And by *predictable sentence*, I mean that a sentence *S* in a physical theory *PT* is predictable if and only if (i) *S* is explicable or understandable in terms of *PT*, (ii) *S* is or would be entailed by *PT* if certain contingent empirical conditions were met, and (iii) *S* is self-consistent and non-paradoxical—hence unpredictable sentences violate one or more of those necessary conditions.

²Gottfried K, Weisskopf VF. Concepts of Particle Physics. Vol. 1. New York: Oxford University Press; 1984. 189 pp. (Robson, 2019: footnote 2).

³Einstein A. The basics of general relativity theory. Annals of Physics. 1916;49:769–822. (Robson, 2019: footnote 3). See also (Einstein et al., 1923/1952; Born, 1962).

⁴Robson BA. The generation model of particle physics. In: Kennedy E, editor. Particle Physics. Rijeka: InTech; 2012. pp. 1–28. (Robson, 2019: footnote 4).

Every system of mathematical logic describes a corresponding real mathematical system and/or a class of such real systems: for example, *Principia Mathematica*-style systems that are rich enough to include the Peano axioms for arithmetic and the primitive recursive functions over the natural numbers describe Peano arithmetic. So too, every physical theory describes a corresponding real physical system and/or a class of such real systems: for example, the Standard Models of cosmology and particle physics describe closed deterministic or indeterministic physical systems that obey The First and Second Laws of Thermodynamics, i.e., equilibrium entropic thermodynamic systems with reversible time and Turing-computable basic quantities. Let's call such systems *mechanical physical systems*.

4.3 From Gödel to Physics 2: Logico-Mechanical Incompleteness and Physico-Mechanical Incompleteness

In 1931, initiating a logico-mathematically earthshaking series of closely-related results demonstrated by Church, Turing, and Tarski, Kurt Gödel proved (i) that all *Principia Mathematica*-style systems rich enough to contain the Peano axioms for arithmetic and the primitive recursive functions over the natural numbers are incomplete because they contain some unprovable sentences that are equivalents of the Liar Paradox, i.e., a self-referring sentence such that necessarily, it's true/provable if and only if it's false/unprovable (such sentences are also undecidable, hence uncomputable), and also (ii) that all such systems cannot prove their own consistency or contain their own truth-definition, on pain of containing unprovable sentences that are equivalents of the Liar Paradox, and thereby being inconsistent systems, hence that the truth-definitions for and consistency of such systems must be established outside those systems (Gödel, 1931/1967; Church, 1936; Turing, 1936/1937; Tarski, 1943, 1956; see also Boolos & Jeffrey, 1989). Let's call all this *logico-mathematical incompleteness*.

Now, just as no *Principia Mathematica*-style system rich enough to contain the Peano axioms for arithmetic and the primitive recursive functions over the natural numbers can contain its own truth-definition, or demonstrate its own consistency, without generating equivalents of the Liar Paradox and its own inconsistency, so too no mechanical physical system can contain its own initial conditions, spacetime-architecture, or the nomological framework (i.e., the framework of causal natural laws) that determines the evolution of states within the system, without generating experimental situations that produce *physical paradox* in the form of empirically true but unpredictable sentences. For example, as Robson puts it:

Unfortunately, both [quantum mechanics] and the [General Theory of Relativity] are considered to be *incomplete* in the sense that they do not provide any understanding of several empirical observations. [Quantum mechanics] does not provide any understanding of the existence of three families or generations of leptons and quarks, the mass hierarchy of these

elementary particles, the nature of gravity, the nature of dark matter, etc.⁵ The [General Theory of Relativity] does not provide any understanding of the Big Bang cosmology, inflation, the matter-antimatter asymmetry in the universe, the nature of dark energy, etc. (Robson, 2019)

Moreover, the Standard Models in contemporary physics, via General Relativity and quantum mechanics, also generate these further examples of physical paradox: the slowing-down of time for objects/observers traveling at speeds close to that of light, quantum indeterminacy, quantum superposition, quantum decoherence, Schrödinger's cat (Schrödinger, 1935/1980), quantum particle/wave duality, quantum complementarity, quantum entanglement, quantum non-locality, and quantum non-separability (Myrvold, 2018). Let's call all this *physico-mechanical incompleteness*.

4.4 From Incompleteness to Creativity

Now, just as, if a system of mathematical logic is incomplete, then necessarily its corresponding real mathematical system and/or class of such systems *inherits that logico-mathematical incompleteness*, so too, if a physico-mechanical theory is incomplete, then necessarily its corresponding real physical system and/or all the members of the class of such real physical systems *inherit that physico-mechanical incompleteness*.

Moreover, just as Tarski's *semantic conception of truth* (aka model-theoretic semantics) theoretically bears witness to logico-mathematical incompleteness by systematically locating truth-definitions and consistency in logical *meta*-languages that are outside of logico-mathematical systems construed as *object*-languages (Tarski, 1943, 1956), so too *relativity theory and quantum theory* theoretically bear witness to physico-mechanical incompleteness by systematically *operationalizing* the fundamental concepts of physical entities, physical properties, physical relations, physical forces, physical quantities, etc., in physico-mechanical systems, strictly in terms of what can be represented by experimental measuring devices.

But, just as the semantic conception of truth doesn't tell us *how* the truth-definitions and consistency are *known*—that's what Benacerraf's Dilemma (Benacerraf, 1973; Hanna, 2015: chs. 6–8) is all about—so too relativity theory and quantum theory don't tell us *how* the initial conditions, spacetime architectures, and nomological frameworks are *created*.

Correspondingly, just as truth-definitions and consistency for every *Principia Mathematica*-style system rich enough to contain the Peano axioms for arithmetic must be *semantically and epistemically established* outside that system in an inherently *non-logical way* (let's call that *mathematical creativity*), so too the initial

⁵Robson BA. The generation model of particle physics. In: Kennedy E, editor. Particle Physics. Rijeka: InTech; 2012. pp. 1–28. (Robson, 2019: footnote 4).

conditions, spacetime architecture, and nomological framework for every mechanical physical system must be *causally established* outside that system in an inherently *non-deterministic, non-indeterministic, non-equilibrium, negentropic, time-irreversible, uncomputable thermodynamic* way (let's call that *natural creativity*).

Therefore, just as the fact of logico-mathematical incompleteness entails *the existence of mathematical creativity*, so too the fact of physico-mechanical incompleteness entails *the existence of natural creativity*.

Given the multiplicity of mathematical axioms and mathematical truths, *there must be a multiplicity of primitive sources of mathematical creativity*, including brilliant mathematicians but not restricted to them—indeed, including all mathematical a priori knowers of mathematical axioms and mathematical truths. For example, you, I, and the people living next door can all know the Peano axioms for arithmetic, the primitive recursive functions over the natural numbers, and that $2 + 2 = 4$. So too, given the multiplicity of mechanical physical systems, *there must be a multiplicity of primitive sources of natural creativity*, including the Big Bang Singularity, but not restricted to it—indeed, including all non-deterministic, non-indeterministic, non-equilibrium, negentropic, time-irreversible, uncomputable thermodynamic systems (aka “Little Bangs”) that causally establish the initial conditions, spacetime architecture, and nomological framework for each *local* mechanical physical system, i.e., every mechanical system that is smaller than the natural cosmos or universe itself. For example, you, I, and the people living next door, by being rational human essentially embodied minded animals (Hanna & Maiese, 2009), whose living organismic bodies are embedded in egocentrically-centered three-dimensional orientable local spaces, in irreversible time, with unique non-deterministic, non-indeterministic, non-equilibrium, negentropic thermodynamic causal powers, can all causally establish the local initial conditions, local spacetime architecture, and local nomological framework for their own intentional body-movements, which are then described—with physico-mechanical incompleteness—by the Standard Models in contemporary physics.

4.5 Conclusion

Therefore, all rational human animals are not only primitive sources of mathematical creativity, as *mathematical a priori knowers* of mathematical axioms and mathematical truths, arguably by means of *mathematical intuition* (Hanna, 2015: chs. 6–8), but also primitive sources of natural creativity, as *rational human free agents*, arguably by means of *deep freedom of the will* and *non-instrumental practical agency* (Hanna, 2018a, b). In short, the creative primitive sourcehood of rational human animals completes mathematical logic and physics alike.

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Chapter 5

Frame-by-Frame: How Early Twentieth Century Physics Was Shaped by Brownie Cameras and Early Cinema



Abstract We design, create, and use tools to change the world, for better or worse; but in so doing, our tools also change *us*, for better or worse. An important elaboration of this truth is what Otto Paans and I have called *the theory of thought-shapers*, or TTS for short (Hanna R, Paans O, *Cosmos Hist* 17(1):1–72, 2021). In this chapter, I apply TTS to early twentieth century physics, and in particular to the Kuhnian-paradigm-shifting, revolutionary physics provided by the Special Theory of Relativity and the General Theory of Relativity (SRT-GRT) and Quantum Mechanics (QM), roughly one hundred years ago.

Straightness or any other geometrical property cannot be directly proved empirically, but is only relative to definite geometrical properties of the apparatus used in measurement (straightness of the ray of light, rigidity of the parts of the instrument).... A critical review of the exact sciences teaches us that all our observations resolve finally into ... coincidences. Each measurement states that a pointer or a mark coincides with some division on a scale simultaneously with the hands of a clock with some divisions of the dial. No matter whether the measurement concerns lengths, times, forces, masses, electrical currents, chemical affinities, or anything else, all that is actually observable consists of space-time coincidences. In the language of Minkowski these are the world points that are marked in the space-time manifold by the intersection of material world lines. Physics is the doctrine of the relations between such marked world points. (Born, 1962: pp. 332–333)

Quantum mechanics is ... a mathematical machine for predicting the behaviors of microscopic particles—or, at least, of the measuring instruments we use to explore those behaviors—and in that capacity, it is spectacularly successful: in terms of power and precision, head and shoulders above any theory we have ever had. Mathematically, the theory is well understood; we know what its parts are, how they are put together, and why, in the mechanical sense (i.e., in a sense that can be answered by describing the internal grinding of gear against gear), the whole thing performs the way it does, how the information that gets fed in at one end is converted into what comes out the other. The question of what kind of a world it describes, however, is controversial; there is very little agreement, among physicists and among philosophers, about what the world is *like* according to quantum mechanics. Minimally interpreted, the theory describes a set of facts about the way the microscopic world impinges on the macroscopic one, how it affects our measuring instruments, described in everyday language or the language of classical mechanics. Disagreement centers on the question of what a microscopic world, which affects our apparatuses in the prescribed manner, is, or even could be, like *intrinsically*; or how those apparatuses could themselves be built out of microscopic parts of the sort the theory describes. (Ismael, 2021)

5.1 Introduction

We design, create, and use tools to change the world, for better or worse; but in so doing, our tools also change *us*, for better or worse. An important elaboration of this truth is what Otto Paans and I have called *the theory of thought-shapers*, or TTS for short (Hanna & Paans, 2021). Bounded in a nutshell, TTS says this:

Necessarily, all human thinking is partially determined, formed, and guided by veridical, essentially non-conceptual mental representations of allegories, analogies, blueprints, catechisms, diagrams, displays, icons, images, lay-outs, metaphors, mnemonics, models, outlines, parables, pictures, scenarios, schemata, sketches, spreadsheets, stereotypes, symbols, tableaux, and templates,¹ featuring egocentrically-centered, action-poised temporal representations and spatial representations as fundamental, in a way that's not only causal but also irreducibly normative, and inherently external-context-sensitive or indexical, for better (i.e., in an organic, generative way) or worse (i.e., in a mechanical, constrictive way). (Hanna & Paans, 2021: section 1; see also Maiese et al., 2023)

In this chapter, I want to apply TTS to early twentieth century physics, and in particular to the Kuhnian-paradigm-shifting, revolutionary physics provided by the Special Theory of Relativity and the General Theory of Relativity (SRT-GRT) and Quantum Mechanics (QM), roughly one hundred years ago.

5.2 The Special and General Theories of Relativity, Quantum Mechanics, and The Representation→Represented Fallacy

The early twentieth-century discoveries or inventions of STR-GTR and QM by Einstein, Lorentz, Mach, Minkowski, Weyl, Planck, Poincaré, de Broglie, Bohr, Born, Heisenberg, Schrödinger, and others, undertook a Kuhnian-paradigm-shifting, revolutionary “turn” from thinking about physics (i) as a mathematical theory *about the manifestly real material or physical natural universe and all the objects in it*, to thinking about physics as (ii) a mathematical theory *about the operations of experimental measuring devices*—measuring rods, light-signals, the Michelson interferometer, weigh-scales, particle-tracking and wave-tracking equipment (including single-slit devices, two-slit devices, the Mach-Zehnder interferometer and so-on), cameras of various kinds, early digital computers, and so-on—that are used for *measuring the manifestly real material or physical natural universe and all the objects in it*.

¹ This list isn't intended to be complete, but instead only to be a working list of paradigm cases that Paans and I are aiming to connect in an essential way to the nature of human thinking, and more generally, to explain (see Hanna & Paans, 2021). After we provide a more precise characterization of thought-shapers in sections 1 and 2 of that essay, the list could in principle be extended according to those criteria. Moreover, allegories, catechisms, and parables differ slightly from the other items on the list, in a way that are briefly described in section 1.

Now, this “turn” in physics was itself basically a *neo-Kantian* move, switching scientific attention from *the objects of representation*, considered as cognitively inaccessible *noumena*, or “things in themselves,” to *the representations of those objects*, considered as experimentally-verified *phenomena* or “mere appearances”; and indeed, neo-Kantian philosophy was still dominant in Europe during the late nineteenth and early twentieth century (Willey, 1978; Köhnke, 1991; Luft & Capeillères, 2010; Beiser, 2014; Crowell, 2017; Heis, 2018; Clarke, 2019).

Nevertheless, if, as I believe, sharply contrary to the neo-Kantians, that the material or physical natural universe and all the objects in it are in fact *manifestly real*, and *neither* inaccessible things-in-themselves *nor* mere appearances (Hanna, 2006: esp. part I, 2015: esp. chs. 2–3, 2017), then it’s a fundamental mistake to hold that the mathematical properties of the operations of experimental measuring devices—which of course, are all *machines*—are to be identified with the mathematical properties of the objects being measured by those devices, most of which are *not* machines. I call this *The Representation → Represented Fallacy*, since it consists in systematically but falsely substituting *properties of the representations of objects* for *properties of the objects being represented*. Correspondingly, I believe that the repeated commission of The Representation → Represented Fallacy by the discoverers of STR-GTR and QM is in large part responsible for our contemporary “crisis in physics” (Smolin, 2013, 2014; Hossenfelder, 2018), one hundred years later.

If I’m correct about all this, then STR-GTR and QM, as created or discovered by means of the Kuhnian-paradigm-shifting, revolutionary, thought-shaped thinking of mathematical physicists like Einstein, Lorentz, Mach, Minkowski, Weyl, Planck, Poincaré, de Broglie, Bohr, Born, Heisenberg, Schrödinger, and others were in fact partially causally determined, formed, and normatively guided, in their historical context, and *ultimately for the worse*, by a small set of mechanical, constrictive thought-shapers that *primitively represent causation*. In turn, I’ll call this set of mechanical, constrictive thought-shapers *high modernist causal thought-shapers*. By “high modernist,” I’m again referring to what James C. Scott has aptly called “a high modernist ideology,” or *high modernism* for short:

[High modernism] is best conceived as a strong, one might even say muscle-bound, version of the self-confidence about scientific and technical progress, the expansion of production, the growing satisfaction of human needs, the mastery of nature (including human nature), and, above all, the rational design of social order commensurate with the scientific understanding of natural laws. (Scott, 1998: p. 4)

In the grip of high modernism, the Kuhnian-paradigm-shifting, revolutionary early twentieth century physicists created or discovered physical theories that postulate systems of *deterministic or indeterministic mathematical natural laws*, but the meanings of the theory-bound statements of those laws are *strictly underdetermined* by their conceptual and propositional content, hence *high modernist causal thought-shapers are required to fix their meanings*.

5.3 John Locke's Big Idea

Now for what I'll call *John Locke's big idea*: that we get cognitive access to causal thought-shapers representing *force*, by generalizing from our own primitive subjective experience—i.e., our *phenomenology*—of *mental causation in rational human intentional action* (see Locke, 1607/1975: book II, ch. xxi; Planck, 1915: p. 12; Hanna & Maiese, 2009: esp. chs. 3–5; Hanna, 2020).

For the purposes of *classical/Newtonian physics*, our phenomenology of rational human intentional action provides a classical causal thought-shaper *that mimics intentional acts that manipulate objects in our local environment, within a single overarching container-space and using a single overarching time-frame/clock*, for example, playing billiards, shaking apple tree limbs until the apples fall down, etc. Then this classical causal thought-shaper is conservatively extended via conceptualization and generalization to all of manifest natural reality, at all basic scales, according to The Force Law $F = MA$ and also The Inverse Square Law for gravitational attraction.

For the purposes of *Einsteinian relativity physics*, our phenomenology of rational human intentional action provides a high modernist causal thought-shaper *that mimics intentional acts using local causal intermediaries*, for example, light signals, and also rulers/measuring rods, clocks, and classic Kodak Brownie film-roll cameras of the kind Einstein would have known circa 1905, used as experimental measurement devices. Then, taking light-signals, and the speed of light operating as an absolute and universal causal intermediary-and-constraint, we derive relativistic causal operationality, aka “locality.” In turn, this high modernist causal thought-shaper is conservatively extended via conceptualization and generalization to all of macrophysical reality, at all basic scales, according to The Energy Law $e = mc^2$, inherently limited, however by light-signals and the speed of light as an absolute and universal causal intermediary-and-constraint.

For the purposes of *the classical Bohrian/Heisenbergian Copenhagen interpretation of quantum mechanics* (Heisenberg, 1927/1983; Faye, 2019), our phenomenology of rational human intentional action provides a high modernist causal thought-shaper *that mimics intentional acts with absolutely synchronous (aka “non-local”) body-movements*—for example, the intentional performance of raising my arm—as captured on film by means of a classic hand-cranked movie camera loaded with classic 35 mm filmstock, 16 frames per second, used in silent films of the kind Bohr and Heisenberg would have known circa World War I and in the early 1920s, and then represented mathematically. In this *cinematic high modernist causal thought-shaper*, each frame in the film stands for a single quantum state. Then, further exploring the internal structure of this cinematic high modernist causal thought-shaper, let's consider the position of any proper sub-part (and let's call that a “particle”) of the picture within a given frame, say, the particle of a framed picture that contains an image of a finger on one of my hands. There's a certain probability as to where that particle will appear in the picture in the next frame, and as to what its black-white pointilliste quality (energy-state quantity: say charge, momentum, or

spin) will be. But its particular position and its black-white pointilliste quality (energy-state quantity) in that next frame will also depend on *all* the positional configurations and black-white pointilliste qualities (energy-state quantities) of *all* the particles in that frame, *and* there's an irreducible causal gap or jump (quantum leap) between frames, no matter how many frames per second the film contains.

5.4 The Cosmic Moviola and The Representation→Represented Fallacy

Now let's even further consider the film rolling, frame by frame, whether forward or backwards (it ultimately makes no difference in an equilibrium, time-reversible system), in a way that that represents the deterministic evolution of the wave function according to the Schrödinger equation. The standpoint of the film viewer/experimenter, who "intervenes" by watching/measuring, is the classical Copenhagen interpretation of quantum mechanics. And the "god's-eye" standpoint of the film editor, who can cut frames, insert/splice bits of film, or doctor individual frames (call those "hidden variables"), is the post-classical Bohmian hidden-variables/pilot wave interpretation of quantum mechanics, *insofar as it's construed as deterministic*² (Bohm, 1952, 1982; Bohm & Hiley, 1975; Goldstein, 2021). The god's-eye deterministic Bohmian editor-physicist sees the whole "movie," the physical universe, as nothing but a single "film roll," the nomologically-necessitated evolution of the wave function, laid out flat on the editing table, or wound up in the Moviola—a film editing device invented in 1924—as a series of essentially static individual "frames," quantum states) with inherently mechanical clock-time development from any given "frame"/quantum state or set of "frames"/quantum states to later "frames"/quantum states, but also with (i) merely probabilistic relations between positions and energy-state quantities of particles between any given "frame"/quantum state and the next "frame"/quantum state, (ii) causal "gaps" or "jumps"/quantum leaps from "frame"/quantum state to "frame"/quantum state, (iii) holistic non-locality inside each frame, and (iv) the in-principle reversibility of the entire film roll of the movie/physical universe, together with enantiomorphic/mirror-reflected flips of the positions of all particles inside the "frames"/quantum states.

As Lee Smolin rightly points out, the cosmological primitive fact of *real, asymmetric time* (as immanent, for example, in my bodily performance of raising my right arm and hand, as subjectively experienced by me, which was being "captured on film" in the cinematic high modernist causal thought-shaper) *has been completely edited out* by classical quantum cosmology (Smolin, 2013: ch. 7, 2014). So too, although Smolin overlooks this, the other cosmological primitive fact of *real,*

²Indeed, *only* insofar as it's construed as deterministic. I specially emphasize this, because in Chap. 6 below I'll spell out a *non*-deterministic version of the Bohmian hidden variables/pilot wave interpretation that *doesn't* require a god's-eye deterministic standpoint on the evolution of the wave-function.

orientable global space with object-embedding-and-local-centering in which, for example, right-handed particles *inherently cannot be made congruent* with left-handed particles within the same global orientable 3-dimensional space, *has also been completely edited out* by classical quantum cosmology.

Wordsworth wrote, in “The Tables Turned,” that

[s]weet is the lore which Nature brings;
Our meddling intellect
Mis-shapes the beauteous forms of things:—
We murder to dissect. (Wordsworth, 1798)

Thus, by means of the nineteenth century mechanistic biologist’s “meddling intellect,” *we murder to dissect* by turn living organisms into nothing but ordered heaps of dead organic material mysteriously related by deterministic causal and mathematical connections, natural machines. Homologously, but now in an infinitely expanded way, and with cosmological scope, in relativity theory and classical or post-classical quantum mechanics, *we murder to represent*. And thereby, by means of our early twentieth century high modernist mechanistic physicist’s equally “meddling intellect,” we turn real, asymmetric time (and especially the real, asymmetric time of our lives) into nothing but the operational tick-tock of clocks measuring light signals recorded by Brownie-style cameras, “captured” in non-Euclidean geometry as curves in a fourth dimension of space (thereby *spatializing time*—but it’s also crucial to note that *the temporalization of space* would be equally mistaken³), or into ordered heaps of quantum states, each of which is an essentially static holistic configuration of entangled, handed particles in a single frozen “now,” comprehended from the platonic god’s-eye standpoint of The Great Quantum Cosmology Film Editor, cranking His cosmic Moviola—whether forward or backwards, and whether with mirror-reversed frames or not, it doesn’t really matter—and extra-cosmologically contemplating (for example) The Implicate Order (Bohm, 1982: esp. chs. 5–7). Genuine but still epicyclical advances in quantum cosmology like quantum gravity block-universe theory, or quantum field block-universe theory, make no essential difference to this fundamentally *chronocidal* or real-time-murdering and *geometrocidal* or real-space-murdering cosmological picture: namely, the cinematic high modernist mechanical, constrictive causal thought-shaper, i.e., *the ultimate franchise* in twentieth and twenty-first century quantum-mechanical movie-making.

As I mentioned above, the Kuhnian-paradigm-shifting scientific revolution in physics that happened in the early twentieth century came about because physicists, in a moment of pure creativity, discovered that by operationalizing our access to manifest reality in terms of the experimental devices we use to measure it, *we can apply mathematical physics to the operations of these experimental devices of measurement themselves*, and thereby generate many true predictions. But although, via his theory

³Indeed, temporalizing space is Smolin’s equal-and-opposite mistake to Einstein’s mistake of spatializing time, insofar as Smolin “murders” real space by turning it into a derivative, purely relational fact that emerges from the primitive fact of asymmetric time at some point after The Big Bang, by means of “geometrogenesis”: see (Smolin, 2013: ch. 15).

of weak or counterfactual transcendental idealism for human sensibility Kant taught us that necessarily, the manifestly real or veridically apparent natural universe conforms to the innately-specified structures of our rational and sensible cognitive capacities for representing that world, and does *not* passively conform either to mind-independent, noumenal objects, as per classical Rationalism, or to subjectively mind-dependent phenomenal objects, as per classical Empiricism (see also Hanna, 2016), nevertheless Kant's Copernican Revolution does *not* extend *either* to the thesis (i) that necessarily, the manifestly real natural universe conforms to the operations of the experimental devices we use to measuring it, *or* to the thesis (ii) that necessarily, the manifestly real natural universe conforms to the mathematical physical theories we apply to the operations of the experimental devices we use to measure it. On the contrary, it's a fundamental fallacy to hold either of these theses: the fallacy of substituting the properties of representations, for the properties of the objects represented by those representations, i.e., The Representation → Represented Fallacy.

This TTS-driven philosophical diagnosis-&-critique of The Representation → Represented Fallacy is made really possible and rationally justified by the fact that essentially embodied, essentially non-conceptual thought-shapers not only provide *direct, veridical cognitive access* to the manifestly real world, but also are *essentially independent of* (i) all concepts and conceptualization, (ii) all measurement, which always and only proceeds under some or another concept of a unit, scale, or system of measurement, and (iii) all theories, which are built out of propositions and logical relations, which in turn are built, respectively, out of concepts and logic. That crucial threefold point, in turn, sharply distinguishes TTS from the thoroughly *conceptualist* and *social-conventionalist* theory of mental representation developed by Nelson Goodman and other leading figures in the emerging post-behaviorist "cognitivist" movement of the 1950s, 1960s, and 1970s (Goodman, 1951, 1978; Gombrich, 1960), that's presupposed, for example, by Kuhn in *Structure of Scientific Revolutions* (Kuhn, 1970). TTS constitutes a *manifest realist* and *dual-content* theory of human cognition that's *neither* a conceptualist/social-conventionalist theory about how we individually or socially *construct* interpretations of complexes of mere appearances *nor* a naïve noumenal realist/"innocent eye" theory of how we passively *copy* a world of things-in-themselves. Instead, TTS says that all our conceptual, logical, and theoretical thinking is necessarily *shaped* by essentially embodied, essentially non-conceptual contents that are, considered on their own, *veridical representations of a manifestly real natural universe*.

Now, to be sure, as I've said, Einstein, Lorentz, Mach, Minkowski, Weyl, Planck, Poincaré, de Broglie, Bohr, Born, Heisenberg, Schrödinger, Bohm, Wheeler, Hawking, and all the other the creators/discoverers of and contributors to the Standard Models of cosmology and particle physics (aka SMC and SMPP) *all* exemplified brilliant, revolutionary pure creativity in bringing about their Kuhnian paradigm shift in physics. I'm not denying that in the slightest. It's just that they *also* all committed The Representation → Represented Fallacy, and that they've all *also* had their thinking partially causally determined, formed, and normatively

guided by high modernist mechanical, constrictive causal thought-shapers, ultimately for the worse.

If we look back 250 years *behind* the early twentieth century modernist relativity-theoretical/quantum-theoretical scientific revolution in physics and its endemic tendency to commit The Representation \rightarrow Represented Fallacy, then we can see that synchronous/non-local causation already appears *macrophysically* in Newtonian physics: for example, The Force Law $F = MA$ says, in effect, that acceleration acts absolutely synchronously/non-locally on mass in order to produce force. But even leaving aside Newton and just focusing on the commonsense or manifestly real natural universe, whenever, for example, you turn a corner to the right in your car, the rotation of the steering wheel and steering column act absolutely synchronously/non-locally in a global orientable space with object-embedding-and-local-centering, on the rotation of the wheels relative to the pavement; and absolutely synchronous/non-local causation applies to the ordinary operations of rotation-devices more generally. Indeed, the minded human animal body is itself a *living rotation device* that's constantly and spontaneously in action throughout its life-span, whether in repose or in self-initiated movement, embedded and locally centered in a global orientable space, and *proprioception* in rational human intentional bodily performances, is an essentially embodied, essentially non-conceptual, pre-reflective or non-self-consciously conscious awareness of that lifelong ongoing absolutely synchronous/non-local action, always embedded and locally centered in global orientable space.

What's radically different in Standard Models-style quantum cosmology and particle physics, however, is that cinematic high modernist mechanical, constrictive causal thought-shapers, via The Representation \rightarrow Represented Fallacy, murder the manifestly real asymmetric time and asymmetric space of the natural universe and of our lives, by being fallaciously exported from experimental measuring devices and the experimental situation, to the manifestly real natural universe in which we actually live, move, and have our being. All the paradoxes of quantum cosmology and particle physics therefore flow from the uncritical, unself-conscious use of cinematic high modernist mechanical, constrictive causal thought-shapers, together with *the original sin of The Representation \rightarrow Represented Fallacy*, including, of course, paradoxical quantum uncertainty/indeterminacy in the two-slit experiment (and other two path experiments), and Schrödinger's not-so-very-practical, yet also highly paradoxical, tragical cat (Schrödinger, 1935/1980).

5.5 Conclusion

Again, however, and finally, it's crucial to see that causally efficacious non-locality in and of itself is *not* paradoxical, and *not* "spooky action-at-a-distance"—on the contrary, it's a commonsensical and phenomenological mainstay of the manifestly real natural universe, and our "human, all-too-human" rational intentional life-careers in and through that natural universe, most intimately and vividly exemplified by the neo-Aristotelian hylomorphic mind-body relation that we ourselves

incarnate (Hanna and Maiese, 2009; and Chap. 2 above). But a particle or cat whose statistically-openended life/death, or momentum/position, in the next cosmological film frame/quantum state depends either on the “intervention” of the viewer/experimenter-measurer or on the Moviola/hidden variable crankings of The Great Quantum Cosmology Film Editor *is* highly paradoxical. Non-locality *appears to be* paradoxical *only if* you have already dogmatically internalized the Einsteinian/STR assumption that, necessarily, all causal efficacy in the natural world *rides the rails of photons* or *surfs the undulations of light-waves*. Nevertheless, *it just ain’t so*, as non-local causation in the manifestly real world self-evidently demonstrates.

The honest-to-goodness truth, then, is that *some* causal efficacy in the manifestly real natural universe *does* indeed conform to the physical properties of light, namely, causal efficacy in narrowly-constrained experimentally-measured domains that are, as it were, pre-formatted for deterministic classical physics, whether Newtonian or Einsteinian, whereas *other and more fundamental* causal efficacy in the manifestly real natural universe *does not*, namely, non-deterministic, non-indeterministic, uncomputable, negentropic, processual, purposive, self-organizing, temporally asymmetric or irreversible, non-equilibrium thermodynamic matter/energy flows, including all organismic life, all minded animal life, and all rational human free agency (Hanna, 2018, 2020; see also Chap. 6 below). Yet purveyors of the Standard Models simply cannot recognize this, because their thinking has been partially causally determined, formed, and normatively guided—*shaped*—for roughly a century, and *ultimately for the worse*, by high modernist mechanical, constrictive causal thought-shapers of various kinds, including mental representations of Brownie cameras and early cinema.

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Chapter 6

How to Complete Quantum Mechanics, Or, What It's Like To Be a Naturally Creative Bohmian Beable



Abstract In this chapter, I argue that if we assume that the Standard Models in contemporary physics are physico-mechanically incomplete, and if we also assume that all rational human animals are primitive sources of natural creativity via their free agency, then, by means of an appeal to a non-deterministic version of Bohmian mechanics, together with the thesis that all rational human animals are primitive sources of natural creativity via their free agency, we can complete quantum mechanics.

6.1 Introduction

In Chap. 4 I argued, by means of a formal analogy between (i) the incompleteness of *Principia Mathematica*-style systems of mathematical logic that are rich enough to contain the Peano axioms for arithmetic and the primitive recursive functions over the natural numbers (i.e., logico-mathematical incompleteness), and (ii) the incompleteness of the Standard Models in contemporary physics (i.e., physico-mechanical incompleteness), that (iii) just as the fact of logico-mathematical incompleteness entails *the existence of mathematical creativity*, so too the fact of physico-mechanical incompleteness entails *the existence of natural creativity*, and that (iv) all rational human animals are not only primitive sources of mathematical creativity, as *mathematical a priori knowers* of mathematical axioms and mathematical truths, arguably by means of *mathematical intuition* (Hanna, 2015: chs. 6–8), but also primitive sources of natural creativity, as *rational human free agents*, arguably by means of *deep freedom of the will* and *non-instrumental practical agency* (Hanna, 2018a, b, 2020).

In this chapter, I'll assume the soundness of that argument for the purposes of developing a further line of thinking that importantly elaborates and extends that argument. More precisely, what I want to argue in this chapter is that if we assume that the Standard Models in contemporary physics are incomplete, and if we also assume that all rational human animals are primitive sources of natural creativity via their free agency, then, by means of an appeal to a non-deterministic version of

Bohmian mechanics, together with the thesis that all rational human animals are primitive sources of natural creativity via their free agency, *we can complete quantum mechanics* (QM).

6.2 Some Definitions

Again for clarity's sake, I'll define or re-define some terminology.

By *the Standard Models in contemporary physics*, again I mean the current Standard Model of Cosmology (SMC), together with a proper sub-part of SMC, the current Standard Model of Particle Physics (SMPP), as per the non-technical description by B.A. Robson that I've already quoted in Sect. 4.2 (Robson, 2019). Correspondingly, by *Bohmian mechanics*, I mean a certain version of QM, as per this non-technical description by Sheldon Goldstein:

Bohmian mechanics, which is also called the de Broglie-Bohm theory, the pilot-wave model, and the causal interpretation of quantum mechanics, is a version of quantum theory discovered by Louis de Broglie in 1927 and rediscovered by David Bohm in 1952. It is the simplest example of what is often called a hidden variables interpretation of quantum mechanics. In Bohmian mechanics a system of particles is described in part by its wave function, evolving, as usual, according to Schrödinger's equation. However, the wave function provides only a partial description of the system. This description is completed by the specification of the actual positions of the particles. The latter evolve according to the "guiding equation," which expresses the velocities of the particles in terms of the wave function. Thus, in Bohmian mechanics the configuration of a system of particles evolves via a deterministic motion choreographed by the wave function. In particular, when a particle is sent into a two-slit apparatus, the slit through which it passes and its location upon arrival on the photographic plate are completely determined by its initial position and wave function.

Bohmian mechanics inherits and makes explicit the nonlocality implicit in the notion, common to just about all formulations and interpretations of quantum theory, of a wave function on the configuration space of a many-particle system. It accounts for all of the phenomena governed by nonrelativistic quantum mechanics, from spectral lines and scattering theory to superconductivity, the quantum Hall effect and quantum computing. In particular, the usual measurement postulates of quantum theory, including collapse of the wave function and probabilities given by the absolute square of probability amplitudes, emerge from an analysis of the two equations of motion: Schrödinger's equation and the guiding equation. No invocation of a special, and somewhat obscure, status for observation is required. (Goldstein 2021)

And finally, by *a better scientific theory*, I mean what's crisply spelled out by the popular physics writer Ethan Siegel:

Every once in a while, a revolutionary idea comes along that has the potential to supersede our best scientific ideas of the day. This happened numerous times in theoretical physics during the 20th century, as Einstein's General Relativity replaced Newtonian gravity, quantum physics replaced our classical view of the Universe, and the quantum field theory-based Standard Model superseded the early-20th century version of our quantum Universe.

Over the past half-century, many novel ideas have sought to surpass the current limitations plaguing theoretical physics, from supersymmetry to extra dimensions to grand unification to quantum gravity to string theory. The ultimate idea of many is to arrive at one unified theory of everything: where one framework elegantly encompasses the entirety of nature’s laws....

When we use the word “theory” in a conventional sense, we talk about it the same way we’d talk about the word “idea” or “hypothesis.” We mean that sure, we have our conventional way of thinking about things that we generally accept, but maybe things are actually this other way instead.

To a scientist, though, a theory is a far more powerful thing than that. It’s a self-consistent framework that has the quantitative power to predict the outcomes (or sets of probable outcomes) of a large set of systems under a wide variety of conditions.

A successful, established theory goes even farther. It contains a large suite of predictions that agree with established experiments and/or observations. It’s been tested in a large number of independent ways, and has passed every test thus far. It has a range of validity that’s well-understood, and it’s also understood that the theory may not be valid outside of that particular range.

Which means, if you want to surpass that theory in a scientific sense, you have a tall order ahead of you. You have to do better than the old theory that you’re seeking to replace with your new idea, and that means you have to take these three very difficult steps.

You have to reproduce all the successes of the currently prevailing theory; your new idea must succeed in all the places where the prior one succeeds.

You need to explain at least one existing observation or measurement that the current theory struggles with; you have to demonstrate why this new idea is more compelling than the one it’s seeking to replace.

You need to make at least one new prediction that differs from the leading theory’s predictions that you can then go out and measure; if your new idea is right, there must be a way to validate or refute it.

This is asking a lot, and most new ideas never make it this far. (Siegel, 2020)

6.3 A “New Idea” About Quantum Mechanics

Now, here’s an eleven-step line of thought that puts forward a “new idea” in Siegel’s sense about QM by conjoining a non-deterministic version of Bohmian mechanics and the thesis that all rational human animals are primitive sources of natural creativity via their free agency.

1. I’ll start off by distinguishing between three fundamentally different kinds of natural process: (i) a *deterministic* process, i.e., an entropic process that’s time-reversible, aka “block-world,” and its basic quantities are Turing-computable from initial conditions/facts about the past together with The Conservation Laws, the First and Second Laws of Thermodynamics, and specific non-probabilistic/non-stochastic laws of nature), (ii) an *indeterministic* process, i.e., a entropic process that’s time-reversible/block-world, and its basic quantities

are Turing-computable from initial conditions/facts about the past together with The Conservation Laws, the First and Second Laws of Thermodynamics, and specific probabilistic/stochastic laws of nature), and (iii) a *non*-deterministic and *non*-indeterministic process, aka a *naturally creative* process, i.e., a process that's time-irreversible, *anti*-block-world, *negentropic*, and *non*-equilibrium thermodynamic, and its basic quantities are *not* Turing-computable from initial conditions/facts about the past together with The Conservation Laws, the First and Second Laws of Thermodynamics, and either specific non-probabilistic/stochastic laws or specific probabilistic/stochastic laws, due to complexity and self-organization.

2. Then I'll define a *mechanical process* as a natural entropic process that's either deterministic or indeterministic, hence it's time-reversible/block-world and its basic quantities are Turing-computable from initial conditions, The Conservation Laws, The First and Second Laws of Thermodynamics, and other specific natural laws.
3. In order to avoid possible misunderstandings, I note that the definitions of deterministic and indeterministic natural processes I've used here are somewhat stronger than would be needed to define *universal natural determinism* and *universal natural indeterminism* in the free will debate, since there can also be time-irreversible/anti-block world determinism and indeterminism alike. But in this context it's not the free will debate per se that's my primary target—rather, my primary target is the debate about the Bohmian hidden variables interpretation of quantum mechanics, and how Bohmian mechanics could be combined with the thesis that all rational human animals are primitive sources of natural creativity via their free agency.
4. As per step 1, I'm defining a *naturally creative process* as a complex, self-organizing, time-irreversible, Turing-incomputable non-equilibrium thermodynamic process that also obeys The Conservation Laws, including The First Law of Thermodynamics—so, no new matter/energy is created, and none that already exists is lost—but *also* systematically creates negentropy (i.e., it reverses or negates entropy) by spontaneously structuring/restructuring or shaping/reshaping the dynamic patterns of matter/energy flow, hence it's not entailed or necessitated by The Second Law of Thermodynamics.
5. Furthermore, an *organism* is a certain special kind of naturally creative process, namely, an “autopoietic” one in Varela, Maturana, and Uribe's terminology (Varela et al. 1974), that self-organizes in such a way that it produces a membrane separating its inner or endogenous states and its interdependent proper parts, from its outer or exogenous interactions and relationships with the environment, and strives to maintain a homeostatic balance between its endogenous states and its exogenous interactions and relationships. Obviously, rational human animals are *also* organisms, hence they are *also* themselves naturally creative processes, *in addition* to being, by hypothesis, primitive sources of natural creativity via their free agency.
6. Now let's consider Bohmian mechanics, and also, relatedly, Prigogine's time-irreversible/anti-block-world attempt to create a unified formulation of quan-

tum mechanics using non-equilibrium thermodynamics (Prigogine, 1997: ch. 6). More specifically, let’s consider Bohmian mechanics and the hidden variables interpretation as a way of avoiding (i) the mysterious intervention of the observer in producing the “collapse of the wave function,” and correspondingly also (ii) the Copenhagen interpretation of quantum mechanics.

7. I’m generally in agreement with the hidden variables interpretation. But it seems to me that Bohm was importantly mistaken in thinking that every version of the hidden variables theory reintroduces *deterministic* natural processes. Indeed, it also seems to me more generally that a characteristic feature of philosophical and natural-scientific debates about mechanistic physics and about the free will problem *alike*, is a basic confusion between at least two different senses of “deterministic process”: (i) *deterministic process*₁, which means a time-reversible/block-world entropic natural process that precisely fixes a causal outcome across a set of alternative relevant possible future worlds, as entailed or necessitated by The Conservation Laws, The First and Second Laws of Thermodynamics, and specific non-probabilistic/non-stochastic laws of nature together with initial conditions/facts about the past, and (ii) *deterministic process*₂, which means a time-irreversible/non-block-world negentropic natural process that precisely fixes a causal outcome in the actual-world-sequence *only*. But a time-irreversible/non-block-world negentropic natural process that precisely fixes an outcome in the actual-world-sequence *only*, i.e., a deterministic process₂, can be (a) a naturally creative process, therefore (b) *not* a deterministic₁ process, and *also* (c) exemplify deeply responsible rational human free agency: such processes are what I’ll call *self-determining*.

This is shown by (Harry) Frankfurt-style counterexamples to The Principle of Alternative Possibilities, aka PAP, about responsibility (PAP: necessarily, responsibility requires alternative possibilities of choice and action) (Frankfurt, 1988b), together with a broadly Frankfurt-style hierarchical-desire conception of the will and freedom of the will (Frankfurt, 1988a, 1988b, 1988c, 1988d, 2004), but without compatibility with determinism at the source of agency, aka *source-incompatibilism*. So I’m talking about a broadly Frankfurt-style conception of rational human free agency (i.e., free will plus practical agency, including deep responsibility, not just free will) that’s also source-incompatibilist.

The distinction between the two importantly different senses of “deterministic process” can be usefully redescribed as the distinction between natural processes that exhibit either (i) *classical determinism* or (ii) *naturally creative non-determinism*, including *self-determination*. Naturally creative non-deterministic processes, including self-determination, precisely fix quantitative (and qualitative) outcomes in nature *in the actual-world-sequence only*, without those outcomes either being *entailed or necessitated by*, or *Turing-computable by virtue of*, The Conservation Laws, The First and Second Laws of Thermodynamics, and specific non-probabilistic/non-stochastic laws of nature together with initial conditions/facts about the past, although naturally creative non-determinism, including self-determination, is still *consistent with and not*

in violation of any natural laws there are—apart, of course, from The Second Law of Thermodynamics, which is *not* universally true if (as I'm supposing) non-equilibrium thermodynamics *is* universally true. Again: *consistency with and non-violation of* the natural laws is sharply distinct from *entailment or necessitation by* the natural laws. Then I can say that according to the broadly Frankfurt-style source-incompatibilist conception of deeply responsible free agency that I'm talking about, rational human free agency *inherently involves naturally creative self-determination*, and thereby is characterized by neither classical determinism nor indeterminism.

8. Bell's Theorem, I think, is often or even usually taken to undermine *all* hidden variables theories; but in my opinion, actually what it undermines is only *local* hidden variables theories. So for the purposes of my present argument, let's assume *that* to be so (i.e., that Bell's Theorem undermines only local hidden variables theories). Then, if one is prepared to accept non-locality/entanglement/complementarity, it follows that one can still accept *non-local* hidden variables; and if the non-local hidden variables are *naturally creative processes*, especially including living organisms, amongst which are rational human animals and their *naturally creative self-determining processes*, it also follows that all the quantum facts can be explained using Bohmian mechanics and non-deterministic/non-indeterministic processes, and an irreversible time/anti-block world approach.
9. Relatedly, The Kochen-Specker Theorem, I think, is also often or even usually taken to undermine *all* hidden variable theories; but in my opinion, actually what it undermines is *only* those hidden variable theories that accept these three assumptions:

Value Realism (VR): If there is an operationally defined real number α , associated with a self-adjoint operator \underline{A} and if, for a given state, the statistical algorithm of QM for \underline{A} yields a real number β with $\beta = \text{prob.}(v(\underline{A}) = \alpha)$, then there exists an observable A with value α .

Value Definiteness (VD): All observables defined for a QM system have definite values at all times.

Noncontextuality (NC): If a QM system possesses a property (value of an observable), then it does so independently of any measurement context. (Held, 2018: section 4)

But if one postulates, as I do, non-local hidden variables that are naturally creative processes, especially including living organisms, amongst which are rational human animals and their naturally creative self-determining processes, then since these sorts of naturally creative processes *inherently belong to, and are therefore inherently sensitive to, the measurement context of any quantum mechanical system*, then I can deny **Noncontextuality** and also assert a special, naturally creative kind of **Contextuality**, *consistently with* The Kochen-Specker Theorem.

10. *Quantum superposition* is the ability of a microphysical thermodynamic system to be in at least two different states at the same time, until resolved by the act of experimental measurement or observation. More explicitly:

Imagine touching the surface of a pond at two different points at the same time. Waves would spread outward from each point, eventually overlapping to form a more complex pattern. This is a superposition of waves. Similarly, in quantum science, objects such as electrons and photons have wavelike properties that can combine and become what is called superposed. While waves on the surface of a pond are formed by the movement of water, quantum waves are mathematical. They are expressed as equations that describe the probabilities of an object existing in a given state or having a particular property. The equations might provide information on the probability of an electron moving at a specific speed or residing in a certain location. When an electron is in superposition, its different states can be thought of as separate outcomes, each with a particular probability of being observed. An electron might be said to be in a superposition of two different velocities or in two places at once.... The concept of quantum superposition might be difficult to visualize. Traditional descriptions have used the analogy of a coin that is heads up and tails up at the same time, or the famous Schrödinger’s cat thought experiment, in which physicist Erwin Schrödinger imagined placing a cat in a sealed box along with a poisonous substance that has an equal chance of killing the cat—or not—within an hour. Schrödinger proposed that, at the end of the hour, the cat could be said to be both alive *and* dead, in a superposition of states until the box is opened, and that the act of observation randomly determines whether the cat is alive *or* dead. Schrödinger intended the example to demonstrate what he saw as the absurdity of quantum science. In mathematical terms, superposition can be thought of as an equation that has more than one solution. When we solve $x^2 = 4$, x can either be 2 or -2 . Both answers are correct. Superposed wave functions will be more complicated to solve, but they can be approached with the same mindset. (Caltech, 2023)

In my opinion, the structure of quantum superposition, resolved by experimental measurement or observation—aka the “collapse” of Schrödinger’s wave function—is essentially analogous to Frankfurt-style thought-experimental counterexamples to PAP, with the actual world of the experimental situation *apart from* the experimenter/observer playing the role of Black (the counterfactual intervener who never actually has to intervene, but if he *did* have to intervene, *would have* collapsed/shut down the relevant alternative) and the experimenter/observer playing the role of Jones₄ (the free chooser who never needs the relevant but counterfactually collapsed/shut-down alternative, because he has already selected the outcome Black wants). The moral of the Frankfurt cases, as I see it, is that PAP is *not* required for moral responsibility by way of the act of self-commitment required by free agency. And the essentially analogous moral of quantum superposition as resolved by the act of experimental measurement or observation, is that what precisely fixes the experimental/observational outcome is *a set of natural processes including but not restricted to the act of measurement or observation*. Since there’s always an actual experimenter/observer involved, they would be *a proper part* of the relevant natural processes, but not *solely* responsible for what precisely fixes the experimental/observational outcome.

This in turn would reconcile the “pared-down truth” of the Copenhagen interpretation of QM (the experimenter/observer indeed *necessarily belongs to* what is doing the physical and metaphysical work, *but without either intervention or requiring indeterminism*) and also the “pared-down truth” of the Bohmian hidden variables interpretation of QM (hidden variables are indeed doing the physical and metaphysical work, *yet not only are they non-local, they also don’t require classical determinism and they’re measurement-context-sensitive*). To be sure, you *still* have

pervasive complementarity/entanglement/non-locality, but, as I indicated in Chap. 4 (see also Chap. 12 below), it also seems to me that complementarity/entanglement/non-locality is simply *a pervasive feature of the manifestly real cosmos at all basic scales, insofar as it contains non-mechanical, organic physical processes and systems.*

Q: Where does STR-GTR, aka the relativity view, fit into all this?

A: You get the relativity view by narrowing formal and natural scientific attention to deterministic₁ natural processes and light-constrained causality, supplemented by gravitation, and also by imposing a 4-D non-Euclidean/Riemannian block-world picture that commits chronocide by turning real dynamic/processual time into something that's fully "spatialized" and reversible. So, just as classical Newtonian mechanics (NM) shows up as a restricted or special case under STR-GTR, so too STR-GTR shows up as a restricted or special case under the Bohmian-mechanics-plus-natural-creativity (BMPNC) transformation of classical Schrödinger (et al.)-style quantum mechanics plus quantum field theory (CQM + QFT): hence the transformative theoretical progression is $NM \rightarrow STR-GTR \rightarrow (CQM + QFT) \rightarrow BMPNC$, and each right-facing arrow also implies proper containment of every theory to the left of it.

11. The Big Bang Singularity happened 9 billion years before unicellular organismic life emerged on Earth, roughly 4 billion years ago. But it's at least logically, metaphysically, and nomologically possible that unicellular organismic life could have emerged elsewhere in the natural universe quite a while before that. So I'm proposing (i) that all the non-local hidden variables for supplementing the Schrödinger equation are *either non-living or living naturally creative (including, in the case of rational human animals, self-determining) processes*, and (ii) that the non-living naturally creative processes were immediately produced by The Big Bang Singularity during the period of cosmic expansion, which then later gradually evolved into *living* processes, i.e., *organismic*, naturally creative processes, at least 4 billion years ago, and then later they evolved into *minded* organismic naturally creative processes, including the self-determining processes of rational human animals, who, as primitive sources of natural creativity, are capable of broadly Frankfurt-style source-incompatibilist deeply responsible rational human free will and practical agency, less than a billion years ago.

6.4 An Experimental Argument Using My "New Idea" About Quantum Mechanics

Now, building on that eleven-step line of thought, I want to work out *an experimental argument* using the "new idea" about QM that I spelled out in Sect. 6.3.

The famous "two-slit experiment," which shows that light and matter can display the behavior of both particles and waves alike, has its origins in Thomas Young's

1801 experiment, which demonstrated that light has wave-like properties. Later, in the early twentieth century, it was shown that light displays both particle-like properties and wave-like properties, a result that was later extended to electrons by Davisson and Gerner in 1927, and then eventually to atoms, molecules, and particles of all kinds by other researchers. The two-slit experiment is a sub-species of double-path experiments that divide a wave into two distinct waves and create an interference pattern, which is then recombined into a single wave, as per, for example., Fig. 6.1 below. A classic version is the Mach-Zehnder interferometer, which uses a mirror to divide a beam of light that’s sent from a single source and projected on a plate containing two slits that are in effect enantiomorphs of one another. Moreover, and most importantly, when detectors are set up at the slits, (i) the detection of particle impacts is fundamentally probabilistic, (ii) detected particles pass through one slit only, and (iii) the wave interference pattern is destroyed whenever the experimental measurement is made (i.e., the so-called “collapse of the wave function”). This exemplifies the general principle of wave-particle duality, which holds for all quantum level phenomena.

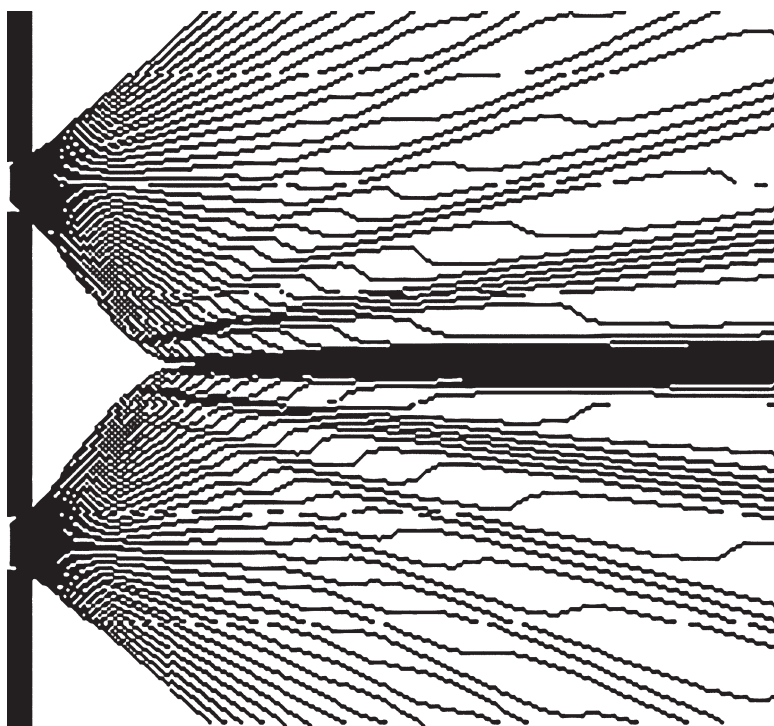


Fig. 6.1 An ensemble of trajectories for the two-slit experiment, uniform in the slits. (Wikimedia Commons, 2006)

As Sheldon Goldstein points out:

The [two]-slit experiment (and its variations) has become a classic thought experiment, for its clarity in expressing the central puzzles of quantum mechanics. [According to Richard Feynman, b]ecause it demonstrates the fundamental limitation of the ability of the observer to predict experimental results, the two-slit experiment for electrons is

a phenomenon which is impossible, *absolutely* impossible, to explain in any classical way, and which has in it the heart of quantum mechanics. In reality it contains the *only* mystery. (Feynman et al. 1963: p. 37)

This experiment has been designed to contain all of the mystery of quantum mechanics, to put you up against the paradoxes and mysteries and peculiarities of nature one hundred per cent. (Feynman, 1967: p. 130)

As to the question,

How does it really work? What machinery is actually producing this thing? Nobody knows any machinery. Nobody can give you a deeper explanation of this phenomenon than I have given; that is, a description of it. (Feynman, 1967: p. 145)

But Bohmian mechanics is just such a deeper explanation. It resolves in a rather straightforward manner the dilemma of the appearance of both particle and wave properties in one and the same phenomenon: Bohmian mechanics is a theory of motion describing a particle (or particles) guided by a wave. Here we have a family of Bohmian trajectories for the two-slit experiment.

While each trajectory passes through only one slit, the wave passes through both; the interference profile that therefore develops in the wave generates a similar pattern in the trajectories guided by the wave.

Compare Feynman's presentation with Bell's:

Is it not clear from the smallness of the scintillation on the screen that we have to do with a particle? And is it not clear, from the diffraction and interference patterns, that the motion of the particle is directed by a wave? De Broglie showed in detail how the motion of a particle, passing through just one of two holes in a screen, could be influenced by waves propagating through both holes. And so influenced that the particle does not go where the waves cancel out, but is attracted to where they cooperate. This idea seems to me so natural and simple, to resolve the wave-particle dilemma in such a clear and ordinary way, that it is a great mystery to me that it was so generally ignored. (Bell, 1987c: p. 191)

Perhaps the most puzzling aspect of the two-slit experiment is the following: If, by any means whatsoever, it is possible to determine the slit through which the particle passes, the interference pattern will be destroyed. This dramatic effect of observation is, in fact, a simple consequence of Bohmian mechanics. To see this, one must consider the meaning of determining the slit through which the particle passes. This must involve interaction with another system that the Bohmian mechanical analysis must include. The destruction of interference is related, naturally enough, to the Bohmian mechanical analysis of quantum measurement [Bohm, 1952]. It occurs via the mechanism that in Bohmian mechanics leads to

the “collapse of the wave function.” (Goldstein, 2021: section 6; square bracketed material added)

For our purposes, so much for the two-slit experiment.

Now, I want to describe an experiment designed to be *essentially analogous to the two-slit experiment*, that I call *the two-mirror experiment*.

First, construct a double-mirror by attaching two identical square mirrors to one another at one of their edges, so that that they form a right angle, and then place the double-mirror on a flat table in a well-lit room.

Second, place a Firestone Walker Union Jack IPA (or any other ordinary aluminum) beer can in the corner of the double-mirror, thereby creating two enantiomorphic (i.e., point-for-point and qualitative-property-for-qualitative-property identical, but topologically reversed in “handedness,” and therefore incongruent) images of the beer can on the surfaces of the two mirrors: the dual images are a superposition of that system.

Third, place a healthy, mature rational human animal—let’s call them “Freddy”—directly in front of the beer can, equidistant from both mirrors, such that, without having to change their location or extend either of their arms beyond a simple relaxed pointing gesture, Freddy is equally able to touch the right hand mirror at the location of the right hand beer can image with the index finger of their right hand, or the left hand mirror at the location of the left hand beer can image with the index finger of their left hand.

Fourth, Freddy is instructed to *either* (i) utter “right” and then touch the corresponding right hand beer can image with their right index finger *or* (ii) utter “left” and then touch the corresponding left hand beer can image with their left index finger.

Fifth, Freddy spontaneously and freely carries out the instructions.

In this essential analogy to the two-slit experiment, Freddy together with Freddy’s intentional act correspond to *the Bohmian “wavicle”* (Eddington, 1929: p. 201), i.e., the Bohmian “pilot wave,” and the enantiomorphic mirror images—which, by hypothesis, are physically identical *except for* their topologically reversed handedness—correspond to *the double path*. As per the two-slit experiment and the Standard Models, it’s impossible to predict which beer can image will be touched. As per unmodified Bohmian mechanics, however, *the hidden variables* determine which beer can image will be touched. But as per non-deterministic Bohmian mechanics *plus* the thesis that all rational human animals are primitive sources of natural creativity via their free agency, then Freddy together with Freddy’s intentional act just *are* the relevant (non-local, measurement-context-sensitive) hidden variables. And Freddy, the rational human animal, can *always* predict *exactly which image will be touched*, simply by spontaneously and freely uttering “right” or “left” and then reaching out with their right arm and hand, or with their left arm and hand, respectively, and touching the right hand beer can image or left hand beer can image with their right or left index finger, respectively.

Let's now recall Siegel's crisp formulation of the three independently necessary and collectively sufficient criteria of what makes a new scientific theory **T2** count as *a better scientific theory* than a currently prevailing theory **T1**:

You have to reproduce all the successes of the currently prevailing theory; your new idea must succeed in all the places where the prior one succeeds.

You need to explain at least one existing observation or measurement that the current theory struggles with; you have to demonstrate why this new idea is more compelling than the one it's seeking to replace.

You need to make at least one new prediction that differs from the leading theory's predictions that you can then go out and measure; if your new idea is right, there must be a way to validate or refute it. (Siegel, 2020)

Some or another version of Bohmian mechanics satisfies criterion 1. And non-deterministic-Bohmian-mechanics-plus-the-thesis-that-all-rational-human--animals-are-primitive-sources-of-natural-creativity-via-their-free-agency satisfies criterion 2 and criterion 3. Therefore, according to the generally-accepted criteria of what counts as a better scientific theory, non-deterministic-Bohmian-mechanics-plus-the-thesis-that-all-rational-human-animals-are-primitive-sources-of-natural-creativity-via-their-free-agency *is a better scientific theory than the Standard Models*.

Q: If, by using explanatory methods based on mechanical principles alone, you've explained everything about physical nature that you can possibly explain, but this explanation is still *incomplete*, then what's left over?

A: In the actual world, in addition to all natural mechanical systems, there's *also* a multiplicity of primitive sources of naturally creative processes that include, but are not restricted to, all living organisms, including rational human animals. Such actual-sequence, naturally creative self-determining processes *cannot* be explained *mechanically* by means of the Standard Models in contemporary physics; but they *can* be scientifically explained *non-mechanically*, by means of non-deterministic Bohmian mechanics together with the thesis that all rational human animals are primitive sources of natural creativity via their free agency.

Let me now briefly explain how this can *be*—pun fully intended.

John S. Bell's conception of physical theories, especially including QM, prominently features the notion of a *beable*:

"Beable" is Bell's term for those elements of a theory which are "to be taken seriously, as corresponding to something real." (Bell, 1987d: p. 239)

The beables of a theory have values that (according to the theory) are supposed to exist independently of any observation or experiment. In this regard Bell contrasts the notion of beable with the notion of "observable" which features prominently in orthodox quantum theory:

The concept of "observable" lends itself to very precise *mathematics* when identified with "self-adjoint operator." But physically, it is a rather woolly concept. It is not easy to identify precisely which physical processes are to be given the status of "observations" and which are to be relegated to the limbo between one observation and another. So it could be hoped that some increase in precision might be possible by concentration on the *beables*, which

can be described in “classical terms,” because they are there. [Bell, 1987b: p. 52, italics in the original]. (Goldstein et al. 2011; square bracketed material added)

Correspondingly, my proposal for scientifically explaining actual-sequence, absolutely unique naturally creative processes, whether organismic or non-organismic, is for the physicist to imagine *what it’s like to be* a naturally creative Bohmian beable, i.e., one or another of the naturally creative Bohmian non-local, measurement-context-sensitive hidden variables, and then experimentally measure whatever can be experimentally measured.

This idea of “what-it’s-like-to-be,” of course, draws directly on Thomas Nagel’s famous essay, “What Is It Like To Be a Bat?” (Nagel, 1979). But it also significantly extends Nagel’s seminal idea of an actual or imagined first-person point-of-view (what-it’s-like-to-be an *X*) from *minded* living organisms, whether non-rational or rational, to *non-minded* living organisms, to *non-minded, non-living* naturally creative processes and systems. In other words, what I’m proposing is that in order to explain actual-sequence, absolutely unique naturally creative processes and systems, the quantum physicist must either (i) by an act of imaginative projection, place themselves *inside* the naturally creative Bohmian non-local hidden variables, construed as beables, thereby empathically mirroring their “Bohmian-beable wavi-
cle’s-eye point of view” (in the non-organismic case) or their “Bohmian-beable organism’s-eye point of view” (in the case of non-minded or minded but non-rational living organisms) and ask themselves *precisely how* the beable itself creatively manages the delicate (non-organismic or organismic) homeostatic balance—thereby creating negentropy—between its inner states and its outer environment, via the causal powers of its (non-organismic or organismic) bodily membrane, and then experimentally measure whatever can be experimentally measured, or (ii) like Freddy, one can simply *be* that (macroscopic) naturally creative Bohmian beable, engage in successful/true predictions via rational human free agency, and then experimentally measure whatever can be experimentally measured.

Let’s call the first sub-method *empathic mirroring*, and the second sub-method *consciousness* (aka, “subjective experience”) (see also Hanna & Maiese, 2009: esp. chs. 1–2). In this sense, anyone’s spontaneously freely-willed intentional bodily performance (say, Freddy’s uttering “right” and then touching the right hand beer can image with their right index finger) is *the paradigm of a successful/true prediction*, precisely because what is *imagined* in the empathic mirroring sub-method (for example, what-it’s-like-to-be a naturally creative Bohmian beable, i.e., one or another of the non-local, measurement-context-sensitive hidden variables that precisely determine₂ the evolution of the wave function according to Schrödinger’s equation) is actually *realized* in the sub-method consisting in one’s own consciousness or subjective experience of free agency.

In 1905, Einstein remembered himself, at age 16, imagining himself *chasing* a beam of light, which in turn directly led to his discovery of the basic idea of special relativity:

How could we be anything but charmed by the delightful story Einstein tells in his *Autobiographical Notes* of a striking thought he had at the age of 16? While recounting the efforts that led to the special theory of relativity, he recalled

a paradox upon which I had already hit at the age of sixteen: If I pursue a beam of light with the velocity c (velocity of light in a vacuum), I should observe such a beam of light as an electromagnetic field at rest though spatially oscillating. There seems to be no such thing, however, neither on the basis of experience nor according to Maxwell's equations. From the very beginning it appeared to me intuitively clear that, judged from the standpoint of such an observer, everything would have to happen according to the same laws as for an observer who, relative to the earth, was at rest. For how should the first observer know or be able to determine, that he is in a state of fast uniform motion? One sees in this paradox the germ of the special relativity theory is already contained. (Norton, 2013: p. 123)

Similarly, as a post-Einsteinian, post-Standard-Models, non-mechanistic/neo-organicist Bohmian physicist, you can imagine yourself *being* one or another of the naturally creative non-local, measurement-context-sensitive hidden variables that satisfy the Schrödinger equation for the evolution of the wave function, which, by means of “your”/its naturally self-determining non-equilibrium thermodynamic activity, *body-surfs the non-deterministic Bohmian wavicle/pilot wave* as it flows through the two-slit device in the two-slit experiment, thereby fixing all the relevant measurable quantities in nature, all the way down to their maximum level of fineness.

6.5 Conclusion

In short, and to conclude this chapter, my “new idea” about quantum mechanics (QM) is that the non-deterministic-Bohmian-beables, i.e., the naturally creative non-local, measurement-context-sensitive hidden variables—including, but not restricted to organisms and their activities, including rational human free agency—successfully/truly *predict* the evolution of the wave function by just *being themselves*, followed by experimental measurement of whatever can be experimentally measured, and *that* (and *that alone*) completes QM.

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Chapter 7

Can Physics Explain Physics? Anthropic Principles and Transcendental Idealism



Abstract In this chapter, I argue that contemporary physics, understood as a natural science that's committed to the Standard Models of cosmology and particle physics, can explain itself only if it supplements the Standard Models by affirming a philosophically defensible and scientifically respectable version of The Anthropic Principle that's also equivalent with a suitably weak version of Kant's metaphysics of transcendental idealism.

Science is a dialogue between [hu]mankind and nature, the results of which have been unpredictable. At the beginning of the twentieth century, who would have dreamed of unstable particles, an expanding universe, self-organization, and dissipative structure? But what makes this dialogue possible? A time-reversible world would also be an unknowable world. Knowledge presupposes that the world affects us and our instruments, that there is an interaction between the knower and the known, and that this interaction creates a difference between past and future. Becoming is the *sine qua non* of science, and indeed, of knowledge itself. (Prigogine, 1997: p. 153)

7.1 Introduction

Can contemporary physics, understood as a natural science that's committed to the Standard Models of cosmology and particle physics, explain *itself*? Yes, but *only if* it supplements the Standard Models by affirming a philosophically defensible and scientifically respectable version of The Anthropic Principle that's *also* equivalent with a suitably weak version of Kant's metaphysics of transcendental idealism. Or so I'll argue in this chapter.

7.2 Some Definitions and Glosses

Again, by *the Standard Models in contemporary physics*, I mean the current Standard Model of Cosmology (SMC), together with a proper sub-part of SMC, the current Standard Model of Particle Physics (SMPP), as per the non-technical

description by B.A. Robson that I've already quoted in Sect. 4.2 (Robson, 2019). Correspondingly, here's an informative non-technical gloss of The Anthropic Principle.

We could not possibly have existed in conditions that are incompatible with the existence of observers. The famous *weak anthropic principle* (WAP) ... suggests that this apparently trivial point may have important consequences:

[W]e must be prepared to take account of the fact that our location in the universe is *necessarily* privileged to the extent of being compatible with our existence as observers. [Carter, 1974: p. 293, Carter's emphasis]

Our methods of empirical observation are unavoidably *biased* towards detecting conditions which are compatible with the existence of observers. For example, even if life-hostile places vastly outnumber life-friendly places in our universe, we should not be surprised to find ourselves in one of the relatively few places that are life-friendly and seek an explanation for this finding, simply because—in virtue of being living organisms—we could not possibly have found ourselves in a life-hostile place. Biases that result from the fact that what we observe must be compatible with the existence of observers are referred to as *observation selection effects*. The observation selection effects emphasized by the weak anthropic principle with respect to location in the universe are emphasized by what Carter dubs the *strong anthropic principle* (SAP) with respect to the universe as a whole:

[T]he Universe (and hence the fundamental parameters on which it depends) must be such as to admit within it the creation of observers within it at some stage. (Carter, 1974: p. 294)

Carter's formulation of the SAP has led some authors, most influentially Barrow and Tipler [Barrow & Tipler, 1986], to misinterpret it along teleological lines and as thereby categorically different from the WAP. (Simon, 2018, bracketted material added)

The philosophical upshot, so far, is threefold.

First, both versions of The Anthropic Principle—i.e., weak (WAP) and strong (SAP)—go significantly *beyond* what's contained in the Standard Models per se, by requiring *an asymmetric or irreversible, forward-directed arrow of time*, and therefore also requiring *the manifest reality of time* (Prigogine, 1997; Smolin, 2013, 2014). Moreover, if, as per the epigraph of this chapter, Prigogine is correct (and I think that he is), then postulating the manifest reality of an asymmetric or irreversible, forward-directed arrow of time, is a necessary condition of adequately explaining human scientific knowledge.

Second, although there are various possible interpretations of WAP, I'm going to interpret it as the thesis *that our nomological possibility as a biological species is built into in the natural world from The Big Bang forward*. It's especially to be noted that WAP is consistent with various versions of metaphysical materialism/physicalism, universal natural determinism, universal natural indeterminism, and universal natural mechanism.

Third, although there are also various possible interpretations of SAP, some of which take SAP to be consistent with WAP, I'm going to interpret SAP as the categorically distinct thesis *that the nomological or metaphysical necessity of our existence as sentient, sapient minded animals is built into the natural world from The Big Bang forward*. It's especially to be noted that WAP is consistent with classical theism and the existence of a "3-O" creator-God: omnipotent, omniscient, and omnibenevolent.

7.3 The Moderate Anthropic Principle

Now, given (i) that we actually exist, (ii) that we also know *a priori* that our actual existence logically follows from the fact of our conscious and self-conscious thinking (the Cartesian *Cogito*: necessarily, if I'm thinking, then I actually exist), (iii) that the manifestly real natural universe actually exists, and (iv) that the manifestly real natural universe actually existed long before rational "human, all-too-human" minded animals began to exist as a biological species, then since actuality entails possibility, it follows that we cannot be either logically, metaphysically, or nomologically *impossible*. Or otherwise and now positively put, necessarily, given that we actually exist and also know *a priori* that our actual existence follows from the fact of our conscious and self-conscious thinking, then *the manifestly real natural universe, from The Big Bang forward, structurally contains our real possibility as rational "human, all-too-human" minded animals*. This is what I call *The Moderate Anthropic Principle*, aka MAP.

MAP is categorically *stronger* than WAP, because MAP entails the denial of metaphysical materialism/physicalism, universal natural determinism, universal natural indeterminism, and universal natural mechanism alike. But MAP is also categorically *weaker* than SAP, since MAP rules out any version of classical theism. Indeed, and perhaps surprisingly, MAP is necessarily equivalent with a suitably weak version of Kant's metaphysics of transcendental idealism. Let me explain.

What I'm talking about—see also Chap. 2, footnote 8 above—is what I call *weak transcendental idealism*, aka WTI, which is my interpretation of a doctrine that Kant presented and defended in the *Critique of Pure Reason* in order to explain the real possibility of *a priori* or non-empirical necessary truth and knowledge in logic, mathematics, metaphysics, and natural science, as well as the real possibility of *a posteriori* or empirical/observational contingent truth and knowledge in natural science.

According to Kant, a mental representation is *transcendental* when it's either part of, or derived from, our non-empirical (hence *a priori*) innately specified spontaneous cognitive capacities. Then transcendental idealism can be stated as a two-part philosophical equation: **transcendental idealism = representational transcendentalism + cognitive idealism**, as per the following definitions.

- (i) **Representational Transcendentalism:** necessarily, all the forms or structures of rational human cognition are generated *a priori* by the empirically-triggered, yet stimulus-underdetermined, activities of our innately specified spontaneous cognitive capacities, i.e., cognitive competences, cognitive faculties, or cognitive powers. (*CPR* A11/B25 and *Prol* 4: 373n.)
- (ii) **Cognitive Idealism:** necessarily, all the proper objects of rational human cognition are nothing but sensory appearances or phenomena, i.e., mind-dependent, spatiotemporal, directly perceivable, manifestly real objects, and never things-in-themselves or noumena, i.e., mind-independent, non-sensible, non-spatiotemporal, real essences constituted by intrinsic non-relational properties. (*CPR* A369 and *Prol* 4: 293–294, 375)

Now (i) + (ii) also = Kant's "Copernican revolution" in metaphysics:

Up to now it has been assumed that all our cognition must conform to the objects; but all attempts to find out something about them *a priori* through concepts that would extend our cognition have, on this presupposition, come to nothing. Hence let us once try whether we do not get farther with the problems of metaphysics by assuming that the objects must conform to our cognition, which would agree better with the requested possibility of an *a priori* cognition of them, which is to establish something about objects before they are given to us. This would be just like the first thoughts of Copernicus.... (*CPR* Bxvi),

which I will rationally reconstruct as **The Conformity Thesis:**

It's not the case that rational human minds passively conform to the objects they cognize, as in classical Rationalism and classical Empiricism. On the contrary, necessarily, all the proper objects of rational human cognition conform to—i.e., they have the same form or structure as, or are isomorphic to—the forms or structures that are non-empirically generated by our innately specified spontaneous cognitive capacities. So necessarily, the essential forms or structures of the manifestly real natural universe that we cognize are mind-dependent.

In this way, all versions of transcendental idealism hold that the manifestly real world we directly perceive conforms to the non-empirical forms or structures of our innately specified cognitive capacities in some modally robust sense.

Many Kantians are also committed to *strong transcendental idealism*, aka STI, which says: (i) things-in-themselves (aka "noumena," or Really Real things, i.e., things as they could exist in a "lonely" way, altogether independently of rational human minds or anything else, by virtue of their intrinsic non-relational properties) really exist and cause our perceptions, although rational human cognizers only ever perceive mere appearances or subjective phenomena, (ii) rational human cognizers actually impose the non-empirical structures of their innate cognitive capacities onto the manifestly real natural universe that they cognize, i.e., necessarily, all the essential forms or structures of the proper objects of human cognition are literally type-identical to the *a priori* forms or structures that are non-empirically generated by our innately specified spontaneous cognitive capacities, and (iii) necessarily, if

either all rational human cognizers went out of existence or all minded beings of any kind went out of existence, then so would the manifestly real natural universe that they cognize, and if either no rational human cognizers had ever existed or no minded beings of any kind had ever existed, then the manifestly real world would never have existed. But I think that STI is clearly objectively false. More specifically, I think that it's clearly objectively false that if either all actual human minds, including mine, or all other kinds of minds, went out of existence, then the manifestly real natural universe would necessarily go out of existence too. I think that it is clearly false that, for example, the actual existence of Pike's Peak—a 14,000 foot mountain near Colorado Springs, CO, USA, with a cog railway that runs right to the summit—strictly depends on the actual existence of human minds, including mine, or on the actual existence of any other kinds of minds. Clearly, I think, Pike's Peak can exist even if everyone, and every minded being, including myself, does not actually exist, and in fact I think that Pike's Peak actually existed millions of years before any conscious minds of any kind existed, including of course the conscious minds of all rational human animals, obviously including mine. In this way, clearly, a great many things, including mountains like Pike's Peak, exist objectively—for example, shoes, ships, sealing wax, cabbages, kings, seas that do not boil, and pigs without wings. They are, all of them, neither subjective (i.e., strictly dependent on individual minds of any kind) nor relative (i.e., strictly dependent on cultures or societies of any kind). It's clear that they are all objectively manifestly real, and to that extent, mind-independent. So STI is clearly objectively false. QED.

On the contrary, then, I believe that Kantians and non-Kantians alike should be committed instead to the objective truth of WTI, which says: (i) things-in-themselves/noumena are logically possible, but at the same time it is knowably unknowable and unprovable whether noumena/things-in-themselves exist or not, hence for the purposes of an adequate anthropocentric or "human-faced" metaphysics, epistemology, and ethics, they can be ignored (= **radical agnosticism and methodological eliminativism about noumena/things-in-themselves**), (ii) necessarily, all the proper objects of rational human cognition have the same forms or structures as—i.e., they are isomorphic to—the forms or structures that are non-empirically generated by our innately-specified spontaneous cognitive capacities, but at the same time those manifestly real natural worldly forms or structures are not literally type-identical to those a priori cognitive forms or structures (= **the isomorphism-without-type-identity thesis**), (iii) it's a necessary condition of the existence of the manifestly real natural universe that if some rational human animals *were* to exist in that world, then they *would* know that natural universe *a priori* and also *a posteriori*, at least to some salient extent (= **the counterfactual knowability thesis**), and (iv) the manifestly real natural universe has at some earlier times existed without rational human minded animals, or any other minded beings, to know it, and could exist even if no rational human minded animals, or any other minded beings, ever existed to know it, even though some rational human animals now actually exist in that manifestly real natural universe (for example, I [R.H.]), who do in fact know it *a priori* (for example, by my knowing some simple necessary truths of logic and mathematics, and also by my knowing that necessarily, if I'm thinking,

then I actually exist) and also *a posteriori*, at least to some salient extent (= **the existential thesis**).

Here's a slightly more precise formulation of WTI's crucial thesis (iii), the counterfactual knowability thesis:

Ap $\Box (\forall x) (\exists y) [MRWx \{ (RHAy \ \& \ MRNUy) \Box \rightarrow Kyx \}]$

Definitions:

- Ap \Box = a priori necessarily.

P $\Box \rightarrow Q$ = If P were the case, then Q would be the case.

MRNUx = x belongs to the manifestly real natural universe.

MRNUy = y belongs to the manifestly real natural universe.

RHAy = y is a rational human animal.

Kyx = y knows x *a priori* and also *a posteriori*, at least to some salient extent.

Natural Language Translation:

- A priori necessarily, anything that belongs to the manifestly real natural universe is such that if some rational human animals were to exist in that world, then they would know that thing and that natural universe *a priori* and also *a posteriori*, at least to some salient extent.

And here are two crucial implications of this thesis. **First**, the counterfactual knowability thesis holds even if *no* rational human minded animals, or any other minded beings, *actually exist, or ever actually existed*.¹ **Second**, if anything is such that rational human minded animals are *unable to know it, at least to some salient extent*—for example, things-in-themselves or noumena—then that thing does *not* belong to the manifestly real natural universe. The first crucial implication conveys the weak mind-independence and ontic integrity of the manifestly real natural universe. The manifestly real natural universe is what it is, even no minds actually exist or ever actually existed. And the second crucial implication conveys the weak mind-dependence and inherent knowability of the manifestly real natural universe. The manifestly real natural universe is what it is, *only in relation to actual or possible rational “human, all-too-human” animal minds like ours*. The single upshot of the two crucial implications is that the manifestly real natural universe is as real as anything can ever possibly be, on the reasonable assumption that some *epistemic-luck-resistant, global-new-evil-demon-skepticism-resistant* rational human knowledge of that natural universe is actual or really possible. Or more precisely, and perhaps most surprisingly of all for anti-Kantians: any epistemically tenable realism—that is, any realism that's truly capable of avoiding *epistemic luck* (i.e., the merely accidental connection between truth and conscious belief) and *global-new-evil-demon-skepticism* (i.e., the worry that in a nearby possible world we'd have the very

¹It's generally believed that not only Kant himself, but also all Kantians, must accept STI. For example, in *Realistic Rationalism*, Jerrold Katz claims that “however Kant's transcendental idealism is understood, it locates the ground of [real] facts within ourselves in at least the minimal sense that it entails that such facts could not have existed if we (or other intelligent beings) had not existed” (Katz, 1998: p. 9, underlining added). But in fact that's not correct: although this claim is true of STI, it's false of WTI.

same beliefs and the same apparent evidence for holding those beliefs, but they'd all be false, hence we aren't rationally justified in holding those beliefs in the actual world [Cohen, 1984])—requires WTI (Hanna, 2015: chs. 6–8).

7.4 Conclusion

The Moderate Anthropic Principle, which, as we've seen, is equivalent with Weak Transcendental Idealism, distinctively gets between The Weak Anthropic Principle and The Strong Anthropic Principle, and also adequately explains the real possibility of contemporary physics as a natural science. MAP is therefore a *theoretically unique* anthropic principle (i.e., categorically it's neither WAP nor SAP) that's not only *philosophically defensible* in that it equally avoids the Scylla of materialism/physicalism, universal natural determinism/indeterminism, and universal natural mechanism, and the Charybdis of classical theism, but also *scientifically respectable* in the strong sense that it extends the Standard Models in a way that enables physics to explain physics as a natural science that includes human a priori knowledge of necessary truths of logic and mathematics, human a priori knowledge of natural laws (see Sect. 3.2 above), and also human a posteriori knowledge of contingent empirical/observational facts. Obviously, if physics can't explain physics, then it's *explanatorily incomplete*. In Chap. 6, I argued that a neo-organicist re-interpretation of the Bohmian hidden variables approach to quantum mechanics (QM) not only metaphysically/ontologically but also epistemically completes QM and The Standard Models of cosmology and particle physics. So The Moderate Anthropic Principle *further completes physics* in this self-explanatory respect.

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Chapter 8

A Neo-Organicist Approach to Formal Science: The Case of Mathematical Logic



Abstract What I've been calling *the explanatory inversion thesis* says that all mechanical systems whatsoever, whether formal or natural, are explanatorily and ontologically dependent upon, and indeed nothing but systematic abstractions from, fundamentally organic systems, and not the other way around. In this chapter, I apply the explanatory inversion thesis to formal science, and in particular, to mathematical logic.

8.1 Introduction

In my opinion, as I've argued in this book so far, the mechanistic worldview is decisively *false* and the neo-organicist worldview is decisively *true*; and the revolutionary theoretical and social-institutional comprehension of this worldshaking conclusion is what I've been calling *the neo-organicist revolution*. One basic part of the neo-organicist revolution, which I've been calling *the explanatory inversion thesis*, is the conceptual and theoretical *flip* of the modern-classical materialist or physicalist metaphysics and ontology of the mechanistic worldview, a flip according to which all mechanical systems whatsoever, whether formal or natural, are *explanatorily and ontologically dependent upon*, and indeed nothing but *systematic abstractions* from, fundamentally organic systems, and not the other way around. Otherwise put, the explanatory inversion thesis says that all mechanical systems whatsoever are nothing but *degenerate cases, fragments, or limiting cases* within the fundamentally organic cosmos, and *do not* capture the fundamental informational or representational and causal structure of the cosmos.

By saying that all mechanical systems are “systematic abstractions” from fundamentally organic systems, I mean more specifically that all mechanical systems whatsoever are *either logically or naturally/nomologically strongly supervenient on* fundamentally organic systems. In turn, the logical or natural/nomological strong supervenience of mechanical systems on fundamentally organic systems entails that

all mechanical systems, in and of themselves, are informationally/representationally and causally *inert*, i.e., informationally/representationally and causally *epiphenomenal*, with *no rich informational/representational powers or efficacious causal powers of their own*, because all rich informational/representational content and causal efficacy in the cosmos ultimately derives from and is inherited from organic systems: hence all mechanical systems are *informational/representational and causal parasites* or *informational/representational and causal shadows* of fundamentally organic systems (see also Chap. 14 below). Correspondingly, all authentic knowledge (i.e., true and sufficiently justified belief) about mechanical systems consists in our (i) insightfully grasping the only-denumerable, recursive, entropic, deterministic/indeterministic, time-reversible or time-symmetric, equilibrium thermodynamic, and informationally/representationally-&-causally parasitic character of such systems, and their inherent limits, and then (ii) systematically embedding them within the essentially richer domains of organic systems. If the explanatory inversion thesis is true, then proponents of materialism or physicalism and the mechanistic worldview have committed what Whitehead aptly called *the fallacy of misplaced concreteness*: mistaking the abstract for the concrete (Whitehead, 1927/1967: p. 51), as if you could somehow explain or construct *living animals* by presenting their *skeletons*. Since proponents of materialism or physicalism and the mechanistic worldview start their theorizing with systematically abstracted, logically or naturally/nomologically strongly supervenient *abstracts* or *bare bones* of essentially richer formal or cosmological systems, and *mistakenly take those abstracts or bare bones to be concrete and fundamental*, then they've flagrantly committed the fallacy of misplaced concreteness.

In this chapter, I apply the explanatory inversion thesis to *formal science*, and in particular, to *mathematical logic*.

8.2 What Is Strong Supervenience?

At this point, many readers will probably be asking themselves: what precisely is strong supervenience, whether logical or natural/nomological? So before we proceed to my argument in this chapter for the explanatory inversion thesis as applied to formal science and mathematical logic, and also in order to help the reader follow my arguments in the subsequent chapters, I'll pause briefly in this section to define these terms explicitly.

Strong supervenience (Kim, 1993: esp. part 1; Horgan, 1993; Chalmers, 1996: chs. 1–3) is a necessary determination-relation between sets of properties or states of different ontological “levels,” a relation that is weaker than strict property/state-identity, and is usually taken to be asymmetric, although two-way or bilateral supervenience is also possible. But assuming for the purposes of simpler exposition that strong supervenience is asymmetric, then, more precisely, *B*-properties/states (= the

higher level properties/states) strongly supervene on *A*-properties/states (= the lower-level properties/states) if and only if (i) for any property/state *F* among the *A*-properties/states had by something *X*, *F* necessitates *X*'s also having property/state *G* among the *B*-properties/states (upwards necessitation), and (ii) there cannot be a change in any of *X*'s *B*-properties/states without a corresponding change in *X*'s *A*-properties/states (necessary co-variation). It follows from strong supervenience that any two things *X* and *Y* share all their *A*-properties/states in common only if they share all their *B*-properties/states in common (indiscriminability).

In turn, *logical* strong supervenience is a super-strong version of strong supervenience which says that the necessitation relations between the *B*-properties/states and the *A*-properties/states are *logical* and *a priori*. Or more simply put: The *B*-properties/states are “nothing more than” and “nothing over and above” the *A*-properties/states. If logical strong supervenience holds, then if there were such a being as an all-powerful and all-knowing creator God, and if They were to create and/or know all the *A*-properties/states, then They would have nothing more to do in order to create and/or know all the *B*-properties/states. By contrast to logical strong supervenience, *natural* or *nomological* strong supervenience is a modally weaker notion which says that the necessitation relations between the *B*-properties/states and the *A*-properties/states are determined by laws of nature, and hold in all and only the worlds in which those natural laws obtain.

It's crucial to recognize that no matter what its level of modal strength, strong supervenience specifies at best a set of *extrinsic modal properties and relations* (namely, upwards necessitation, necessary co-variation, and indiscriminability) between a thing's *A*-properties/states and its *B*-properties/states, or between any two things' *A*-properties/states and *B*-properties/states. If relations of strong supervenience hold for a thing or things, as such, then there is no further implication that these are relations of *constitution*, *essence*, or *efficacious causal power*, such that a thing's or things' immanent structural characteristics—and in particular, if the thing or things are natural or physical, their efficacious causal powers—depend on these relations. Conversely, if relations of constitution, essence, or causal efficacy hold for a thing or things, then there is no further implication that strong supervenience holds for them. In short, the metaphysics of strong supervenience is modally *shallow*, not modally deep, unlike the *real* metaphysics of manifestly real constitution, essence, or causality (Hanna, 2017a).

Correspondingly, as Jaegwon Kim repeatedly pointed out (Kim, 1993), the fundamental metaphysical flaw in the notion of strong supervenience is that, given the modal shallowness of the strong supervenience relation, except in the limiting case of “downward” strict property/state-identity, the possession of a set of efficacious causal powers by the supervenience base inherently rules out and undermines—excludes—the transmission of those efficacious causal powers to the supervening properties/states, thereby rendering the supervening properties/states epiphenomenal and causally inert. Hence this is known as *The Causal Exclusion Problem*, aka *Kim's Causal Exclusion Worry*.

8.3 Formal Systems and Rational Human Mindedness

Ever since I wrote a brace of books during the 00 s called *Kant, Science, and Human Nature* (Hanna, 2006a) and *Rationality and Logic* (Hanna, 2006b), I've been deeply interested in the thesis that there are necessary and indeed essential connections between *formal systems* and *rational human mindedness*. What are these connections?

In *Rationality and Logic*, and in a later book from the 10 s, *Cognition, Content, and the A Priori*, I argued that every actual and possible logic is cognitively constructed by rational (human) animals, and that logic itself is the set of categorically normative, innately specified first principles of human theoretical rationality—a universal a priori minimally non-contradictory proto-logic—when taken together with all the supplementary humanly-constructed *ceteris paribus* principles of an open-ended plurality of logical systems, just as morality is the set of categorically normative, innately specified first principles of human practical rationality—a universal a priori dignitarian proto-morality—when taken together with all the supplementary humanly-constructed *ceteris paribus* principles of an open-ended plurality of moral systems (*the morality-of-logic thesis*) (Hanna, 2006a, b, 2015: ch. 5). But in this section, I want to pursue another route to an even broader yet essentially similar conclusion, that includes basic logico-mathematical systems and also any physical system or physical theory that presupposes or uses basic arithmetic, and thereby confirms the explanatory inversion thesis for the case of mathematical logic.

As we saw in Chap. 7, what I'm calling *weak transcendental idealism* says that (i) necessarily, the basic metaphysical and ontological structures of the manifestly real natural universe conform to the basic innately-specified structures of our rational human cognitive capacities, especially including conceptualization, consciousness, self-consciousness, and sensibility, (ii) necessarily, if the manifestly real natural universe exists, then if rational human cognizers *were* to exist, they *would be* able to cognize that natural universe veridically to some salient extent, which in turn is fully consistent with rational human cognizers *not* actually existing at any given time, and (iii) the existence of the manifestly real natural universe necessitates *the real possibility* of rational human cognizers, but *not* their actual existence at any given time (see also Hanna, 2015: section 7.3). Nevertheless, as a matter of contingent fact, some rational human cognizers *do actually exist now*, simply because they do actually *think* and can also *know* that the statement “Necessarily, if I think, then I exist” is true a priori: for example, the writer of this sentence and all sapient readers of it. Weak transcendental idealism is philosophically justified by inference-to-the-best-explanation, because it's the best overall explanation of *skepticism-resistant human knowledge*, especially *a priori knowledge* (Hanna, 2015: chs. 6–8). As we also saw in Chap. 7, weak transcendental idealism is necessarily equivalent with what I've called *the moderate anthropic principle for cosmology*, which says that our real possibility as conceptualizing, conscious, self-conscious, and sensible rational human cognizers is built into the nomological structure of the natural universe from the Big Bang forward, although, again, this

does *not* entail that we *must* actually exist at some time, even though, as a matter of contingent fact, we *do* actually exist now.

Relatedly, I also hold a thesis I call *potentiality panpsychism*, which says that necessarily, all parts of the natural universe are either (i) actually organismic minded systems, (ii) actual societies of organismic minded systems, (iii) actually or at least potentially, proper parts of organismic minded systems, or (iv) actually or at least potentially constitutive necessary conditions for organismic minded systems. Potentiality panpsychism is importantly weaker than *Analytic panpsychism*, since potentiality panpsychism *doesn't* require that *everything* in the natural universe *actually* has consciousness, proto-consciousness, or experiences. More precisely, as we saw in Sect. 2.4, Analytic panpsychism is the two-part metaphysical thesis which says (Pi) that mental properties are *at least as basic in the natural universe* in its total spatiotemporal extent and all its parts, aka the cosmos, *as physical properties* (aka, *liberal naturalism*), and (Pii) that at least some mental properties are *universally actually instantiated* in the cosmos (aka, *the ubiquity of the mental*) (Nagel, 1979; Chalmers, 1996; Strawson, 2006a, b; Goff, 2017, 2023; Goff et al., 2021; Murphy, 2022). As we also saw in Sect. 2.4, it's plausibly arguable that liberal naturalism (i.e., sub-thesis Pi above) is *true*, but that the ubiquity of the mental (i.e., sub-thesis Pii above) is *false*, for two reasons: **first**, the ubiquity thesis is *much too strong a thesis*, because it's highly implausible *that literally everything in the cosmos*, including, for example, beer cans, rocks, clouds, random specks of dust, etc., etc., is *actually* sentient or proto-sentient, and **second**, the ubiquity thesis *mistakenly attributes consciousness to mechanical systems*. But at the same time, potentiality panpsychism is also strong enough to entail the neo-organicist worldview, provided that we also add to potentiality panpsychism the thesis that *all organisms*, even unicellular ones, are at least *proto-conscious*. More generally, the thesis that *all and only living organisms* are actually sentient or proto-sentient, aka *the mind-in-life thesis* (Thompson, 2007; Hanna & Maiese, 2009; Deacon, 2011; Torday et al., 2020; Kauffman & Roli, 2023), is substantially more plausible than Analytic panpsychism.

Now, there's a hierarchy of formal systems, running from *decidable* formal systems to *incomplete* formal systems, that (i) mirrors their degree of semantic and structural richness from *least* rich to *most* rich and *also* (ii) is necessarily and indeed essentially connected with weak transcendental idealism, the moderate anthropic principle for cosmology, potentiality panpsychism, and the neo-organicist worldview. Or so I'll argue in Sect. 8.5. But before we get there, I want to spell out the foundational difference between *computability* and *uncomputability*.

8.4 Computability and Uncomputability

A *function* is a rule-governed mapping from a set of objects (aka the “arguments” or “inputs”), to another set of objects (aka “the values” or “outputs”), and, along with the very ideas of a *set* and of an *object*, the very idea of a function is not only

foundational for all logic and mathematics, but also, insofar as all formal and natural sciences presuppose and use logic and/or mathematics, it's *foundational for all the formal and natural sciences*. Among the most important kinds of functions are *computable functions*, and in order to understand these, we need the notion of a *Turing machine and its operations*.

So, what is a Turing machine, and what are its operations? Here's a compact and elegant way of characterizing them:

No human being can write fast enough, or long enough, or small enough, to list all members of a... [d]enumerably infinite set [e.g., the positive integers] by writing out their names, one after another, in some notation. But humans can do something equally useful, in the case of certain [d]enumerably infinite sets: They can give explicit instructions for determining the n th member of the set for an arbitrary finite n . Such instructions are to be given quite explicitly, in a form in which they could be followed by a computing machine, or by a human who is capable of carrying out only very elementary operations on symbols. The problem will remain, that for all but a finite number of values of n it will be physically impossible for any human or any machine to actually carry out the computation, due to limitations on the time available for computation, and on the speed with which single steps of the computation can be carried out, and on the amount of matter in the universe which is available for forming symbols. But it will make for clarity and simplicity if we ignore these limitations, thus working with a notion of computability which goes beyond what actual men or machines can be sure of doing.... The notion of computation can be made precise in many different ways, corresponding to different possible answers to such questions as the following. "Is the computation to be carried out on a linear tape, or on a rectangular grid, or what? If a linear tape is used, is the tape to have a beginning but no end, or is it to be endless in both directions? Are the squares into which the tape is divided to have addresses (like addresses of houses on a street) or are we to keep track of where we are by writing special symbols in suitable squares (as one might mark a trail in the woods by marking trees)? And so-on.... Since there is no end to the possible variations in detailed characterizations of the notions of computability and effectiveness, one must finally accept or reject the *thesis* [aka "Church's thesis," aka "the Church-Turing thesis"] ... that the set of functions computable in our sense [i.e., the set of recursive functions] is identical with the set of functions that men or machines would be able to compute by whatever effective method, if limitations on time, speed, and material were overcome. (Boolos & Jeffrey, 1989: pp. 19–20, square-bracketed material added; see also Turing, 1936/1937; Church, 1937)

So in other and fewer words, a Turing machine is a *digital computer*, and its operations are all and only the computations that fall within the scope of *recursive functions* (Turing, 1936/1937; Church, 1937). Recursive functions, in turn, are step-by-step algorithms, routines, or rule-governed sequences, such that precisely the same algorithm/routine/rule-governed sequence is applied to the result of the preceding step, in a denumerable (countable) sequence, up to some arbitrarily-fixed terminal step. Something that's absolutely essential to note about Turing machines/digital computers from the get-go, however, is that

certain functions are not computable, and that certain [d]enumerable sets are not effectively (mechanically) [d]enumerable—even if physical limitations on time, speed, and amount of material could somehow be overcome. (Boolos & Jeffrey, 1989: p. 19, square-bracketed material added)

In particular, as we'll see in the next section, it's logically demonstrable that truth and proof in Peano arithmetic, and also in classical first-order polyadic predicate

logic, aka *elementary logic*, are uncomputable, aka *undecidable* (Gödel, 1931/1967; Church, 1936; Boolos & Jeffrey, 1989: chs. 10, 15, 16, 21, 22, 28). More generally, all functions over *non*-denumerable domains—for example, over transfinite sets like the real numbers; but also over finite or infinite domains that cannot be divided or partitioned into any denumerable set of discrete, determinate individuals or units, owing to irreducible complementarity, holism, partial overlapping, or ontological indeterminacy, gappiness, or vagueness—are *not* computable or decidable, precisely because they're *not* recursive functions. Therefore, digital computation has *inherent formal limits*.

8.5 The Hierarchy of Formal Systems

Let's begin with *elementary logic* (Mates, 1972), and more specifically with that fragment of elementary logic known as *sentential logic*, aka SL. SL is *consistent* (i.e., it contains no contradictions), *sound* (i.e., all provable sentences or theorems are true sentences), *complete* (i.e., all true sentences are provable sentences or theorems), and *decidable* (i.e., there's a computable procedure for determining the truth or falsity of any sentence). And this is all because SL is simply *the logic of boolean (binary-coded) truth-functions*. Moreover, SL holds *even if there are no objects in the world*, i.e., even for empty domains, since all that matters is the truth or falsity of the sentences, *without* any appeal to semantic devices for reference to objects, one-place properties, or many-place relations. From a broadly Kantian point of view, all true sentences (tautologies) of SL are *analytically true* according to Kant's "supreme principle," or necessary and sufficient *contradiction-criterion*, for analyticity: a sentence is analytically true if and only if its denial entails a contradiction (CPR A150–153/B189–193; Hanna, 2001: ch. 3, 2015: ch. 4).

The next formal system in our hierarchy, *monadic predicate logic*, aka MPL, another fragment of elementary logic, with unary first-order quantification into one-place predicates, is *also* consistent, sound, complete, and decidable, for essentially the same reasons that SL is consistent, sound, complete, and decidable (Boolos & Jeffrey, 1989: ch. 25); and just like SL, MPL also holds even if there are no objects in the world, i.e., even for empty domains. But MPL can *also* be supplemented by *decomposable intensions* assigned to its one-place predicate-terms, which allows for sentences to be analytically true according to Kant's sufficient but not necessary *containment-criterion* or *identity-criterion* for analyticity: a sentence of categorical subject-predicate form is analytically true if either (i) its predicate-intension is contained in its subject-intension or (ii) its predicate-intension is identical to its subject-intension (CPR A6–7/B10–11; Hanna, 2001: ch. 3). Let's call this intensional-analyticity-supplemented version of MPL, MPL*. MPL* is equivalent to Kant's *pure general logic* (CPR A52–55/B76–79; Hanna, 2015: ch. 4, 2021a). And, just like SL and MPL, MPL* or pure general logic *also* holds even if there are no objects in the world, i.e., even for empty domains.

Next in line, *polyadic predicate logic with identity*, aka PPLI, which is elementary logic itself, with multiple first-order quantification into many-place predicates, is consistent, sound, and complete—and therefore all truths of PPLI are provable sentences or theorems—but *not* decidable (Church, 1936). Correspondingly, in my opinion, there are two independently sufficient reasons why PPLI/elementary logic *isn't* decidable, even though it's still complete.

First, truth-functionality alone isn't sufficient to determine the truth or falsity of *every* sentence in PPLI/elementary logic: given the law of (numerical, or token-token) identity as a law of logic,

$$(x)x = x$$

one of whose substitution-instances is

$$a = a$$

at least *one* object has to exist in the world, namely the object named by “a”; and, given the truth of any relational sentence containing a two-place relational predicate with two distinct terms naming different objects, for example,

$$R^2ab$$

at least *two* objects have to exist in the world, and so-on for all *n*-adic relational predicates.

In short, in PPLI/elementary logic, *domains have to be populated*: so, necessarily, it has *existential commitment*. For Kant, existential commitment, which is guaranteed only by *intuitional* sensible cognition, not *conceptual* cognition, determines the difference between analyticity and syntheticity: so, from a broadly Kantian point of view, PPLI/elementary logic is a *synthetic* logic, not an *analytic* logic, and therefore it falls outside pure general logic (Hanna, 2001: chs. 4–5).

Second, in order to do proofs beyond decidability in PPLI/elementary logic, both *rules* and also *rule-following* are needed, and, as it turns out, rule-following is an irreducibly normative activity that presupposes conscious and self-conscious rational cognizers, as members of a community of language-users, *whenever it exceeds mere boolean computability*, as the later Wittgenstein's and also Saul Kripke's or “Kripkenstein's” solution to *the rule-following paradox* shows (Kripke, 1982; Hanna, 2006b: pp. 158–168, 2021b: ch. XII). The rule-following paradox has two versions: (i) no rule can be applied without requiring another rule to interpret the first rule, and so-on, which entails a vicious regress of rules (Kant also explicitly recognized this problem at CPR A132–134/B171–174), and (ii) given only a finite and denumerable set of inputs (arguments) and outputs (values) to a given function, i.e., given only a *partial function*, nevertheless an indeterminately large number of *different* rules can describe the *same* set of inputs/outputs and also *diverge* on subsequent inputs/outputs, so therefore *the*

different rules will determine different complete functions, even given the same partial functions, and there's no purely mechanical, materialist/physicalist, or private/solipsistic way to avoid this underdetermination of the rules by those partial functions. Moreover, according to later Wittgenstein and "Kripkenstein" alike—and I strongly agree—in order to fix the interpretation and applications of a rule, language-using communities of rational human cognizers are needed in order to figure out "how to go on" and therefore also to decide what counts as correct, as opposed to incorrect, applications of the rule (Hanna, 2006b: pp. 158–168, 2021b: ch. XIII).

Anticipating later Wittgenstein and "Kripkenstein" by roughly 200 years, Kant calls this very same ability "so-called mother-wit" or *Mutterwitz*, and in turn this ability is essentially bound up with the innately-specified rational human cognitive capacity for judgment, or what he calls "the natural power of judgment" or *natürlicher Urteilstkraft* (CPR A133–134/B172–174), not only for "determining" judgment, which *subsumes* individual objects under given general concepts, but also and especially for "reflecting" judgment, which *projects* from individual objects to general concepts, either inductively or abductively (CPJ 5: 179–181; see also Hanna, 2017b).

Moreover, and most importantly for our purposes here, once we have rational human cognizers in play as members of language-using communities, then, as per the above, in order to explain skepticism-resistant a priori knowledge, weak transcendental idealism is required and therefore also the moderate anthropic principle for cosmology is required, since they're necessarily equivalent (Hanna, 2015: chs. 6–8; and Chap. 7 above).

Moving another step upwards in the hierarchy of richness, there's a formal system of arithmetic, *primitive recursive arithmetic*, aka PRA (Skolem, 1923/1967), that's weaker than full-dress Peano Arithmetic, because, unlike PA, PRA contains no quantifiers, that's also consistent, sound, complete, *and* decidable, if we extend decidability from mere boolean computability to all recursive functions, as per *The Church-Turing Thesis*, which says that necessarily, all computable functions are recursive functions and conversely (Turing, 1936/1937; Church, 1937). Like PPLI/elementary logic, from a broadly Kantian point of view, PRA is also *synthetic*, not analytic, since it necessarily requires populated domains and existential commitment to numbers or sets. From a broadly Kantian point of view, then, when we advance from SL to PRA, we've advanced from *analytic* (mere boolean) computability to *synthetic* (Church-Turing) computability. Significantly, PRA is *also* subject to the rule-following paradox, as per later Wittgenstein and "Kripkenstein," hence rule-following in PRA is *also* irreducibly normative and presupposes conscious and self-conscious rational human cognizers, and therefore *also* invokes weak transcendental idealism and the moderate anthropic principle for cosmology.

Finally, moving onwards and upwards to the richest logico-mathematical system in our hierarchy, Peano Arithmetic, aka PA—which consists of any logical system essentially like that presented in Whitehead's and Russell's *Principia Mathematica* (Whitehead & Russell, 1962), plus the basic Peano Axioms for arithmetic, for example: (i) 0 is a number, (ii) the successor of any number is a number, (iii) no two

numbers have the same successor, (iv) 0 is not the successor of any number, and (v) any property which belongs to 0, and also to the successor of every number which has the property, belongs to all the numbers—and also the primitive recursive functions, is consistent, sound, and *incomplete* (if consistent), and contains not only *undecidable*, but also *unprovable* true sentences (Gödel, 1931/1967). This is of course because Gödel showed in 1931 that there are true but undecidable, unprovable sentences in PA when we map the truth-definition for PA into PA itself, using the formal method of assigning self-referring Gödel-numbers to sentences (the first incompleteness theorem); moreover, this proof requires non-denumerably infinite or transfinite numbers or sets, as per Georg Cantor's argument for the existence of the transfinite domain (Cantor, 1891, 2019; Gödel, 1931/1967).

So, in addition to the fact that any logico-mathematical system richer than mere boolean computable systems like SL requires irreducible rule-following normativity and therefore presupposes conscious and self-conscious rational human cognizers as members of language-using communities, hence also invokes weak transcendental idealism and the moderate anthropic principle for cosmology, the necessarily populated domains and existential commitments of PA (guaranteeing syntheticity) *also* exceed denumerable infinity and therefore *also* exceed not only mere boolean computability, but also all computability that satisfies the Church-Turing thesis (Turing, 1936/1937; Church, 1937), and *therefore* is non-mechanical or organic, since Turing-computability is a necessary condition of formal mechanistic and natural mechanistic alike (see also Hanna, 2018: ch. 2; Hanna & Paans, 2020; Torday et al., 2020). Moreover, because mapping the truth-definition for PA into PA itself, entails the existence of undecidable, unprovable true sentences, then, assuming consistency, *every formal system that's at least as rich as PA* cannot demonstrate its own consistency (the second incompleteness theorem), hence it requires that its consistency and the truth of its sentences be established *outside* that system itself, for example, as Gödel himself held, by acts of *mathematical intuition* that constitute *a priori mathematical knowledge*, and therefore by conscious and self-conscious rational human cognizers (Gödel, 1931/1967; Tait, 2010).

Therefore, the existence of true but undecidable, unprovable sentences in PA entails (i) the first and second incompleteness theorems, (ii) the necessity of populated domains and existential commitment (hence syntheticity), (iii) non-denumerably infinite or transfinite domains, and (iv) rule-following for the provable but undecidable sentences, all of which jointly entail or at least strongly suggest—in the particular case of what secures consistency and the truth of undecidable and unprovable mathematical axioms, as per Gödel's own view—(v) rational human cognizers as members of language-using communities, hence also jointly necessitate (vi) weak transcendental idealism and (vii) the moderate anthropic principle for cosmology, and in turn jointly entail (viii) Turing-incomputability and (ix) anti-mechanicity or organicity, therefore also jointly entail (x) the neo-organicist worldview, if we add the thesis of potentiality panpsychism to weak transcendental idealism and the moderate anthropic principle for cosmology.

8.6 Conclusion

Finally, then, it follows that any formal logico-mathematical system that's rich enough to contain the Peano axioms for PA, together with the primitive recursive functions, and any *physical* system or physical theory that presupposes or uses PA, will *also* have *all ten* of these fundamentally important features. Or in other words, every logico-mathematical system and physical system or physical theory that's semantically and structurally rich enough to provide an even minimally adequate model or theoretical representation of the manifestly real natural universe in its logical and/or mathematical specific character, will be necessarily and indeed essentially connected with rational human mindedness, and thereby fully embedded within and also logically or naturally/nomologically strongly supervenient on the essentially richer informational or representational and causal structures of organic systems. Hence the neo-organicist turn's explanatory inversion thesis, as specifically applied to the case of mathematical logic, is true.

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Chapter 9

A Neo-Organicist Approach to the Löwenheim-Skolem Theorem and “Skolem’s Paradox”



Abstract In this very short chapter, I provide another confirmation of the neo-organicist turn’s *explanatory inversion thesis* as applied to formal science, this time with respect to the famous or notorious *Löwenheim-Skolem Theorem* and also to what’s sometimes called “Skolem’s Paradox.”

9.1 Introduction

In this very short chapter, I’ll provide another confirmation of the neo-organicist turn’s explanatory inversion thesis as applied to formal science, this time with respect to the famous or notorious *Löwenheim-Skolem Theorem* and also to what’s sometimes called “Skolem’s Paradox.”

9.2 The Löwenheim-Skolem Theorem

In what follows, by *a model* I’ll mean any set of objects that’s intended to be an interpretation of some mathematical theory and also to make that mathematical theory true; by *a denumerable model* I’ll mean any model that’s countable by virtue of putting each of its elements into a one-to-one correspondence with the elements of the set of natural numbers; and by *a non-denumerable model* I’ll mean any model that’s got more objects in it than can be counted. Now, as it turns out, all non-denumerably infinite models (say, the real numbers) contain denumerably infinite or finite sub-models (say, the integers, or some of the integers), so by *an only-denumerable model* I’ll mean a model that’s *exclusively* denumerable and *not also* non-denumerable.

In the late nineteenth century, Cantor proved that there are non-denumerably infinite numbers (Cantor, 1891, 2019), for example, the real numbers: hence, any consistent mathematical theory that’s *about* such numbers has a non-denumerable model. But then, two or three decades later, *enter* The Löwenheim-Skolem Theorem

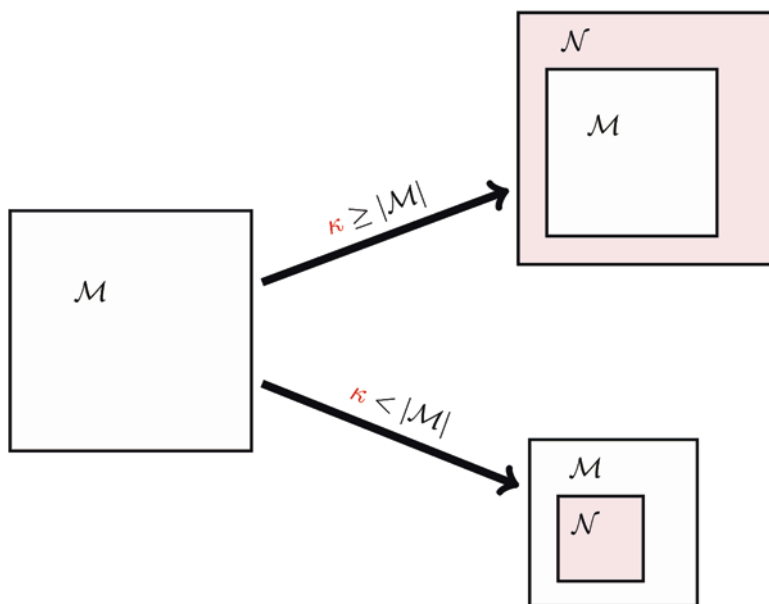


Fig. 9.1 The Löwenheim–Skolem Theorem, Upward and Downward (Wikimedia Commons, 2016)

(Löwenheim, 1915/1967; Skolem, 1922/1967; Boolos & Jeffrey, 1989: Ch. 15), aka LST, as diagrammatically represented in Fig. 9.1 above, which says that if a set theory is consistent (i.e., has a model, i.e., has an objective interpretation that makes it true), then it has an only-denumerable model, and more generally any consistent set theory has a *non*-denumerable model if (aka “the upward LST”) and only if (aka “the downward LST”) it has an only-denumerable model.

This leads to what’s sometimes called “Skolem’s Paradox” (Bays, 2014): How can true mathematical theories that are about *non*-denumerably infinite domains be made-true by *only*-denumerably infinite or finite domains? From the standpoint of neo-organicism, however, “Skolem’s Paradox” is only a *so-called* paradox, and not a *genuine* paradox. And that’s because the explanatory inversion thesis of organicism predicts that *only-denumerable mechanical models and/or mathematical-theories-about-them are logically strongly supervenient on non-denumerable organic models and/or mathematical-theories-about-them, and not conversely*. And that modal fact suffices to dispel any whiff of paradox about LST.

9.3 Explaining Away “Skolem’s Paradox”

By way of showing this, let’s consider any consistent mathematical theory about a non-denumerably infinite domain, call it T : Then LST says that T has an only-denumerable sub-model, call it M , and also that the mathematical specific character

(i.e., the defining set of mathematical properties) of M is necessarily determined by the mathematical specific character of the essentially richer theory T . By saying that T is an “essentially richer theory” I mean that because T is about a non-denumerably infinite domain that includes M as an only-denumerable sub-model, then any other mathematical theory T^* that was about M *alone*, would not *also* be about the *entire* non-denumerably infinite domain comprehended by T , and therefore T^* would be a categorically less rich theory than T .

Let’s now consider any only-denumerable model that’s identical to M : Then LST says that any such M is an only-denumerable sub-model of an essentially richer consistent mathematical theory T , such that the mathematical specific character of M is strictly determined by T . In other words, given the consistency of T , M is *upwardly necessitated* by T , and M ’s mathematical specific character *necessarily co-varies* with the mathematical specific character of T , but *not* conversely. Therefore, M is logically supervenient on T , and not conversely, or otherwise put, M is systematically abstracted from T , and not conversely, and *that* sufficiently dispels any whiff of paradox about LST.

It stands to reason that if T is consistent, then it’s made-true not only by the non-denumerable model that it’s about, but also by all the only-denumerable models M that are sub-models of that non-denumerable model and whose mathematical specific characters are also necessarily determined by T .

Now, although this is not generally true of *all* only-denumerable models—for example, it’s not true of the only-denumerable models of classical first-order polyadic predicate logic, which is undecidable (Church, 1936), and therefore it’s *not Turing-computable or recursive* (Boolos & Jeffrey, 1989: Chs. 3 and 22)—let’s assume more specifically for the purposes of my argument that any such M is not only an only-denumerable model but *also* a Turing-computable or recursive model, and let’s call that computable or recursive model M^* . In short, M^* is a *mechanical model*. So it follows that every Turing-computable or recursive, aka mechanical, model M^* is logically supervenient on some essentially richer *non-mechanical* or organic theory T that’s about a *non-denumerably* infinite and therefore *non-Turing-computable or non-recursive*, hence *non-mechanical* or organic, domain, and not conversely.

9.4 Conclusion

Therefore, The Löwenheim-Skolem Theorem confirms the neo-organicist explanatory inversion thesis as applied to formal science, namely that formal mechanical systems logically strongly supervene on essentially richer non-mechanical, aka organic, formal systems, and not conversely.

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Chapter 10

How to Solve Zeno's Paradox of Motion Without Supertasks



Abstract In this chapter, I argue that there's an intelligible and defensible broadly Kantian neo-organicist solution to Zeno's paradox of motion, as epitomized by the famous Dichotomy paradox, that doesn't appeal to supertasks. Moreover, this broadly Kantian neo-organicist solution also explains why the popular solution in terms of supertasks and the infinitesimal calculus is fundamentally philosophically misguided and indeed fallacious.

10.1 Introduction

According to mathematicians and mathematically-minded metaphysicians, a *supertask* is a task—i.e., a manifestly real act, operation, or terminating procedure—composed of infinitely many steps, that's nevertheless completed in a finite amount of time (Manchak & Roberts, 2022). In turn, supertasks, when taken together with the calculus of infinitesimals, have been popularly proposed as the solution to Zeno's paradox of motion, for example, in its famous "Dichotomy" version (Fig. 10.1).

According to a broadly Kantian cognitive semantics and metaphysics, however, although supertasks are *analytic a priori* (i.e., conceptually, logically) *possible*, nevertheless they're *synthetic a priori* (i.e., metaphysically, non-logically) *impossible*.¹ For in manifestly real spacetime, synthetically a priori necessarily, every single step in a many-step task, whether it's a task that's composed of a finite number of steps or an infinite number of steps, takes a determinate, denumerably finite amount of time in order to complete that single step. Therefore, a many-step task is composed of a finite number of steps if and only if it's

¹For a detailed presentation and defense of a general theory of the analytic-synthetic distinction, analytic a priori necessity vs. synthetic a priori necessity, and a priori knowledge, see (Hanna, 2015: esp. chs. 4–8).

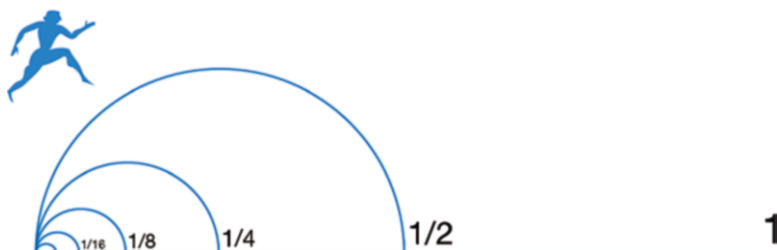


Fig. 10.1 Zeno's Dichotomy Paradox (Wikimedia Commons, [2017](#))

completed in a determinate, denumerably finite amount of time; a many-step task is composed of an infinite number of steps if and only if it's completed in a determinate, denumerably infinite amount of time; and any task that's completed in a determinate, denumerably finite amount of time cannot be composed of an infinite number of steps, i.e., it cannot be a supertask. More generally, a supertask is *noumenal*, which is to say that it's *consistently thinkable*, yet also *non-spatiotemporal*, *non-phenomenal* or *non-apparent*, and essentially *non-relational*, and thereby not only humanly scientifically *unknowable*, but also such that it *cannot occur* in manifestly real spacetime (CPR A235–260/B294–315).

Moreover, and quite apart from broadly Kantian cognitive semantics and metaphysics, as Joseph Wayne Smith and Saxon J. Smith have convincingly argued, supertasks also have *another* basic problem associated with them: *they entail the inconsistency of the system of real numbers* (Smith & Smith, [2023](#)). Therefore, if mathematicians and mathematically-minded metaphysicians want to *affirm* the consistency of the system of real numbers, then they had better also *reject* supertasks. But then the popular solution to Zeno's paradox of motion, as epitomized by the Dichotomy paradox, using supertasks and the calculus of infinitesimals *also* goes down, along with the rejection of supertasks.

So it would be mathematically and metaphysically beneficial and important, if an intelligible and defensible solution to Zeno's paradox of motion could be found that *doesn't* employ supertasks. And in fact, that's just what I'm going to argue in this chapter: that there's an intelligible and defensible broadly Kantian *neo-organicist* solution to Zeno's paradox of motion, as epitomized by the Dichotomy paradox, *without* appealing to supertasks. And that's not all. As a philosophical bonus, this broadly Kantian neo-organicist solution *also* explains why the popular solution in terms of supertasks and the infinitesimal calculus is fundamentally philosophically misguided and indeed paradigmatically fallacious.

10.2 The Problem of the Continuum and the Neo-Organicist Worldview

The classical *Problem of the Continuum* can be formulated like this: What is the correct characterization of the fundamental quantitative structure of the manifestly real natural spacetime universe as a whole and all its sub-parts, aka *the cosmos*?² According to *The Continuum Hypothesis*, aka CH, proposed by Cantor, the fundamental quantitative structure of the cosmos is that of *the mathematical continuum*, and the mathematical continuum has *either* the infinite denumerable cardinality of the natural numbers (= aleph null, i.e., \aleph_0) *or* the infinite non-denumerable cardinality of the real numbers (= 2 to the power of aleph null, i.e., \aleph_0), *and* there is no number applicable to the mathematical continuum with a cardinality that falls strictly between that of the naturals and that of the reals (see, e.g., Koellner, 2019).

If CH is true, then one way in which it *can* be true is if the fundamental quantitative structure of the cosmos is *not only* countably or denumerably infinite as per the natural numbers, *but also* uncountably or non-denumerably infinite, aka “transfinite,” as per the real numbers, *and* there is no intermediate fundamental quantitative structure between those two. *That* way of understanding the truth of CH, in turn, would be consistent with The Löwenheim-Skolem Theorem (Löwenheim, 1915/1967; Skolem, 1922/1967; Boolos & Jeffrey, 1989: ch. 15; and Chap. 9 above), aka LST, which says that if a set theory is consistent (i.e., has a model, i.e., has an objective interpretation that makes it true), then it has an only-denumerable model, and more generally any consistent set theory has a *non*-denumerable model if (aka “the upward LST”) and only if (aka “the downward LST”) it has an *only*-denumerable model. And of course, it’s also consistent with Zermelo’s and Fraenkel’s well-ordered set theory plus the Axiom of Choice, which is equivalent to licensing the power-set operation (constructing the set of all subsets) on finite or infinite sets, aka ZFC (Zermelo, 1930, 1967a, b, c; Hallett, 1984; Potter, 1990: ch. 7).

To be sure, CH is one of the most central and important “open”—i.e., unsolved—problems in set theory (Koellner, 2019); but my own view is that CH can in fact be shown to be true on broadly Kantian grounds (Hanna, 2015: pp. 391–392). I won’t try to reproduce that line of reasoning fully in this chapter (for a detailed version of the argument, see Chap. 11 below), but the basic idea is that (i) if ZFC is interpreted in terms of Kant’s theory of pure spatial and temporal intuition in the Transcendental Aesthetic section of the *Critique of Pure Reason* (CPR A19–49/B33–73), when it’s taken together with Kant’s theory of extensive quantity and intensive quantity as captured by the “mathematical” principles of pure understanding, namely the

²Gödel frames the problem more compactly, but also somewhat less philosophically, this way—

Cantor’s continuum problem is simply the question: How many points are there on a straight line in Euclidean space? In other terms: How many different set of integers do there exist? (Gödel, 1947: p. 515)

Axioms of Intuition and the Anticipations of Perception (CPR A162–176/B201–218), then (ii) if we conjoin ZFC with the two further Kantian theses (iia) that there are two and only two forms of intuition, our innately specified a priori representations of space and time, which veridically pick out the two and only two elements of spacetime, namely, space and time as “infinite given wholes,” and (iib) that these elements have either denumerably infinite extensive quantity or denumerably infinite intensive quantity, or some exponentiated combination of them, and no *other* kinds of quantity, it follows that (iii) CH is true.

In any case, even assuming that CH *is* true, from that very fact it does *not* follow that the fundamental structure of the cosmos is *only* quantitative, i.e., that it's *only* numbers all the way down. That would be an extreme and questionable thesis in the broadly Pythagorean tradition, and therefore too narrow and/or reductive (even leaving aside the worry about its apparent commitment to some or another version of mathematical platonism) to provide an adequate and complete characterization of the fundamental structure of the cosmos. In particular, if the neo-organicist worldview is correct—and of course I do think that it's correct—then (i) the cosmos is essentially uncomputable, negentropic, irreversible, temporally asymmetric/unidirectional, processual, purposive, self-organizing, and non-equilibrium thermodynamic, and (ii) there's a single, unbroken metaphysical continuity between (iia) The Big Bang Singularity, (iib) uncomputable, negentropic, irreversible, temporally asymmetric/unidirectional, processual, purposive, self-organizing, and non-equilibrium thermodynamic, (iic) organismic life, (iid) conscious, intentional minded animals of all kinds including conscious, intentional minded human animals, (iie) human rationality, and (iif) human free agency (Hanna & Paans, 2020; Torday et al., 2020; and Chaps. 1, 2, 3, 4, 5, 6, 7, 8 and 9 above).

Now, the neo-organicist worldview includes the thesis that the fundamental *quantitative* structure of the cosmos is captured by CH, but it also includes the thesis that the fundamental structure of the cosmos *is not captured by quantitative structure alone*. For, if the neo-organicist worldview is correct, then one central and fundamental feature of the cosmos is *real motion*. Moreover, I also think that Zeno's paradox of motion, as epitomized by The Dichotomy Paradox, show that real motion *cannot* be explained solely in terms of the translation of a point or body across the mathematical continuum, hence real motion cannot be explained solely in terms of quantitative structure, but instead must be explained in *topological, modal, and essentially embodied mentalistic* terms. In the next section, I'll argue for that claim.

10.3 A Neo-Organicist Theory of Real Motion

Motion, in general, is continuous change in the position or configuration of a physical system in space, including four basic sub-types: uniform motion, translational motion, oscillation, and rotation. The most famous version of Zeno's paradox of motion, The Dichotomy, unfolds as follows:

The first [of the versions of Zeno's paradox of motion] asserts the non-existence of motion on the ground that that which is in locomotion must arrive at the half-way stage before it arrives at the goal. (Aristotle *Physics*, 239b11)

This paradox is known as the “dichotomy” because it involves repeated division into two (like the second paradox of plurality). Like the other paradoxes of motion we have it from Aristotle, who sought to refute it.

Suppose a very fast runner—such as mythical Atalanta—needs to run for the bus. Clearly before she reaches the bus stop she must run half-way, as Aristotle says. There's no problem there; supposing a constant motion it will take her $1/2$ the time to run half-way there and $1/2$ the time to run the rest of the way. Now she must also run half-way to the half-way point—i.e., a $1/4$ of the total distance—before she reaches the half-way point, but again she is left with a finite number of finite lengths to run, and plenty of time to do it. And before she reaches $1/4$ of the way she must reach $1/2$ of $1/4 = 1/8$ of the way; and before that a $1/16$; and so on. There is no problem at any finite point in this series, but what if the halving is carried out infinitely many times? The resulting series contains no first distance to run, for any possible first distance could be divided in half, and hence would not be first after all. However it does contain a final distance, namely $1/2$ of the way; and a penultimate distance, $1/4$ of the way; and a third to last distance, $1/8$ of the way; and so on. Thus the series of distances that Atalanta is required to run is: ..., then $1/16$ of the way, then $1/8$ of the way, then $1/4$ of the way, and finally $1/2$ of the way (for now we are not suggesting that she *stops* at the end of each segment and then starts running at the beginning of the next—we are thinking of her continuous run being composed of such parts). And now there is a problem, for this description of her run has her travelling an *infinite* number of *finite* distances, which, Zeno would have us conclude, must take an infinite time, which is to say it is never completed. And since the argument does not depend on the distance or who or what the mover is, it follows that no finite distance can ever be traveled, which is to say that all motion is impossible. (Note that the paradox could easily be generated in the other direction so that Atalanta must first run half way, then half the remaining way, then half of that and so on, so that she must run the following endless sequence of fractions of the total distance: $1/2$, then $1/4$, then $1/8$, then). (Huggett, 2019: section 3.1)

Various solutions to The Dichotomy have been offered, the most popular of which is that if physical space has the structure of the mathematical continuum, then the mathematics of that structure—especially the calculus of infinitesimals, as progressively developed by Leibniz, Newton, Cauchy, Weierstrass, Riemann, Robinson, and others—shows that Atalanta's complete run can be broken down into an infinite series of half-runs, which can be summed into a complete run, i.e., it's a paradigmatic *supertask*.

Now, Henri Bergson and Whitehead both argued, from an *organicist* point of view, that Zeno's paradox of motion arises *only* because it's *falsely* assumed that motion in the manifestly real cosmos can be really resolved into a series of discrete, discontinuous sub-tasks, moment-by-moment, that are in one-to-one

correspondence with discrete points or line-segments in the mathematical continuum, whereas, *in truth*, motion is essentially *an unbroken process through space-time* (Bergson, 1911: pp. 246–259; Whitehead, 1925/1967: pp. 126–127). I strongly agree with Bergson and Whitehead. But if they're correct that it's false that motion in the manifestly real cosmos can be really resolved into a series of discrete, discontinuous sub-tasks, moment-by-moment, that are in one-to-one correspondence with discrete points or line-segments in the mathematical continuum, then there's a *further* burden of proof upon me, as a defender of the neo-organicist worldview, to provide an intuitive, non-metaphorical definition of motion such that (i) this definition conforms to the general definition of motion as continuous change in the position or configuration of a physical system in space, and (ii) this definition tells us what the structure of real motion in the manifestly real cosmos *truly* is, such that real motion is at once (iia) essentially uncomputable, negentropic, irreversible, temporally asymmetric/unidirectional, processual, purposive, self-organizing, and non-equilibrium thermodynamic, and (iib) cannot be really resolved into a series of discrete, discontinuous sub-tasks, moment-by-moment, that are in one-to-one correspondence with discrete points or line-segments in the mathematical continuum.

So here's an attempt to meet those requirements.

1. Let there be a sequence of partially but not wholly overlapping distinct space-time regions, R1, R2, R3, etc., such that synthetically a priori necessarily, if anything occupies the overlap between R1 and R2, then it also occupies the overlap between R2 and R3. Let's call that relational property of regions, *the transitive overlap of regions*.
2. Moreover, let each individual region—for example, R1—be such that it fully contains within its boundaries a sequential set of smaller partially but not wholly overlapping distinct spacetime sub-regions, R1₁, R1₂, R1₃, etc., such that there's transitive overlap between those sub-regions. Let's call that relational property of sub-regions, *the transitive overlap of sub-regions*.
3. Anything X occupies any spacetime region R_n or sub-region R_n_i at time t₁ if and only if X has *egocentric centering* in and throughout the 3-dimensional orientable space of R_n or R_n_i at t₁. In other words, I'm taking the paradigm of occupation to be a *conscious minded animal's*—and especially a *rational* conscious, intentional, self-conscious, *human* minded animal's—essentially embodied actual existence in and throughout its own living organismic body in manifestly real spacetime (Hanna & Maiese, 2009; see also Chap. 2 above). For all non-conscious physical systems, their egocentric centering is *imaginatively projectible* by rational conscious, intentional, self-conscious human minded animals, especially including natural scientists.
4. Assuming the transitive overlap of regions, then anything X enters region R2 if and only if its occupation of R1 at time t₁ necessitates X's later occupation of the overlap between R1 and region R2 at time t₂.
5. Assuming the transitive overlap of regions, then anything X exits region R2 if and only if X's occupation of R1 at time t₁ and its later occupation of the overlap between R1 and region R2 at time t₂, necessitates X's later occupation of the overlap between R2 and region R3 at time t₃.

6. Assuming the transitive overlap of regions, then *X* is *in either uniform or translational motion* from region *R*₁ to region *R*₃ if and only if *X* both enters and exits *R*₂. Otherwise put, assuming the transitive overlap of regions, then *X* is in either uniform or translational motion from region *R*₁ to region *R*₃ if and only if *X* *changes its position by means of the unbroken process of spontaneously transiting from R₁ to R₃.*
7. Assuming the transitive overlap of regions, then *X* is *at rest*, in the sense of being *stationary*, in *R*₁ if and only if *X* occupies *R*₁ but neither enters nor exits *R*₂.
8. Assuming the transitive overlap of regions and also the transitive overlap of sub-regions, then *X* is *in either oscillatory or rotational motion* in region *R*₁ if and only if either (i) *X* is at rest or stationary in *R*₁ and *X* also both exits and enters sub-region *R*_{1₂} or (ii) *X* both enters and exits *R*₂ and *X* also both enters and exits sub-region *R*_{1₂}. Otherwise put, assuming the transitive overlap of regions and also the transitive overlap of sub-regions, then *X* is in either oscillatory or rotational motion in region *R*₁ if and only if *X* either does or does not transit from *R*₁ to *R*₃, and *X* *also changes its configuration by means of the unbroken process of spontaneously sub-transiting from R₁ to R_{1₃}.*
9. Therefore, motion, in general, is continuous change in the position or configuration of a physical system in space, including four basic sub-types—uniform motion, translational motion, oscillation, and rotation—in the neo-organicist sense that an essentially embodied conscious-and-intentional or non-conscious negentropic, uncomputable, temporally asymmetric, processual, purposive, and self-organizing non-equilibrium thermodynamic system that's (actually or by means of projective natural-scientific imagination) egocentrically centered in and throughout a certain region in 3-dimensional orientable space, either changes its position by means of the unbroken process of spontaneously transiting from region to region, or changes its configuration by means of the unbroken process of spontaneously sub-transiting from sub-region to sub-region, or both, *and* it's also false that motion in the manifestly real cosmos can be really resolved into a series of discrete, discontinuous sub-tasks, moment-by-moment, that are in one-to-one correspondence with discrete points or line-segments in the mathematical continuum.

In this way, *not only* is it the case that Zeno's paradox of motion, as epitomized by The Dichotomy, can be solved by the neo-organicist approach, *but also* the case that there's an intuitive neo-organicist definition of motion that avoids Zeno's paradox of motion from the get-go, by refusing to assimilate the structure of real motion in the manifestly real cosmos to the structure of the mathematical continuum.

10.4 A Derivation of Motion in the Parasitic Sense

Moreover and finally, let's postulate that the neo-organicist definition of manifestly real motion picks out a set of organic structures—the topology of regional overlap and transitive overlap, and the synthetically a priori necessitated relation of

spontaneous transiting from region to region or sub-region to sub-region, and the essentially embodied mentalistic nature of occupation—that are even more metaphysically and ontologically fundamental than the cosmos insofar as it embeds the structure of the mathematical continuum. Then we can also provide a metaphysical/ontological derivation of what I'll call *motion in the parasitic sense*, aka *motion_p*, that embeds the structure of the mathematical continuum within the cosmos by systematic abstraction from the more basic organic structures, as follows.

First, we treat every possible overlap between regions *as if* it were a single discrete point or line-segment in the mathematical continuum.

Second, we treat every synthetically a priori necessitated transit between two regional or sub-regional overlaps *as if* it were a single distance in the mathematical continuum of physical spacetime that can be traveled by something that is in motion_p.

Third, we treat every essentially embodied occupation of a region *as if* it were a single non-organic—i.e., entropic, computable, reversible, temporally bidirectional or symmetric, non-processual, non-purposive, non-self-organizing, equilibrium thermodynamic, non-living, non-conscious-and-non-intentional—material or physical object with simple location at a single discrete point or line-segment in the mathematical continuum, at any given moment in time, that must engage in motion_p in order to travel some distance over time.

Now, let's consider the total set of mappings from the more basic organic structures of real motion to parts of the mathematical continuum. Then we have something quite similar to what Whitehead calls *the method of extensive abstraction* (Whitehead, 1920/1971: ch. IV), the crucial difference being that Whitehead thinks of the more basic organic structures as flowing from *overlapping atomic events*—which nine years later, in the panexperientialist cosmology of *Process and Reality*, he explicitly interprets as standing in basic *mentalistic* relations called “prehensions” (Whitehead, 1929/1978)—to be interpreted as the primitive organic fact or phenomenon, whereas by contrast, as I've said, instead I'm postulating *real motion* as the primitive organic fact or phenomenon, together with its essential topological, modal, and essentially embodied mentalistic structures as I've described them.

10.5 Conclusion

In this chapter, I've shown that not only is it the case that Zeno's paradox of motion, as epitomized by The Dichotomy Paradox, can be solved by my broadly Kantian neo-organicist approach, but also the case that there's an intuitive neo-organicist definition of motion that avoids Zeno's paradox of motion from the get-go, by refusing to assimilate the structure of real motion in the manifestly real cosmos to the structure of the mathematical continuum. Moreover, assuming the set of mappings from the structures of real motion to parts of the mathematical continuum that I've postulated in Sect. 10.4 by means of my revised and updated neo-organicist version

of Whitehead's method of extensive abstraction, then we have before us the set of systematically abstracted and essentially *derivative* and *fragmentary* structures that are uncritically presupposed *not only* by Zeno's paradox of motion, *but also* by the popular solution to The Dichotomy Paradox that appeals to supertasks and the infinitesimal calculus. Indeed, in turn, the proponents of the supertasks-plus-infinitesimal-calculus solution to Zeno's paradox of motion have not only engaged in some highly questionable noumenal metaphysics, but have also committed another paradigmatic example of the fallacy of misplaced concreteness (Whitehead, 1925/1967: p. 51).

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Chapter 11

Sensible Set Theory



Abstract In this chapter, I argue that we not only can but also should accept only a version of set theory that's essentially restricted in a broadly Kantian way: I call this version of set theory, *Sensible Set Theory*, aka SST.

11.1 Introduction

What is set theory? As Michael Potter crisply and informatively puts it:

In every part of mathematics we study objects. Whether these objects be numbers, points in space, or elements of a locally convex topological vector space, they can be formed into collections [aka sets]. [Set theory studies] the properties which collections [aka sets] have simply by virtue of being *collections* [aka sets], no matter what they are collections [aka sets] *of*. In other words, [set theory is] concerned only with properties arising from the relationship which holds between an object and any collection [aka set] to which it belongs: this relationship is called membership. (Potter, 1990: p. 7; square-bracketed material added)

In this chapter, I'm going to argue that we not only *can* but also *should* accept *only* a version of set theory *that's essentially restricted in a broadly Kantian way*: I call this version of set theory, *Sensible Set Theory*, aka SST.

11.2 Kant's Theory of Sensibility in Nutshell, and Manifest Realism

According to Kant's Critical philosophy, the objects of *human sensibility* (*Sinnlichkeit*), which is the essentially non-conceptual mode of rational human cognition, specifically include (i) the directly-intuitable, empirically real objects of empirical intuition or sense perception, including objects of either inner sense (phenomenal subjective experience, or consciousness) or outer sense (essentially embodied awareness of the external world), (ii) the objects of imagination, including mental imagery, objects of fictional imagining, objects of projective anticipation

about the future, the objects of episodic memory, objects in motion, and schematic objects, and (iii) the directly-intuitable, abstract formal objects of pure a priori intuition, namely, phenomenal space and phenomenal time, as “infinite given wholes” (CPR A19-49/B33-73, B151-156, A140-143/B179-182; Hanna, 2006: esp. Chs. 1–2 and 6, 2020). In this way, the objects of human sensibility, aka *sensible objects*, are *phenomena* in the broadest sense of that term, and their nature is also essentially *relational*, in that their actual or really possible existence inherently requires (i) intrinsic structural phenomenal spatial or temporal relations, and also (ii) the actual or really possible existence of rational, conscious, self-conscious human cognizers possessing an innately specified capacity for sensibility (Hanna, 2006: esp. Chs. 1–2 and 6).

By a diametric contrast, again according to Kant’s Critical philosophy, *noumena*, aka *supersensible objects*, are specifically the objects of the rational human *conceptual* mode of cognition, aka *thinking*, hence they’re specifically “entities of the understanding” or *Verstandeswesen* (CPR B306), such that, if they were to exist, they would be knowable only by a superhuman being possessing “intellectual intuition,” and furthermore these objects would be *non-sensible*, *non-spatiotemporal*, and have *intrinsic non-relational essences*, i.e., they would have “lonely” natures, such that they would be able to exist on their own even if nothing else existed in the world (CPR B71-72, A235-260/B294-315).

Now, those points about Kant’s theory of sensibility add up to the first part of the neo-organicist revolution, or what I’ve been calling *manifest realism*:

The natural universe is, at least in principle, *directly accessible* to rational human pure or a priori intuition and human sense perception alike, precisely because the natural universe consists of a complete, unified, structuralist system of *objective veridical appearances*, such that, X appears to be Y if and only if (i) X *really and truly is* Y, and (ii) the fact of X’s being Y is, at least in principle, *intersubjectively directly accessible* to all actual or possible rational human animals, and *not* idiosyncratically restricted to any single rational human individual or to any particular rational human community/social institution or special set of such communities/social institutions.

11.3 An Argument for the Core Thesis of Sensible Set Theory

Let’s assume that manifest realism is true. For the purposes of this chapter, by *set theory* I mean, in general, *classical Cantorian set theory*, but more specifically *Zermelo’s and Fraenkel’s well-ordered set theory plus the Axiom of Choice*, the latter of which is equivalent to licensing the power-set operation (constructing the set of all subsets) on finite or infinite sets, aka *ZFC* (Zermelo, 1930, 1967a, b, c; Hallett, 1984; Potter, 1990: Ch. 7).

Now, as we saw in Chap. 10 above, the classical Cantorian *Problem of the Continuum* can be formulated like this: What is the correct characterization of the fundamental quantitative structure of the manifestly real natural spacetime universe as a whole and all its sub-parts, aka *the cosmos*? According to *The Continuum*

Hypothesis, aka CH, also proposed by Cantor, the fundamental quantitative structure of the cosmos is that of *the mathematical continuum*, and the mathematical continuum has *either* the infinite denumerable cardinality of the natural numbers (= aleph null, i.e., \aleph_0) *or* the infinite non-denumerable cardinality of the real numbers (= 2 to the power of aleph null, i.e. 2^{\aleph_0}), *and* there is no number applicable to the mathematical continuum with a cardinality that falls strictly between that of the naturals and that of the reals (see, for example, Koellner, 2019). If CH is true, then one way in which it *can* be true is if the fundamental quantitative structure of the cosmos is *not only* countably or denumerably infinite as per the natural numbers, *but also* uncountably or non-denumerably infinite, aka “transfinite,” as per the real numbers, *and* there is no intermediate fundamental quantitative structure between those two. Correspondingly, by *the core thesis of SST*, I mean the biconditional thesis which says: *if and only if ZFC restricts itself to objects of human sensibility, aka sensible objects, is it really possible to prove CH.*

And here’s my argument for the core thesis of SST.

1. Let’s start with the “if” clause: if ZFC restricts itself to objects of human sensibility, aka sensible objects, then it’s really possible to prove CH.
2. We interpret ZFC in terms of manifest realism and Kant’s theory of pure a priori spatial and temporal intuition in the Transcendental Aesthetic section of the *Critique of Pure Reason* (CPR A19-49/B33-73), when it’s *also* taken together with Kant’s theory of extensive quantity and intensive quantity as captured by the “mathematical” principles of pure understanding, namely the Axioms of Intuition and the Anticipations of Perception (CPR A162-176/B201-218).
3. More specifically, we conjoin ZFC with manifest realism and these two additional Kantian theses (3.1) that there are two and only two forms of intuition, our innately specified a priori representations of space and time, which veridically pick out the two and only two elements of spacetime, namely, space and time as infinite given structural wholes, and (3.2) that these elements have either denumerably infinite extensive quantity or denumerably infinite intensive quantity, or some exponentiated combination of them, and no *other* kinds of quantity.
4. Then it follows that CH is true.
5. Here’s a detailed version of the argument I just sketched in steps 2–4, taken from *Cognition, Content, and the A Priori*:

According to [my view], the real number structure is logico-mathematically a priori constructible from the set of all consciously experienceable points and stretches in spacetime, together with the set of all possible degrees of any consciously experienceable sensory quality, for each consciously experienceable point or stretch in spacetime. What I mean is that it is an a priori fact about the nature of human experience that any set of points or stretches of experienceable spacetime can instantiate any [possible] degree of some or another sense-experienceable quality. Building on that a priori fact, [my] proposal is that for each distinct point or stretch in sense experienceable spacetime, of which there are a denumerably infinite number, we can also find a denumerably infinite number of different [possible] degrees of some or another sense-experienceable quality. Then we can think of the latter cardinal number as an exponent of the former cardinal number in an operation that yields the former’s power set—the set of all its subsets. The cardinality of the result of that power set operation is the same as the first transfinite number, aleph₁, which in turn has the

same cardinality as the real numbers— 2^{\aleph_0} . Putting the same point in specifically Kantian terminology taken from the first *Critique*, [I’m proposing] that the basic structure of the continuum is the non-empirical extensive quantity structure as described in The Axioms of Intuition (CPR A162–166/B201–207) insofar as it is also exponentiated, according to the power set operation, by the non-empirical intensive quantity structure as described in The Anticipations of Perception (CPR A165–176/B207–218). In this sense, the basic structure of the continuum is the Kantian synthesis of the extensive quantity structure and the intensive quantity structure. (Hanna, 2015: p. 391, square-bracketed material added)

6. Therefore, if ZFC restricts itself to objects of rational human sensibility, aka sensible objects, then it’s really possible to prove CH, i.e., I’ve proved the “if” clause.
7. Now what I need to prove is the “only if” clause: only if ZFC restricts itself to objects of human sensibility, aka sensible objects, is it really possible to prove CH.
8. As is well-known, CH is one of the most central and important “open”—i.e., unsolved—problems in set theory (see, e.g., Koellner, 2019).
9. Therefore, one crucial bit of evidence for the truth of the “only if” clause is that, if we assume that my argument for the “if” clause is indeed sound, then since CH is an open or unsolved problem, it follows that no one so far has been able to prove CH in any way *other* than the one I sketched in steps 2–6.
10. But of course that’s not a logically *decisive* argument, since it’s at least *prima facie conceivable* that in the future someone might in fact be able to prove CH in some way other than the one I sketched in steps 2–6.
11. Nevertheless, there *is* a logically decisive argument for the “only if” clause, by *reductio*, as follows.
12. Let’s suppose that we’re allowed to form sets in ZFC using not only objects of human sensibility, aka sensible objects, but also *noumenal* objects, aka *supersensible* objects.
13. Then, *the universal set or the biggest set*, aka “the class of all ordinals,” aka “the universe V of all sets” (Bagaria, 2021: section 4), aka ∞ , paradigmatically, is one of those noumenal or supersensible objects: indeed, ∞ is essentially the same as what Kant calls the *omnitude realitatis* (CPR A576/B604), i.e., *that which contains all of reality*.
14. But ∞ , when considered *as* a set, *cannot* also contain itself as a member: for if ∞ *were* also to contain itself as a member, then (contrary to hypothesis) ∞ would *not* be the universal set or biggest set, because there would be an even *bigger* set than ∞ , containing all the members of ∞ *plus* ∞ itself.
15. Therefore, ∞ is not a member of itself.
16. Now, let’s consider the set of *all* sets that, like ∞ , are not members of themselves, and call that set K : is K a member of itself, or not?
17. Obviously, K is a member of itself if and only if it is not a member of itself, i.e., Russell’s paradox.
18. So, if noumenal or supersensible objects (paradigmatically, like ∞) are allowed into ZFC as sets, then ZFC is inconsistent; now to be sure, calling ∞ a “proper class” and therefore *not* a “set,” technically avoids the paradoxical inconsis-

tency, but it does not isolate the *genuine* source of the problem about ∞ and its logico-mathematical kith-&-kin—for example, “large cardinals” (Bagaria, 2021: section 10; Koellner, 2011)—which is *not explicitly ruling out the admission of noumenal or supersensible objects into ZFC*.

19. Therefore, in order for ZFC to be consistent *and* usable for proving CH—given the “independence results” which show that the truth of ZFC is consistent with the falsity of CH (Bagaria, 2021: section 8; Koellner, 2011)—then ZFC must be restricted to forming sets using objects of human sensibility, aka sensible objects, *only*, i.e., only if ZFC restricts itself to objects of human sensibility, aka sensible objects, is it really possible to prove CH, i.e., I’ve proved the “only if” clause.
20. Then, conjoining steps 6 and 19, it follows that if and only if ZFC restricts itself to objects of human sensibility, aka sensible objects, is it really possible to prove CH, i.e., I’ve proved the core thesis of SST.

11.4 Conclusion

It follows from everything I’ve argued in this chapter, that in order for ZFC to be a *consistent* set theory that’s *also* able to used, together with manifest realism and some additional broadly *Kantian* theses, *for proving CH*, then we not only can but also should accept *only* a version of classical Cantorian set theory/ZFC that’s essentially restricted in a broadly Kantian way, namely Sensible Set Theory. Indeed, I think it’s self-evidently clear from steps 12–18 in the argument in Sect. 11.3, that many if not most of the hard philosophical or otherwise theoretical problems about infinity for *naïve, non-manifest-realist, unKantian* classical Cantorian set theory in general and ZFC in particular (see, for example, Rucker, 2005), flow from these theories’ deployment of a metaphysically/ ontologically and epistemically *unconstrained* notion of an object, that fails to bear theoretical witness to the basic manifest realist and Kantian metaphysical/ontological and epistemic distinction between objects of human sensibility, aka sensible objects, on the one hand, and noumenal or supersensible objects on the other.

That point in turn allows me to pun relevantly on another meaning of the term “sensible” in my neologism “Sensible Set Theory,” namely, “having or showing wisdom or common sense; reasonable, judicious” (Hawkins & Allen, 1991: p. 1321). Or, to conclude this chapter by putting the gravamen of my overall argument in many fewer words, ZFC not only can but should enact a “transcendental turn,” and henceforth be interpreted and deployed only as a *fully sensible set theory*, namely, Sensible Set Theory, aka SST, aka *Kantian* ZFC, aka KZFC.

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Chapter 12

Neo-Organicism and the Rubber-Sheet Cosmos



Abstract In this chapter, I argue that the affirmation and recognition that complementarity, entanglement, and nonlocality pervade manifest natural reality at all basic scales finally enables us to reject the paradoxically problematic *layered world picture*, characteristic of metaphysical materialism or physicalism, and also part-&-parcel of the mechanistic worldview, and replace it with the inherently non-paradoxical, non-problematic, and original and paradigm-shifting no-layered scalar dynamic world picture that's part-&-parcel of what I call *the rubber sheet cosmos*.

What, then, is time? I know well enough what it is, provided that nobody asks me; but if I am asked what it is and try to explain, I am baffled. (Augustine, 1961: book XI, section 14, p. 264)

Quantum Gravity, broadly construed, is a physical theory (still “under construction”) incorporating both the principles of general relativity and quantum theory. Such a theory is expected to be able to provide a satisfactory description of the microstructure of spacetime at the so-called Planck scale, at which all fundamental constants of the ingredient theories, c (the velocity of light in vacuo), \hbar (the reduced Planck's constant), and G (Newton's constant), come together to form units of mass, length, and time. This scale is so remote from current experimental capabilities that the empirical testing of quantum gravity proposals along standard lines is rendered near-impossible.... Dutch artist M.C. Escher's elegant pictorial paradoxes are prized by many, not least by philosophers, physicists, and mathematicians. Some of his work, for example *Ascending and Descending*, relies on optical illusion to depict what is actually an impossible situation. Other works are paradoxical in the broad sense, but *not* impossible: *Relativity* depicts a coherent arrangement of objects, albeit an arrangement in which the force of gravity operates in an unfamiliar fashion.... Quantum gravity itself may be like this: an unfamiliar yet coherent arrangement of familiar elements. Or it may be more like *Ascending and Descending*, an impossible construction which looks sensible in its local details but does not fit together into a coherent whole when using presently existing building materials. If the latter is true, then the construction of a quantum theory of gravity may demand entirely unfamiliar elements. Whatever the final outcome, the situation at present is one of flux, with a great many competing approaches vying for the prize. However, it is also important to note that the prize is not always the same: string theorists seek a unified theory of all four interactions that has the power of explaining such things as the numbers of generations of elementary particles and other previous inexplicable properties. Other approaches are more modest, and seek only to bring general relativity in line with quantum theory, without necessarily invoking the other interactions. Hence, the *problem* of quantum gravity can mean very different things to different researchers and

what constitutes a possible solution to one group might not qualify as such to another.... Given that quantum gravity does not yet exist as a working physical theory, one might legitimately question whether philosophers have any business being involved at this stage. Certainly the philosopher's task will be somewhat different from that faced when dealing with a more-or-less settled body of theory such as classical Newtonian mechanics, general relativity, or quantum mechanics. In such cases, one typically proceeds by assuming the physical soundness of the theory or theoretical framework and drawing out the ontological and perhaps epistemological consequences of the theory, trying to understand what it is that the theory is telling us about the nature of space, time, matter, causation, and so on. Theories of quantum gravity, on the other hand, are bedeviled by a host of technical and conceptual problems, questions, and issues that make them largely unsuited to this kind of interpretive approach. (Weinstein & Rickles, 2021: synopsis and section 1)

12.1 Introduction: From the 2022 Nobel Prize in Physics to the No-Leveled Scalar Dynamic World Picture

The gravamen of the press release for the 2022 Nobel Prize in Physics reads as follows:

Alain Aspect, John Clauser and Anton Zeilinger have each conducted groundbreaking experiments using entangled quantum states, where two particles behave like a single unit even when they are separated. Their results have cleared the way for new technology based upon quantum information.

The ineffable effects of quantum mechanics are starting to find applications. There is now a large field of research that includes quantum computers, quantum networks and secure quantum encrypted communication.

One key factor in this development is how quantum mechanics allows two or more particles to exist in what is called an entangled state. What happens to one of the particles in an entangled pair determines what happens to the other particle, even if they are far apart.

For a long time, the question was whether the correlation was because the particles in an entangled pair contained hidden variables, instructions that tell them which result they should give in an experiment. In the 1960s, John Stewart Bell developed the mathematical inequality that is named after him. This states that if there are hidden variables, the correlation between the results of a large number of measurements will never exceed a certain value. However, quantum mechanics predicts that a certain type of experiment will violate Bell's inequality, thus resulting in a stronger correlation than would otherwise be possible.

John Clauser developed John Bell's ideas, leading to a practical experiment. When he took the measurements, they supported quantum mechanics by clearly violating a Bell inequality. This means that quantum mechanics cannot be replaced by a theory that uses hidden variables.

Some loopholes remained after John Clauser's experiment. Alain Aspect developed the setup, using it in a way that closed an important loophole. He was able to switch the measurement settings after an entangled pair had left its source, so the setting that existed when they were emitted could not affect the result.

Using refined tools and long series of experiments, Anton Zeilinger started to use entangled quantum states. Among other things, his research group has demonstrated a phenomenon called quantum teleportation, which makes it possible to move a quantum state from one particle to one at a distance.

“It has become increasingly clear that a new kind of quantum technology is emerging. We can see that the laureates’ work with entangled states is of great importance, even beyond the fundamental questions about the interpretation of quantum mechanics,” says Anders Irbäck, Chair of the Nobel Committee for Physics. (Nobel Prize, [2022](#))

For the purposes of this chapter, I’ll use the following contextual definitions of *complementarity*, *entanglement*, and *nonlocality*.

Complementarity: Two facts, phenomena, properties, things, or states of affairs X and Y are *complementary* if and only if X and Y are *essentially different*, and in that sense they’re *mutually exclusive*, yet they also *mutually necessitate each other in the overall constitution of a more comprehensive fact, phenomenon, property, thing, or state of affairs Z*, such that Z has a *dual essence* consisting of the mutually necessitating dual aspects, elements, or factors X and Y.

Entanglement: Two facts, phenomena, properties, things, or states of affairs X and Y are *entangled* if and only if X and Y are *non-identical* and also *mutually causally co-determining*, in the sense that fixing the precise quantities and specific characters of X’s causal operations and causal powers also requires fixing the the precise quantities and specific characters of Y’s causal operations and causal powers, and conversely.

Nonlocality: An act, event, or process of causal determination CD is *nonlocal* if and only if CD operates at any distance whatsoever, no matter how near or far, at greater-than-light or superluminary speeds, up to and including *synchronous causation* at any distance whatsoever, even despite the fact that this mode of causal determination is in violation of General Relativity Theory (GRT), which postulates the speed of light, 186,000 miles per second, as a universal cosmological causal speed limit and causal constraint, and therefore from the standpoint of GRT, as per Einstein’s famous quip, nonlocal CD is nothing but “spooky action at a distance.”

Granting those definitions, then here are four claims.

First, in a simple or complex living organism, the *life* of that organism is the negentropic, non-equilibrium thermodynamic, autopoietic or self-organizing *global activating form or structure* of that organism, thereby standing in a *complementary hylomorphic (i.e., matter-form) relation* to that organism, and, in order to survive, a living organism must achieve a *nonlocal and synchronous* homeostatic balance between the self-organized causal operations of its inner states and the causal operations of its outer environment (Schrödinger, [1944/1967](#); Bernal, [1967](#); Nicolis & Prigogine, [1977](#); Varela et al., [1974](#); Varela, [1979](#); Prigogine & Stengers, [1984](#); Prigogine, [1997](#); Torday et al., [2020](#)).

Second, in a rational human animal, the conscious and self-conscious *mind* of that highly complex kind of organism is the non-equilibrium thermodynamic autopoietic or self-organizing *global activating form or structure* of that kind of organism, thereby standing in a *complementary hylomorphic relation* to that kind of organism, and, other things being equal, whenever I spontaneously consciously

effectively desire, or will, to raise my arm (or move my body in any other way, within the limits of its causal powers and contextual constraints), then *I am the ultimate source of that basic act*, which is therefore *free* and neither deterministic nor indeterministic, and my free performance of that arm movement is *nonlocal* and *synchronous* with my act of willing (Hanna & Maiese, 2009; Hanna, 2018; and also Sect. 2.3 above).

Third, in classical Newtonian mechanics, the equation $F = MA$ says that acceleration—especially including acceleration due to gravity—acts *nonlocally and synchronously* on the mass of any object of any size, so as to generate its force; although, of course, classical Newtonian mechanics would have to be systematically embedded as a restricted fragment within an essentially richer physics that not only includes Special Relativity Theory and General Relativity Theory (STR-GTR) and quantum mechanics (QM), but also combines them in a way that overcomes STR-GTR's and QM's various *prima facie* gaps, mutual discontinuities, and mutual inconsistencies.

Fourth, when I drive my car around a corner, the movement of the steering wheel as I turn it, the causal operations of the steering column, the causal operations of the rest of the steering system, and the movement of car's wheels on the pavement, are all *nonlocal* and *synchronous*.

From these four claims, I want to derive the thesis *that complementarity, entanglement, and nonlocality pervade manifest natural reality at all basic scales*.

For my purposes here, the crucial point made by the Nobel Prize press release I quoted above is the widespread contemporary scientific *acceptance* of the fact and notion of entanglement in quantum mechanics (Bub, 2020). But actually, if one *also* accepts the fact and notion of *nonlocality* in quantum mechanics, then one can also consistently and coherently accept not only entanglement but also *a hidden variables theory*, for example, a non-standard version of Bohmian mechanics (Goldstein, 2021) that's *non-equilibrium-thermodynamic*, *non-deterministic*, and also *non-indeterministic*, according to which there are wave-particle duality and complementarity, entanglement, nonlocality, and, as Bohmian “beables” (Bell, 1987b), *naturally creative “pilot wavicles,”* which necessarily include the experimental situation and the free acts of the experimenter who is performing the relevant measurements (hence, also accepting “contextuality”), that guide the nonlocal causal operations and causal powers of entangled particles. Indeed, I've already argued for this in Chap. 6 above.

Moreover, it should be obvious already that precisely because the cases I've briefly described span all the basic scales of natural reality—from the *micro-* or very small-sized scale (i.e., manifest natural reality insofar as it involves particles and waves), through the *meso-* or middle-sized scale (i.e., manifest natural reality insofar as it involves organisms, rational human animals, aka people, and everyday objects and events like driver-piloted cars going around corners), to the *mega-* or very large-sized scale (i.e., manifest natural reality insofar as it involves very large distances and time-scales, and immense forces applying to masses of very great density or very large size, especially including gravitational force, e.g., planets, stars, black holes, galaxies, etc.)—then it follows that complementarity,

entanglement, and nonlocal synchronous causation are *shared inherent features of all the cases at all basic scales*.

Now, supposing that one accepted this thesis, then the fundamental problem that the theory of *quantum decoherence* (Bacciagaluppi, 2020), i.e., the theory of quantum systems in which complementarity, entanglement, and/or nonlocality are suppressed, is supposed to solve, namely, the fundamental problem of how complementary, entangled, nonlocal microphysical facts, phenomena, properties, things, or states of affairs at the micro- or quantum scale studied by QM mysteriously emerge upwards to become *non-complementary, non-entangled, local* macrophysical facts, phenomena, properties, things, or states of affairs at the meso- or organismic, rational human animal, and everyday-objectual scale studied by biology and philosophy, and also at the mega- or cosmological scale studied by STR-GTR, *would be dissolved*. For there would be *no such thing* as mysterious *upwards strong supervenient emergence*—and no such thing as equally mysterious *downwards strong supervenient reduction*, either—from one ontological layer or level to another ontological layer or level of natural reality; indeed, there would be no such thing as *different ontological layers or levels* of natural reality at all, but instead only *different basic scales* of the same all-encompassing *no-layered* natural reality: micro-, meso-, and mega-. In short, the affirmation and recognition that complementarity, entanglement, and nonlocality pervade natural reality at all scales finally enables us to reject the paradoxically problematic *layered world picture*, characteristic of metaphysical materialism or physicalism, and also part-&-parcel of the mechanistic worldview, and replace it with the inherently non-paradoxical, non-problematic, and original and paradigm-shifting no-layered scalar dynamic world picture that's part-&-parcel of what I call *the rubber sheet cosmos*. And that's what coming up next.

12.2 From the No-Layered Scalar Dynamic World Picture to the Rubber Sheet Cosmos

I just introduced *the no-layered scalar dynamic world picture*, which says that natural reality is pervaded by *complementarity, entanglement, and nonlocality* at all basic scales—the *micro-* or very small-sized scale (i.e., natural reality insofar as it involves particles and waves), through the *meso-* or middle-sized scale (i.e., natural reality insofar as it involves organisms, rational human animals, aka people, and everyday objects and events like driver-piloted cars going around corners), to the *mega-* or very large-sized scale (i.e., natural reality insofar as it involves very large distances and time-scales, and immense forces applying to masses of very great density or very large size, especially including gravitational force, e.g., planets, stars, black holes, galaxies, etc.). Correspondingly, (i) the physics of the micro-scale is approximately correctly described by QM, as per the current Standard Model of particle physics (SMPP), but with some modifications, (ii) the physics of the

meso-scale is approximately correctly described by classical Newtonian mechanics (NM), but with some modifications, and (iii) the physics of the mega-scale is approximately correctly described by STR-GTR, as per the Standard Model of cosmology (SMC), but with some modifications.

These modifications, however, *matter a lot*—pun intended. More specifically, just as, in the early twentieth century, NM had to be systematically embedded as a restricted fragment within an essentially richer physics that included QM and STR-GTR, so too, if the neo-organicist revolution, aka science for humans, is correct, then in the future QM and STR-GTR *will both have to be systematically embedded as restricted fragments within an essentially richer physics* that's *neither* indeterministic like QM *nor* deterministic like NM and STR-GTR, and in which the speed of light is *not* a universal cosmological causal speed limit and causal constraint—that is, *universal locality* will have to go.

Does this mean that according to me, the famous Einsteinian energy-mass equation $e = mc^2$ is false? No: I think that it's true. It just means that according to me, $c = \text{whatever quantity it is}$ that guarantees *not only* the null result of the Michelson-Morley experiment in STR-GTR and all other similar experiments, as well as Einstein's prediction about the perihelion of Mercury, *but also* guarantees the result of the Two Slit experiment in QM and all other similar dual-path experiments. And it's also entirely possible that c is not a *single* quantity, but in fact a *class* of quantities, the set of outputs of a more fundamental one-place or many-place function. And *gravity* will have something essential to do with c , whatever it is. So, if I'm correct about all this, then what will this essentially richer physics look like, at least in non-technical outline? In the next section, I'm going to argue that manifest natural reality as a whole and in all its parts, at all the basic scales, aka *the cosmos*, is fundamentally an uncomputable, negentropic, irreversible, processual, purposive, self-organizing, time-unidirectional or time-asymmetric, non-equilibrium thermodynamic *topological* system, that I'll call *the rubber-sheet cosmos*.

12.3 The Rubber Sheet Cosmos

I'll begin with two informative non-technical definitions of the mathematical science of *topology*, the first one very brief, and the second one somewhat more detailed:

Topology studies properties of spaces that are invariant under any continuous deformation. It is sometimes called “rubber-sheet geometry” because the objects can be stretched and contracted like rubber, but cannot be broken. (Univ. of Waterloo, [2022](#))

Topology is the mathematical study of the properties that are preserved through deformations, twistings, and stretchings of objects. Tearing, however, is not allowed. A circle is topologically equivalent to an ellipse (into which it can be deformed by stretching) and a sphere is equivalent to an ellipsoid. Similarly, the set of all possible positions of the hour hand of a clock is topologically equivalent to a circle (i.e., a one-dimensional closed curve with no intersections that can be embedded in two-dimensional space), the set of all possible

positions of the hour and minute hands taken together is topologically equivalent to the surface of a torus (i.e., a two-dimensional surface that can be embedded in three-dimensional space), and the set of all possible positions of the hour, minute, and second hands taken together are topologically equivalent to a three-dimensional object.... Topology began with the study of curves, surfaces, and other objects in the plane and three-space. One of the central ideas in topology is that spatial objects like circles and spheres can be treated as objects in their own right, and knowledge of objects is independent of how they are “represented” or “embedded” in space. For example, the statement “if you remove a point from a circle, you get a line segment” applies just as well to the circle as to an ellipse, and even to tangled or knotted circles, since the statement involves only topological properties. Topology has to do with the study of spatial objects such as curves, surfaces, the space we call our universe, the space-time of general relativity, fractals, knots, manifolds (which are objects with some of the same basic spatial properties as our universe), phase spaces that are encountered in physics (such as the space of hand-positions of a clock), symmetry groups like the collection of ways of rotating a top, etc. (Wolfram MathWorld, 2022)

With that introductory gloss of topology in front of us, and assuming for the purposes of argument, the soundness of what I’ve already argued in Chaps. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11 above, especially in Chaps. 3, 7, and 11, then I want to emphasize, as a preliminary to what follows in this section, that hypotheses in recent and contemporary physics about the initial conditions of the early cosmos, that appeal, for example, to “cosmic inflation” and/or “the Multiverse,” are (i) scientifically unnecessary, (ii) ontologically in violation of Ockham’s Razor (i.e., “don’t multiply entities without necessity”), and above all, (iii) *noumenal* hypotheses. According to Kant’s Critical philosophy, *noumena*, aka *things in themselves*, aka *supersensible objects*, are specifically the objects of the rational human *conceptual* mode of cognition, aka *thinking*, hence they’re specifically “entities of the understanding” or *Verstandeswesen* (CPR B306), such that, if they were to exist, they would be knowable only by a superhuman being possessing “intellectual intuition,” and furthermore these objects would be *non-sensible*, *non-spatiotemporal*, and have *intrinsic non-relational essences*, i.e., they would have “lonely” natures, such that they would be able to exist on their own even if nothing else existed in the world (CPR B71-72, A235-260/B294-315). The correct philosophical responses to noumenal hypotheses in recent and contemporary physics, and correspondingly to speculative theoretical commitments to the existence and natures of noumena more generally, in recent and contemporary physics—let’s call that, collectively, *noumenal thinking in physics*—are *radical agnosticism* and *methodological eliminativism* with respect to the noumenal objects postulated by these physical theories (Hanna, 2017; see also Hossenfelder, 2018).

By sharp contrast to noumenal thinking in physics—and indeed also to noumenal thinking in any *other* formal or natural science, in philosophy, or in theology—the *sensibility first* approach to Kant’s Critical philosophy and to broadly and radically Kantian philosophy alike, says that

[i]n the practical realm just as in the theoretical realm, everything comes down to *human sensibility* as an equally empirical and non-empirical primitive starting point that constitutively motivates, intentionally pervades, and intentionally structures our innately-specified yet also “human, all-too-human” capacities for theoretical and practical rationality, *all the way up*. *Strong Kantian non-conceptualism* says that ... the faculty of human intuition or

Anschauung, that is, human inner and outer sense perception, together with the faculty of imagination or *Einbildungskraft* [Hanna, 2020], jointly constitute this sensible starting point for objective cognition and theoretical reason; and *strong Kantian non-intellectualism* says that ... human affect, desire, and moral emotion—in a word, the human *heart*—jointly constitute this sensible starting point for free agency and practical reason. (Hanna, 2021: p. 97, square bracketed material added; see also Hanna, 2016)

In this connection, it's crucial to recognize that there's a radical philosophical *Gestalt*-shift about the nature of human cognition and knowledge that's packed into the sensibility first approach to Kantian philosophy, which is that *human sensibility is veridical*, insofar as it *directly referentially delivers* the actually existing manifestly real world *just as it objectively is*; and in turn, *all error and falsity come in via conceptual interpretations of, judgments or propositions about, and theories about*, what's "always already" (*immer schon*) veridically delivered through human sensibility. The sensibility first *Gestalt*-shift about the nature of human cognition and knowledge precisely inverts the classical idea, characteristic of classical Rationalism and Empiricism alike, and also of non-Western philosophies like Buddhism, that human sensibility is nothing but a subjective distortion of—in effect, nothing but an illusory filter, screen, or "veil" placed over—a noumenal or "really real" world, and that *only* conceptualization, judgment or propositional thinking, and theorizing can yield veridical reference, truth, and knowledge about the world. Nevertheless, this sensibility first *Gestalt*-shift *doesn't* mean that conceptualization, judgments or propositions, and theories are *always*, or necessarily, erroneous or false, but only that they're *fallible*: that is, they *can* be erroneous or false, although also *sometimes* correct and true, and in this way, all error and falsity *derives from* this discursive (i.e., conceptual, judgmental/propositional, and theorizing) source of human cognition, and *not* from the sensible source of human cognition, which is veridical. Moreover, the veridical referentiality of the sensible source is—to use early Wittgenstein's terminology—a *showing* (*zeigen*), and not a *describing* or *saying* (*sagen*) (Wittgenstein, 1921/1981: p. 79, prop. 4.1212).

Now I'm in a position to raise the following question: When our innately-specified non-empirical or empirical capacity for *human sensibility* delivers its veridically referential, essentially non-conceptual cognitions of the manifestly real natural world, then how is the representational content of human sensible cognition formatted and structured? Answer: *spatiotemporally*.

Therefore, according to weak or counterfactual transcendental idealism (see esp. Chap. 7 above), manifestly real infinite space, as having infinite extension or extent/stretch and infinite divisibility (aka "extensive quantity"), *necessarily conforms* to the innately-specified structure (as it were, the "factory-setting") of our specifically human capacity for spatial representation, i.e., pure spatial intuition, which is *proto-Euclidean*, in that it presents manifestly real space as (i) *rectilinear* (i.e., having zero curvature), (ii) *egocentrically-centered* on our own living organismic minded animal bodies, and (iii) fully embedded in an *orientable* (i.e., *intrinsically directional*) *topological framework*. But, even though our innately specified "factory-setting" is proto-Euclidean, and thus presents the manifestly real infinite extensive space as being rectilinear/having zero curvature, egocentrically-centered, and orientable, in

fact manifestly real infinite space itself is of *variable curvature*, from zero to infinity. Hence the classical science of Euclidean geometry, as a *mathematical theory* about space, is erroneous and false to the extent that it claims that *all* space is rectilinear/has zero curvature and *neutral* with respect to centeredness and directionality. At the same time, however, our proto-Euclidean innately specified “factory-setting” for representing manifestly real infinite extensive space as being rectilinear/having zero curvature, is *only a lower-bound limit case with respect to curvature*, so just as factory-settings on ordinary machines can be readjusted and reconfigured when you’ve taken them home, so too our non-mechanical innately specified capacity for representating manifestly real infinite extensive space can be readjusted and reconfigured *via human spatial imagination*, for *all degrees of curvature*, right up to the upper-bound limit case of virtually infinite curvature, occurring at the center of a black hole.

Correspondingly, again according to weak or counterfactual transcendental idealism, manifestly real infinite *time* also necessarily conforms to the innately specified structure or “factory-setting” of our specifically human capacity for *temporal* representation, pure *temporal* intuition, which presents manifestly real infinite time as (i) an *asymmetrically forward-directed*, aka successive, *recursively-generated series of homogeneous units*, aka moments, (ii) each moment of which has some or another degree of consciously-experienceable quality, including monadic qualities like colors, but also relational qualities like force, bulk/mass, and weight (aka “intensive quantity”). By virtue of feature (i), manifestly real infinite time is *the intended model of the theory of the natural numbers* (Hanna, 2015: ch. 8), i.e., time has the cardinality of aleph null, i.e., \aleph_0 , the only-denumerable infinity that frames the mathematical continuum of the cosmos at its lower bound. Moreover, the upper bound cardinality of the mathematical continuum is *transfinite*, i.e., 2 to the power of aleph null, i.e., 2^{\aleph_0} , the cardinality of the real numbers, which Cantor proved using the diagonal argument, i.e., a specifically *topological* argument, and the power set operation, but which can also be proved in a broadly and radically Kantian framework by taking the only-denumerable set of *extensive* quantities to be *exponentiated* by the only-denumerable set of *intensive* quantities (Cantor, 1891, 2019; Hanna, 2015: pp. 391–392; and Chap. 11 above). But above all, *both* kinds of cardinality are veridically referred to and *shown* by human sensibility. Closely related, the Löwenheim-Skolem theorem, which in its simplest formulation says that every consistent set theory has an only-denumerable model, entails that since our theory of the mathematical continuum has a *non-denumerable* model (i.e., the real numbers), then it also has an *only-denumerable* model (i.e., the natural numbers) (Löwenheim, 1915/1967; Skolem, 1922/1967a; and Chap. 9 above). Therefore, *the representation of this only-denumerable model is built right into the innately specified structure or “factory-setting” of human sensible pure intuition* and thus it’s built right into our capacity for representing manifestly real infinite intensive time. So, whenever, by means of human sensibility, we represent the manifestly real cosmos, and thereby represent manifestly real infinite intensive time in a necessarily complementary relation to manifestly real infinite extensive space, then we’re always and necessarily veridically referring to and thereby *showing* (although by no

means always or necessarily describing or *saying*) the truth of Cantor's *Continuum Hypothesis* (Koellner, 2019; and Chap. 11 above).

Now, what about causation and motion in the manifestly real cosmos? In my opinion, the great causal discovery of the modern period, made first—it seems—by Kant (Hanna, 2006: pp. 232–236), but in any case also made by others later, especially including Einstein in the early twentieth century, is what can be called *dynamic field causation* or, in the terminology of this chapter, *dynamic rubber-sheet causation*. As is well-known, the existence of a *static fluid aether* was disproved by the null result of the Michelson-Morley experiment, together with Einstein's assumptions about the speed of light and the Fitzgerald-Lorentz contraction (Einstein et al., 1923/1952: esp. pp. 3–71; Eddington, 1929: ch. 1; Born, 1962: pp. 214–224), and correspondingly, the static aether's non-existence was incorporated into Einstein's STR and GTR. But it's *also* not only conceptually, but also physically possible, for the fluid aether *itself* to be inherently active and causally efficacious, i.e., an inherently active and causally efficacious *dynamic fluid aether*, and indeed Einstein himself did seriously consider this conceptual and physical possibility, and *never definitively ruled it out* (Rynasiewicz, 1996: esp. pp. 293–299). In any case, what I'm proposing is that we construe such an inherently active and causally efficacious dynamic fluid aether as a manifestly real, inherently active and causally efficacious *rubber-sheet spacetime continuum* that's pervaded by complementarity, entanglement, and nonlocality at all basic scales: micro-, meso-, and mega-.

In order to get a handle on this further “new idea” (Siegel, 2020; and Chap. 6 above), let's begin by imagining a huge and indeed cosmic rubber sheet being inherently deformed in various ways: the rubber sheet in this analogy is the topological “fabric” or finegrained structure of microcosmic, mesocosmic, and megacosmic spacetime, with variable space-curvature. At the microcosmic scale, waves, construed as *non-deterministic*, *non-indeterministic* “pilot-wavicles” for guiding particles, constituting *nonlocal* “hidden variables,” thereby inherently involving nonlocal causal operations and powers, that also inherently involve the experimental situation and the free acts of the experimenter, i.e., *contextuality* (Bohm, 1952; Bohm & Hiley, 1975), are salient ripples in the cosmic rubber sheet, like a blanket suspended over the ground and attached somewhat loosely at all four corners to pegs, flapping in a light wind, or even better, like a large elastic sheet—for example, a trampoline—that's attached somewhat loosely to its moorings, flapping in a heavy wind; but in any case, the crucial difference is that in the inherently active and causally efficacious rubber-sheet spacetime continuum itself, the waves are being spontaneously internally generated, starting with the Big Bang Singularity and carrying forward throughout the total past, present, and future causal evolution of the rubber-sheet cosmos.

Now, assuming spontaneous internal generation as a primitive fact about the rubber-sheet cosmos, if the cosmic rubber sheet is contracted or shrunk around a center point, then that's *attraction or centripetal force*, but if it's expanded or stretched outwards from a center point, that's *repulsion or centrifugal force*. Moreover, the rubber-sheet cosmos can also be conceived as being expanded or stretched outwards as a whole, over time, in all directions, from the Big Bang Singularity forward, which

is *cosmic expansion*. We can also think of material objects, at all basic scales, all the way from galaxies, stars, and planets (mega-scale), through organisms, rational human animals or people, and everyday objects (meso-scale), to particles and waves (micro-scale), as *being essentially embedded in the cosmic rubber sheet itself*: then, by analogy, *gravitation* is the spontaneous internal generation of a salient indentation in the cosmic rubber sheet, which thereby contracts or shrinks the sheet attractively or centripetally around the material object embedded in that indentation. Elaborating the gravitational analogy, then *black holes* are spontaneously internally generated maximally deep indentations in the cosmic rubber sheet, embedding maximally dense material objects, which go so far down that if the rubber-sheet fabric or fine-grained structure of spacetime were any further deformed in that way, then it would rip or tear. Relatedly, what's misleadingly called "dark matter" or "dark energy" is just *the proper sub-set or amount* of all material or physical objects that are, or energy that is, essentially embedded in the fabric or finegrained structure of the inherently active, causally efficacious, holistically expanding rubber-sheet spacetime continuum, such that the specific character of each of the members of that proper sub-set, is that none of them is massive enough on its own to make salient ripples (waves) or indentations (gravitational fields) in the cosmic rubber sheet (see also, e.g., Oppenheim, 2023; Oppenheim & Russo, 2024).

Now, thinking of the *total set or amount* of material or physical objects that are, or energy that is, essentially embedded in the cosmic rubber sheet, i.e., that's essentially embedded in the inherently active, causally efficacious, holistically expanding rubber-sheet spacetime continuum—whether it's embedded in "salient ripples" or waves, in "salient indentations" or gravitational fields, or non-saliently embedded in the cosmic rubber sheet as "dark matter" or "dark energy"—then it's clear that if any part of the sheet is deformed in a spontaneously internally generated way, whether by making waves, by attraction/indentation, by repulsion/expansion, or in some other way, then absolutely everything else in the cosmic rubber sheet, including all the essentially embedded material or physical objects and energy, whether salient or "dark," is also thereby deformed in a necessarily reciprocal way: that's complementarity, nonlocality, and entanglement.

Of course, as I mentioned above, Einstein rejected the static aether because of the null result of the Michelson-Morley experiment, together with the assumption or fact that light always travels at the same velocity, 186,000 miles per second, with respect to every observer/inertial frame, together with the assumption or fact of the Fitzgerald-Lorentz contraction. Using those assumptions or facts, Einstein also put a universal cosmological speed limit and constraint on causation, aka *locality*, such that causal operations can never exceed the speed of light, whether via individual particles interacting (efficient causation) or interactive waves (which he conceptualized as constellations or teams of particles, so basically an extension of efficient causation). To be sure, Einstein's model of gravitation, somewhat like my rubber-sheet cosmos model (which, however, *unlike* Einstein's model, is *three-dimensional*, and *doesn't* explanatorily or ontologically reduce the categorically distinct structure of time to space), centrally includes the thesis that gravitational fields are salient indentations in a *four-dimensional* rubber-sheet spacetime manifold with variable

space curvature, in which (salient, not “dark”) material objects are, or energy is, essentially embedded. But as I mentioned above, Einstein *also* adamantly refused to go all the way to a universal dynamic aether, i.e., he refused to go all the way to any sort of manifestly real, inherently active and causally efficacious, holistically expanding rubber-sheet spacetime continuum, like the one I’ve briefly described: why?

In my opinion, it’s at least in part because Einstein realized that this would entail that entanglement and nonlocality are *pervasive features of causation* in the rubber-sheet spacetime continuum, which he famously rejected in the context of QM as “spooky action at a distance.” Above all, however, it would also have involved Einstein’s giving up his brilliant and revolutionary idea that the speed of light places a universal cosmological speed limit and constraint on causation—which, again in my opinion, is intimately related to the fact that SRT is essentially a way of operationalizing the basic concepts of physics, by conceiving it as a mathematical theory about the operations of experimental measuring instruments, especially those used for tracking light-signals, not about the manifestly real cosmos itself (see Chap. 5 above). In any case, according to my neo-organicist conception of the rubber sheet cosmos, *motion* is *also* a primitive fact. More precisely, according to my neo-organicist conception, the primitive fact of motion is the synthetic a priori necessitated spontaneous transiting of uncomputable, negentropic, irreversible, processual, purposive, self-organizing, time-unidirectional or time-asymmetric, non-equilibrium thermodynamic systems, in explanatorily and ontologically irreducible manifestly real time, modelled on our own essentially embodied mentalistic occupation of spacetime regions, across overlapping regions or sub-regions in the inherently active and causally efficacious rubber-sheet spacetime continuum (see Chap. 10 above); and another name for the primitive fact of motion is *natural creativity*.

In turn, moreover, the spontaneous internally generated operations of the inherently active and causally efficacious rubber-sheet spacetime continuum, together with the naturally creative processes embedded it, would be the neo-organicist analogue of Aristotle’s pre-modern idea of “matter” (*hyle*), as potentiality (*dynamis*); and *time*, considered as an essential factor that’s at least *functionally*—if not ontologically—discriminable from space within the spacetime continuum, would be the neo-organicist analogue of Aristotle’s pre-modern idea of teleological-biological “form” (*morphe*), as activation/actualization (*energeia*). And in this way, the neo-organicist rubber-sheet cosmos is, in effect, a *global* neo-Aristotelian hylomorphic, inherently active, causally efficacious, and holistically *expanding* and *unbounded* matter/form, spacetime composite, whereas rational human minded animal free agents are paradigmatic examples of *local* neo-Aristotelian hylomorphic, inherently active, causally efficacious, and holistically *compacted* and *bounded* matter/form composites—i.e., “body-bounded minds” (Hanna & Maiese, 2009; Hanna, 2011). Correspondingly, attentive readers will also have noticed that the neo-organicist rubber-sheet cosmos is, in effect, an elaborated, extended, and updated version of Kant’s Neo-Aristotelian Natural Power Grid, as I spelled it out in Chap. 2.

But perhaps most importantly, we’re now in a position to re-ask Augustine’s famously hard question (Augustine, 1961: book XI, section 14, p. 264), quoted in

the first epigraph of this chapter: *what is time?* My highly speculative and tentative proposal is this:

Time—by which I mean unidirectional or asymmetric, manifestly *real* time—is the global dynamic activating and guiding intrinsic form or structure of the entire rubber sheet cosmos and all the naturally creative systems embedded in it, just as *minds* are the global dynamic activating and guiding intrinsic forms or structures of living animal bodies and their natural creativity.

To be sure, according to this proposal, on the one hand, real time wouldn't be *literally* any sort of cosmic mega-mind, or even a cosmic meso-mind or micro-mind for that matter. That would be panpsychism or pan-experientialism, which I've mostly rejected (see Sect. 2.4 above). But on the other hand, given the truth of weak or counterfactual transcendental idealism, it would be surprising if there *weren't* some important specific analogies, or structural parallels, between real time and mind. So the analogies I'm further proposing are (i) that real time's "memory" is the closed or fixed *past* of the natural universe, (ii) that real time's "consciousness" is the always-ongoing, always-unique, universal, non-local causal synchrony, or *absolute simultaneity*, of the real durational or "thick" *present* of the natural universe, and (iii) that real time's "intentionality" is the *future-directed arrow* of the natural universe, aimed at a future filled with live options or real potentialities for natural creativity.

Now, what about *clock* time and only-denumerable, *mechanical* time more generally? My proposal is that the infinite, successive, recursively-generated series of homogeneous units, or moments, that makes up clock time or mechanical time, results from a systematic *many-to-one mapping* from the essentially richer multiplicity of the always-ongoing, always-unique, real durational or "thick" present of the natural universe, as it always becomes part of the closed or fixed past and also always projectively proceeds into the creatively open future, *onto the elements of the set of natural numbers*.

What is The Big Picture I am proposing? It has two basic parts.

1. The cosmos as a whole is an *infinite*—according to the Continuum Hypothesis, not only non-denumerably and transfinitely infinite, with the cardinality of the real numbers, but also only-denumerably infinite, with the cardinality of the natural numbers, and no other kind of infinity in between—and *unbounded* rubber-sheet spatial continuum, which we can imagine as a sort of *cosmic rubber inner tube*, or *torus*, being *infinitely holistically inflated in all directions*, according to its global dynamic activating and guiding intrinsic form or structure, time, as per Fig. 12.1 at the beginning of this chapter

To be sure, the torus is a closed, finite, spatial shape, in the sense that if you travelled in a straight line from any given point, you'd eventually return to the same point. And of course, since the Big Bang Singularity is the beginning of the cosmos, then it's temporally finite in that sense. But a torus can also be forever expanded, in the sense that the distance between any two points on its surface can be forever getting longer, thereby revealing more and more of the fine-grained structure of the

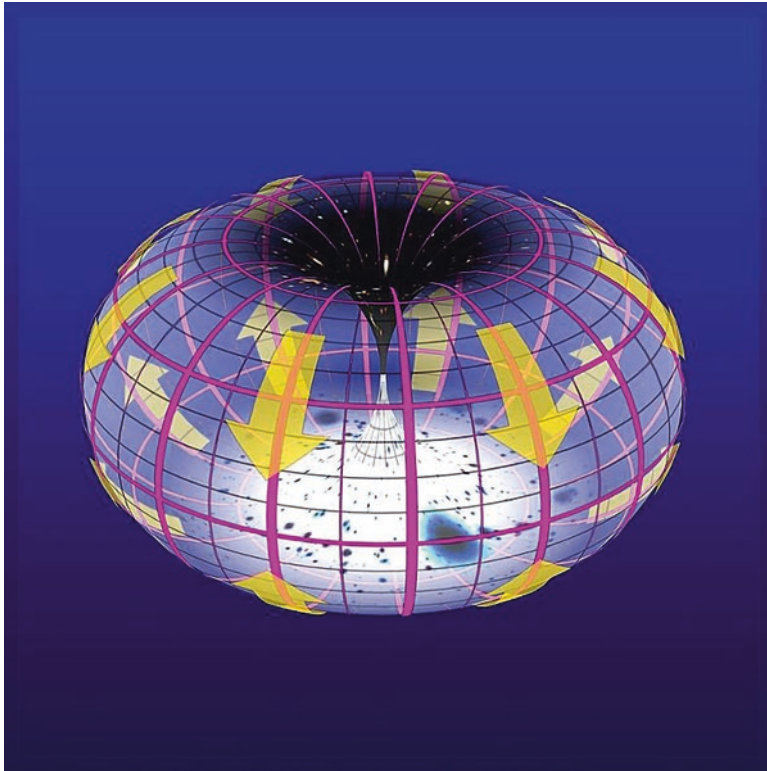


Fig. 12.1 The Cosmic Rubber Sheet Torus (Wikimedia Commons, [2012](#))

mathematical continuum. Hence the cosmic rubber sheet torus is also an open and spatioemporally infinite structure.

2. The Earth is a *finite* but *unbounded* sphere (approximately spherical, that is), filled with organismic living systems and other uncomputable, negentropic, irreversible, processual, purposive, self-organizing, and time-unidirectional or time-asymmetric, non-equilibrium thermodynamic systems; and we human animals, denizens of the Earth, co-habiting there with all the other living organisms, whether minded or non-minded, are *finite* and *bounded* living organisms, whose local and global environment is the rest of the Earth and the natural universe existing outside and extending infinitely beyond our living animal bodies, in which, by virtue of our essential embodiment, our unique lives unfold according to our own global dynamic activating and guiding intrinsic forms or structures, our minds (Hanna & Maiese, [2009](#); Hanna, [2011](#); and Chap. 2 above).

Finally, *embedded within* the rubber sheet cosmos as a holistic, organic, totality, there are various fragmentary, restricted domains, occurring at one or another of the basic scales, in which clock-timeable, computable, entropic, reversible, time-symmetric, equilibrium thermodynamic, speed-of-light constrained, causally

efficacious systems operate, under *deterministic or indeterministic natural laws*, including the classical Newtonian laws, the First and Second Laws of Thermodynamics, The Principle of Least Action (see, e.g., Planck, 1915: pp. 135–153), $F = MA$, $e = mc^2$, Schrödinger’s wave function equation governing quantum-mechanical systems, and so-on. Like the rubber sheet cosmos itself, these mechanical natural causal systems are also all manifestly *real*, in that their operations and basic quantitative properties are adequately confirmable by experimental measurement, but at the same time, *they’re not so damned real*, in that they’re also all explanatorily and ontologically *necessarily dependent* on special contextual cosmic initial conditions as parameters, and ultimately on the more fundamental, essentially non-mechanical, and thereby *organic* elements of the rubber sheet cosmos. Therefore, even though all the mechanical natural causal systems are indeed manifestly real, they’re nothing more and nothing less than *systematic abstractions* from the fundamentally organic nature of the rubber sheet cosmos.

In turn, as I pointed out in Chap. 1, the explanatory and metaphysical or ontological function of natural mechanical systems is nothing more and nothing less than to provide a relatively fixed, rigid, and static *skeleton* for channelling, distributing, focusing, framing, and more generally supporting the essentially richer causal powers of organic systems, just as the relatively fixed, rigid, and static skeleton inside a living animal channels, distributes, focuses, frames, and more generally supports the essentially richer causal powers of the organism itself. And when natural organic systems fully unfold, naturally die, or otherwise creatively realize themselves and achieve closure inside the rubber sheet cosmos, then the skeletons of their embedded mechanical systems continue to exist, in a state of calcified or frozen thermodynamic energy dispersal and equilibrium, i.e., *heat-death*.

12.4 Partners of Gravity: How We Move Our Own Bodies

But now back to the land of the living. In the rubber sheet cosmos, how do we move our own bodies? Riffing now on Augustine’s famously puzzled answer to his own question, I want to say: I know well enough what moving my own body is, provided that nobody asks me, since, other things being equal, *I just spontaneously move my own body around when I want to and as I want to*; but whenever I’m asked what it is and try to explain it *by theorizing about* it, then I’m baffled—I just run into profound puzzles. More specifically, Zeno’s paradoxes of motion, the mind-body problem and the problem of mental causation, the problem of free will and determinism-or-indeterminism, and the problem of the nature of spacetime, all combine and conspire to make the problem of explaining how we move our own bodies almost impossibly difficult to solve.

Still, even in the face of that almost-impossible-difficulty, and now rushing in where angels fear to tread and also where, as the philosophers of science Steven Weinstein and Dean Rickles admonishingly and rather officiously put it, “one might legitimately question whether philosophers have any business being involved at this

stage” (Weinstein & Rickles, 2021: section 1), namely, the domain of *quantum gravity*, I persist in believing that at least *some* philosophical headway can be made toward solving the problem of explaining how we move our own bodies.

I’ll begin by making five explicit assumptions required for explaining how we move our own bodies.

First, according to *the essential embodiment theory of the mind-body relation and mental causation* (Hanna & Maiese, 2009; Hanna, 2011; and Chap. 2 above), in rational, conscious (i.e., subjectively experiencing), intentional (i.e., act- or object-directed), caring (i.e., desiring, emoting, or feeling), sensible (i.e., perceiving, imagining, or remembering), self-conscious human animals like us, mental properties and physical properties are mutually irreducible, yet also synthetically or non-conceptually a priori mutually necessitating, properties, hence complementary, fused, or entangled properties. Hence, our rational, conscious, intentional, caring, sensible, self-conscious human animal minds are *essentially embodied minds*: that is, our rational, conscious, intentional, caring, sensible, self-conscious human animal minds are synthetically or non-conceptually a priori necessarily and completely embodied minds, and our minds and our bodies stand to one another in a synthetically or non-conceptually a priori necessary relation of complementarity, fusion, or entanglement. More specifically, our rational, conscious, intentional, caring, sensible, self-conscious, human animal minds are the global dynamic activating and causally efficacious guiding structures of our living organismic bodies, so that the mind-body relation is essentially morphetic-hyletic, or *hylomorphic*.

Second, according to *natural libertarianism about our free agency* (Hanna, 2018, 2020; and Chap. 2, Sect. 2.3 above), even though rational conscious, intentional, caring, sensible, self-conscious human animals like us never violate any universal causal laws of nature and/or mathematical laws of probability and never bring any new matter or energy into the natural world, it remains really possible for us, in context, to choose and do some things we want to, in purposive, naturally creative, and morally-empowered ways, by spontaneously and synchronously locally re-organizing and re-structuring the total quantity of matter or thermal energy that’s always already available then and there.

Third, according to *the neo-organicist worldview*, as we’ve seen throughout this book, (i) everything in the world is essentially or fundamentally uncomputable, negentropic, processual, purposive, self-organizing, time-irreversible or time-asymmetric, and non-equilibrium thermodynamic, (ii) there’s a basic metaphysical and ontological continuity, running from the Big Bang singularity to uncomputable, negentropic, time-irreversible or time-asymmetric, non-equilibrium thermodynamic energy flows, to living organisms, to conscious minded animals, to rational, self-conscious minded animals with free will and practical agency, and finally to social institutions of all kinds, and (iii) all mechanical systems whatsoever, whether formal or natural, are nothing but systematic abstractions from—that is, degenerate cases of, fragments of, or limiting cases of—fundamentally organic systems, and therefore all mechanical systems whatsoever are logically or nomologically strongly supervenient on organic systems.

Fourth, according to *the neo-organicist approach to real motion* (see Chap. 10 above)—where motion, in general, is continuous change in the position or configuration of a physical system in space, including four basic sub-types: uniform motion, translational motion, oscillation, and rotation—then real motion occurs whenever any essentially embodied rational, conscious, intentional, self-conscious human animal, or any non-conscious natural item, provided that it's (i) an organic system, i.e., an essentially uncomputable, negentropic, irreversible, processual, purposive, self-organizing, temporally irreversible/asymmetric, and non-equilibrium thermodynamic system, (ii) either changes its position by means of the unbroken process of spontaneously transiting from region to region, or changes its configuration by means of the unbroken process of spontaneously sub-transiting from sub-region to sub-region, or both, *and* (iii) it's also false that real motion in the manifestly real cosmos can be really resolved into a series of discrete, discontinuous sub-tasks, moment-by-moment, that are in one-to-one correspondence with discrete points or line-segments in the mathematical continuum.

It's particularly important to notice that in this chapter, I'm talking about *real motion* only. I'll discuss the explanatorily and metaphysically/ontologically derivative phenomenon of *mechanical motion* in Chaps. 13 and 14 below.

Fifth and finally, I'll assume the existence of *the rubber sheet cosmos* as I described it in Sect. 12.3 above.

Granting all that for the purposes of argument, then when we move our own bodies by performing basic actions—that is, when we perform intentional body movements involving uniform, translational, oscillational, or rotational motion—then, as we transit *through* overlapping regions or sub-regions with synthetic a priori necessity, the dynamic rubber sheet spacetime we occupy nonlocally spontaneously deforms so as to produce *a synthetically or non-conceptually a priori necessarily complementary, living-body-shaped conduit* through those overlapping regions, and *continuously conduct us to our destination*, i.e., to our new location. More generally, here's the three-part hylomorphic analogy I'm working with: (i) life (inherently activating and guiding dynamic form or structure) *is to* living organisms (inherently dynamic matter or thermal energy), *as* (ii) our conscious, intentional, caring, sensible, self-conscious mind (inherently activating and guiding dynamic form or structure) *is to* our living animal bodies (inherently dynamic matter or thermal energy), *as* (iii) the freely-performed, self-legislated intentional body movements of our living animal body (inherently activating and guiding dynamic form or structure) *is to* the dynamic rubber sheet spacetime in which we live, move, and have our being (inherently dynamic matter or thermal energy). Or otherwise and more fancifully put, we move our own bodies *like dancing raisins—dancing to the music of time—embedded in a synthetically or non-conceptually a priori necessarily complementary dynamic cosmic cake*.

Moreover, there's a universal law-governed dynamic force *constant* that's always and everywhere operative inside the dynamic rubber sheet spacetime, namely *gravity*—the universal attractive force between material bodies, according to Newton's inverse square law, operating at any distance, whose immanent or internal structure in the rubber sheet cosmos will also incorporate, under various special initial and

contextual conditions, Einstein's c = the speed of light in a vacuum, Planck's constant h , and the holistic triad of complementarity-entanglement-&-nonlocality at all basic scales—that co-determines the specific character of the spontaneous deformation of that dynamic rubber sheet spacetime, according to the mass and acceleration of our living animal bodies in their freely-performed, self-legislated intentional body movements. Going back to the fanciful raisins-dancing-to-the-music-of-time-in-the-dynamic-cosmic-cake analogy, gravity *bakes* the dancing raisins *into* the dynamic cosmic cake. In any case, we're not *prisoners of gravity*: on the contrary, we're *partners of gravity*, precisely because *we're rational, autonomous co-determinants, together with gravity*, of the specific characters of the spontaneous deformations of the total dynamic rubber sheet spacetime in which we live, move, and have our being.

Finally then, and perhaps most surprisingly, since according to my five-part explanation of how we move our own bodies, the holistic triad of complementarity-entanglement-&-nonlocality hold at all the basic scales of manifest natural reality, i.e., micro-, meso-, and mega-, then *precisely because we're partners of gravity*, it follows that that theoretical will-o'-the-wisp, *quantum gravity* (see, e.g., Weinstein & Rickles, 2021), is and has always been in plain view all along, literally right there in front of our own faces. For *quantum gravity* is nothing more and nothing less than *gravity* in the dynamic rubber sheet cosmos as a whole, with an emphasis on the *micro*-scale, where the particles and waves complementarily cohabit and are partners of gravity, even despite the fact that they can have virtually infinitely small mass, density, or weight, as a limiting case. Nevertheless, it's the *very same* gravity at the *meso*-scale, where organisms and rational, conscious, intentional, caring, sensible, self-conscious, free agent human animals like us are the egocentric centers and partners of gravity, and also again at the *mega*-scale, where planets, stars, galaxies, black holes, and the other cosmic analogues of Gargantua (Rabelais, 1534/2006)—all of them *also* partners of gravity—spontaneously evolve, move, and have their being, even despite the fact that in the center of a black hole, space-time curvature can be virtually infinitely great, as another limiting case.

But since, as Weinstein and Rickles admonishingly and rather officiously say in the second epigraph for this chapter, I'm supposed to be minding my own business and not philosophizing about quantum gravity in the first place, I'll leave things there.

12.5 Conclusion: A Plea for Speculative and Value-Laden Philosophy of Science

That admittedly ironic retort to Weinstein and Rickles leads to a pertinent critical-metaphilosophical observation, by way of concluding this chapter. My neo-organicism theory of the rubber sheet cosmos is clearly and distinctly an investigation in what Joel Katzav and Krist Vaesen aptly call *speculative and value-laden philosophy of science*, which, as they've persuasively argued, was *systematically*

marginalized by post-classical Analytic philosophers of science and also by many formal and natural scientists heavily influenced by them, in the mechanistic, scientific tradition of the exiled Vienna Circle logical empiricists/positivists, during the 1950s (Katzav & Vaesen, 2022)—and, in fact, *also* through the end of the twentieth century and the first two decades of the twenty-first century, right up to 6 am this morning. So, in effect, precisely the kind of speculative and value-laden philosophy of science that I’ve been doing here in this book—see also, for example (Nagel, 2012)—and more specifically in this chapter, is *streng verboten* (i.e., “strictly forbidden”) and highly apt to be strangled in its intellectual cradle, by the undead social-institutional dead hand of the Vienna Circle.

Nevertheless, if I’m right and Vienna-Circle-heavily-influenced, post-positivist, mechanistic, scientific philosophy of science is wrong, then in *the near future* there will be an *Überwindung* (i.e., an “overcoming,” just as the Vienna Circle proposed *to overcome metaphysics*) of precisely *this* kind of philosophically and scientifically repressive and retrograde dogmatism in the philosophy of science and in the formal and natural sciences alike, and above all, *a new Kuhnian paradigm shift* (see, e.g., Kuhn, 1970), the paradigm shift to end all Kuhnian paradigm shifts, the mother of all Kuhnian paradigm shifts, The Big Kahuna of all Kuhnian paradigm shifts, and the alpha-&-omega of all Kuhnian paradigm shifts: namely, the not only figuratively *earthshaking* but also as we’ve seen in this chapter, quite literally *cosmos-stretching*, neo-organicist revolution. When formal and natural science finally become *science for humans*, that progressive revolutionary longjump will not only figuratively but also quite literally change the world.

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Chapter 13

A Philosophical Case for Holding That the Second Law of Thermodynamics Is Only a *Special* Law of Nature, and *Not* a Universal Law



Abstract Even despite A.S. Eddington’s stern warning to the effect that any serious theoretical challenge to the universality of The Second Law of Thermodynamics will end in “deepest humiliation” (Eddington, 1929: p. 74), in this chapter I argue that The Second Law is only a *special* law of nature, and *not* a universal law of nature.

The law that entropy always increases—the second law of thermodynamics—holds, I think, the supreme position among the laws of Nature.... [I]f your theory is found to be against the second law of thermodynamics I can give you no hope; there is nothing for it but to collapse in deepest humiliation. (Eddington, 1929: p. 74)

[L]iving matter, while not eluding the “laws of physics” as established up to date, is likely to involve “other laws of physics” hitherto unknown, which however, once they have been revealed, will form just as integral a part of science as the former. (Schrödinger, 1944/1967: p. 73)

Let us see whether we cannot draw the correct non-contradictory conclusion from the following two premises:

- (i) My body functions as a pure mechanism according to Laws of Nature; and
- (ii) Yet I know, by incontrovertible direct experience, that I am directing its motions, of which I foresee the effects, that may be fateful and all-important, in which case I feel and take full responsibility for them.

The only possible inference from these two facts is, I think, that I—I in the widest meaning of the word, that is to say, every conscious mind that has ever said or felt “I”—am the person, if any, who controls the “motion of the atoms” according to the Laws of Nature. (Schrödinger, 1944/1967: pp. 92–93)

Consciousness is never experienced in the plural, only in the singular.... Consciousness finds itself intimately connected with, and dependent on, the physical state of a limited region of matter, the body.... The only possible alternative [to the thesis that there is a plurality of consciousnesses] is to keep to the immediate experience that consciousness is the singular of which the plural is unknown; that there *is* only one thing and that what seems to be a plurality is merely a series of different aspects of this one thing, produced by a deception.... What is this “I”? If you analyse it closely, you will, I think, find that it is just a little bit more than a collection of single data (memories and experiences), namely the *canvas* upon which they are collected. And you will, on close introspection, find that what you

really mean by “I” is that ground-stuff upon which they are collected. (Schrödinger, 1944/1967: pp. 94–96)

According to [many physicists], the complexity we see around us is accidental and necessarily temporary. In their view, the universe is fated to end in a state of equilibrium. This is a state, called the *heat death of the universe*, in which matter and energy are uniformly distributed throughout the universe and nothing ever happens except rare random fluctuations.... In the [contrary] picture I propose, the universe is a process for breeding novel phenomena and states of organization, which will forever renew itself as it evolves to states of ever higher complexity and organization. The observational record tells us unambiguously that the universe is getting more interesting as time goes on. Early on, it was filled with a plasma in equilibrium; from that simplest of beginnings, it has evolved enormous complexity over a wide range of scales, from clusters of galaxies to biological molecules.... Even now, more than 13 billion years after the Big Bang, our universe is not in equilibrium.... The question of why the universe is interesting and appears to be getting more so is akin to the question of why the second law of thermodynamics has yet to act to randomize the universe into thermal equilibrium, in spite of billions of years of apparent opportunity to do just that. (Smolin, 2013: pp. 194, 203)

13.1 Introduction

Even despite A.S. Eddington’s stern warning, as per the first epigraph of this chapter, that any serious theoretical challenge to the universality of The Second Law of Thermodynamics will end in “deepest humiliation” (Eddington, 1929: p. 74), in this chapter I’m going to argue that The Second Law is only a *special* law of nature, and *not* a universal law of nature.

13.2 Entropy and Negentropy, with a Dash of Isentropy

In physics, *entropy is the unavailability of thermal energy for conversion into causal (aka “mechanical”¹) action or work*. Sometimes, entropy is described as “disorder,” but this is conceptually misleading: actually, an increase in entropy is an increase in the amount of thermal energy that’s in a *cold or causally inert state*, hence it’s an overall ordering or structuring of thermal energy that’s *less complex, less differentiated, and less variegated*—as it were, a *more boring* ordering or structuring of thermal energy, a *dispersal* of thermal energy—whereby the natural universe is in a partial or total *equilibrium* state, i.e., a partially or totally *settled* state, with nothing coming in or going out across the impermeable borders of that state, *such that*

¹I surround “mechanical” with shudder quotes here and other places in the book where I discuss entropy, because that standard terminology begs the question in favor of the mechanistic worldview, which is of course precisely what I’m challenging.

nothing can be done or happen. Now, when natural systems spontaneously evolve so that they causally operate *entropically*, let's call that *natural mechanism*.

Contrariwise, *negative entropy* or *negentropy* is the negation or reversal of entropy, hence it's the *availability* of thermal energy for conversion into causal ("mechanical") action or work, sometimes also called "free energy," or "order," but those labels are *also* conceptually misleading; actually, an increase in negentropy is an increase in the amount of thermal energy that's *in a hot or causally empowered state*, hence it's an overall ordering or structuring of thermal energy that's *more complex, more differentiated, and more variegated*—as it were, a *more exciting* ordering or structuring of thermal energy, a *concentration* of thermal energy—whereby the natural universe is in a partial or total *non-equilibrium* state, i.e., a partially or totally *unsettled* state, with things coming in and going out across the permeable membranes of that state, *such that things can be done or happen.* Now, when natural systems spontaneously evolve so that they causally operate *negentropically*, let's call that *natural creativity*.

You can create a toy model of entropy by making yourself a cup of fresh hot coffee, stirring it fairly vigorously, then slowly pouring a little cream or half-and-half into the little vortex you've created, then watching what happens: that's entropy. Now, consider your act of creating that little black-&white swirly whirlpool, the evanescent performance-art object you created, and your aesthetic enjoyment of it: that's negentropy.

According to the Standard Models of cosmology and particle physics, and more specifically, according to The Second Law of Thermodynamics, (i) in the spontaneous evolution of a closed or isolated natural system, entropy is never negated or reversed, but only ever either stays the same (aka "isentropy") or increases—although it *is possible to reduce the rate of its increase*, for example, by eliminating friction or lowering temperature—and (ii) the natural universe is a closed system, hence (iii) in the natural universe, entropy is never negated or reversed, but only ever either stays the same or increases (allowing for reductions in the rate of its increase), i.e., The Second Law is a universal natural law.

In thinking about The Second Law, it's crucial to recognize the categorical distinction between, on the one hand, merely *decreasing entropy*, i.e., merely reducing the rate of increase of entropy, and on the other hand, *negentropy*, i.e., negating or reversing entropy. This distinction is precisely analogous or parallel to the distinction in simplified, non-thermal dynamics between, on the one hand, *deceleration*, i.e., reducing the rate of increase of velocity by applying a counterforce (say, by putting on the brakes in your car while accelerating and driving from left to right →), and on the other hand, *negative acceleration*, i.e., reducing the rate of increase of velocity by accelerating in the intrinsically opposite direction in an orientable spatial coordinate system (say, by putting your car in reverse and thereby driving from right to left ← in that system, instead of from left to right →). Like acceleration, which is a *spatial vector* whose components are increasing velocity and *intrinsic directionality in orientable space*, so too entropy is a *temporal vector* whose components are increasing unavailability of thermal energy for conversion into causal ("mechanical") action or work and *intrinsic directionality in orientable time*, i.e., the asymmetric or

irreversible, intrinsic arrow of time in an open, non-equilibrium system—i.e., *the intrinsic directionality of natural creativity*. Similar points have been made by Prigogine (1997) and Lee Smolin (2013). As they point out, it literally makes *all the difference in the world* whether an extrinsic, symmetric or bidirectional *pseudo*-arrow of time (which I'll call *unreal* or *mechanical* time) is fixed by entropy alone in a closed, equilibrium system, or, on the contrary, an intrinsic, asymmetric or unidirectional *echt*-arrow of time (which I'll call *real* or *organic* time) is fixed by the intrinsic directionality of natural creativity in an open, non-equilibrium system.

In turn, insofar as The Second Law of Thermodynamics *is* a universal natural law, then the natural universe falls under the thesis of *universal natural mechanism*, which says that all the causal powers of everything whatsoever in the natural universe are ultimately fixed by what can be digitally computed on a universal deterministic or indeterministic real-world Turing machine, provided that the following three plausible “causal orderliness” and “decompositionality” assumptions are all satisfied: (i) its causal powers are necessarily determined by the universal deterministic or indeterministic causal natural laws, especially including The Conservation Laws, including The First Law of Thermodynamics, and also The Second Law of Thermodynamics, together with all the settled quantity-of-matter-and/or-energy facts about the past, especially including The Big Bang, (ii) the causal powers of the real-world Turing machine are held fixed under the general causal laws of nature, and (iii) the “digits” over which the real-world Turing machine computes constitute a complete denumerable set of spatiotemporally discrete physical objects.

But as Erwin Schrödinger pointed out in *What is Life?* (Schrödinger, 1944/1967), the fact or phenomenon of organismic life presents us with an apparent paradox, since organismic life is *negentropic*, which apparently contradicts The Second Law of Thermodynamics, if we hold, as per the thesis of universal natural mechanism, that the natural universe is a closed, equilibrium system, and also that in the natural universe, entropy is never negated or reversed, but only ever stays the same or increases (allowing for reductions in the rate of its increase), i.e., that The Second Law is a universal natural law. Nevertheless, there's a way out of this apparent paradox, if we distinguish between two different senses of “the natural universe”: (i) the natural universe as a whole, *necessarily including all its proper parts*, and (ii) the natural universe as a whole, but *not necessarily including all its proper parts*. Then it's possible to hold that the natural universe *as a whole* is a closed, equilibrium system and that in the natural universe as a whole, entropy never decreases, but only ever stays the same or increases (allowing for reductions in the rate of its increase), i.e., that The Second Law is a universal natural law, *even though some of its proper parts—i.e., living organisms—are negentropic*. In order to hold this, however, as Schrödinger also points out, some *special causal laws* have to be assumed to hold and some *special causal powers* have to be assumed to operate, under *special contextual conditions*, and these special causal laws, special causal powers, and special contextual conditions *also* have to be such that they also *guarantee* that ultimately, *the negentropy of organisms is balanced out by corresponding proportional increases in entropy elsewhere in the natural universe as a whole*—which is sometimes called “free energy minimization.” In short, under “free energy minimization,” these cosmological specialty items must also guarantee that ultimately, there's

no such thing as a thermal-energy “free lunch” in the natural universe as a whole, and that sooner or later, somewhere, somehow, living organisms must pay the thermal-energy price for their *prima facie* “unlawful activity,” or “crime,” of emerging and existing in it while being negentropic.

13.3 Schrödinger's Two-Part Explanatory Hard Problem, and a Six-Part Counterproposal

It's true that the theoretical gambit described at the end of the previous section avoids the apparent paradox, but it also raises the further serious worry: If it's true that that the natural universe as a whole is a closed, equilibrium system and that in the natural universe as a whole, entropy never decreases, but only ever stays the same or increases (allowing for reductions in the rate of its increase), even though some of its proper parts—for example, living organisms—are negentropic, *then how did these negentropic proper parts ever come to be in the first place, that is, what could ever sufficiently explain the emergence and existence of the special causal laws, special causal powers, and special contextual conditions under which organismic life—including of course, human animal life—also emerges and exists?* This worry is serious enough; but the same worry can also be converted into a *mega-serious* worry if one *also* holds, as Schrödinger does, that

[c]onsciousness finds itself intimately connected with, and dependent on, the physical state of a limited region of matter, the body. (Schrödinger, 1944/1967: p. 94)

For if it's true that that the natural universe as a whole is a closed, equilibrium system and that in the natural universe as a whole, entropy never decreases, but only ever stays the same or increases (allowing for reductions in the rate of its increase), even though some of its proper parts—for example, living organisms—are negentropic, then how did these negentropic parts ever come to be in the first place, that is, what could ever sufficiently explain the emergence and existence of the special causal laws, special causal powers, and the special contextual conditions under which *not only* organismic life in general, *but also* conscious, intentional, free-willed organismic life in particular—including, of course, rational, conscious, intentional, caring, self-conscious, free-willed human animal life—emerges and exists?

Interestingly, Schrödinger himself proposes a new set of special causal laws, special causal powers, and special contextual conditions under which organismic life emerges and exists, consistently with the theses that the natural universe as whole is a closed, equilibrium system and that The Second Law of Thermodynamics is a universal law of nature. But at the same time, Schrödinger *also* holds that conscious, intentional, caring, sensible, self-conscious, free-willed mind *is a primitive, singular, non-physical fact that obtains throughout the natural universe, and is as basic as physical matter or energy*—in other words, he proposes a version of *pan-psychism*. Or in other words, for Schrödinger, organismic life is a *big* explanatory mystery, and rational, conscious, intentional, caring, sensible, self-conscious,

free-willed human animal life is a *mega-big* explanatory mystery (see also Schrödinger, 1956/1967). Let's call this *Schrödinger's two-part explanatory hard problem*.

But actually, this two-part explanatory hard problem isn't only *Schrödinger's* problem. Anyone who has followed, even if only from afar, the basic literature in mainstream professional academic physics, biology, and philosophy of mind for the last 70 years, knows that Schrödinger's two-part explanatory hard problem is virtually *everyone's* two-part explanatory hard problem, with *no real progress whatsoever* ever having been made. To be sure, there have been various non-trivial scientific and philosophical technical improvements in precisely *how* the hard problems can be formulated, and there have been literally *scads* of technically ingenious yet inevitably failed attempts at solving them within the framework of the Standard Models of cosmology and particle physics, and more specifically under the assumption that the Second Law of Thermodynamics is a universal law of nature, including twentieth century versions of classical Cartesian *ontological dualism*, non-classical twentieth century *property dualism*, *reductive* materialism or physicalism, *eliminative* materialism or physicalism, *non-reductive* materialism or physicalism, and *panpsychism*; but basically, *they never have, and they never will, get any further than Schrödinger did* (see, e.g., Chalmers, 1996, 2002; Kim, 2005, 2006).

Now, in the face of these two explanatory mysteries—the big mystery of organismic life and the mega-big mystery of rational, conscious, intentional, caring, self-conscious, free-willed human animal life—and in view of the apparent impossibility of real progress in mainstream professional academic physics, biology, and philosophy of mind, within the framework of the Standard Models of cosmology and particle physics, and more specifically under the assumption that The Second Law of Thermodynamics is a universal law of nature, then I want to offer a six-part counterproposal as follows.

First, we *deny* that the natural universe as whole is a closed, equilibrium system.

Second, we also *deny* that The Second Law of Thermodynamics is a universal natural law.

Third, we *assert* that the natural universe as a whole is an *open, non-equilibrium* system—in the specific six-part sense that it's (i) denumerably infinite and non-denumerably infinite—more specifically, it has the cardinality of the natural numbers *and also* the cardinality of the real numbers, as well as the other basic formal properties of the classical mathematical continuum as per Cantor's Continuum Hypothesis and Chap. 10 above, (ii) inherently spatial, topological, and dynamic—more specifically, it's a spontaneously deforming, orientable, and unbounded manifestly real *cosmic rubber sheet torus*, as per Chap. 12 above, (iii) inherently temporally asymmetrically open-ended, in the intrinsic direction of the future, i.e., the intrinsic directionality of natural creativity, (iv) such that things are always coming in and going out across the permeable membranes of any and all proper parts of the natural universe as a whole that are also open systems, (v) such that complementarity, entanglement, and nonlocality pervade the manifestly real natural universe at all scales, again as per Chap. 12 above, and (vi) such that there's no upper-bound on the number or kinds of things that can be done or happen in any and all proper parts

of the natural universe as a whole that are also open systems, *under* the constraints of the Conservation Laws, especially including The First Law of Thermodynamics, i.e., that there's a fixed totality of matter and/or energy in the natural universe, with none ever newly created or destroyed.

Fourth, we *assert* that rational, conscious, intentional, caring, sensible, self-conscious, free-willed, essentially embodied human mind, and organismic life, as *irreducible natural facts or phenomena*, are *metaphysically continuous*:

[l]ife and mind have a common abstract pattern or set of basic organizational properties. The . . . properties characteristic of mind are an enriched version of the . . . properties that are fundamental to life in general. Mind is literally life-like. (Godfrey-Smith, 1996: p. 320; see also Thompson, 2007; Hanna & Maiese, 2009; and Chap. 2 above).

Fifth, we *assert* that the natural universe as a whole, especially including organismic life in general and rational, conscious, intentional, caring, self-conscious, free-willed human animal life in particular, is *negentropic, uncomputable, and naturally creative*.

And finally, **sixth**, we *also assert* that all closed, computable, entropic, reversible, equilibrium thermodynamic, naturally mechanical systems, incorporating the pseudo-arrow of unreal or mechanical time, for which The Second Law of Thermodynamics is a *special* natural law, are nothing but *degenerate cases, fragments, or limiting cases* of—hence, systematic abstractions from, skeletons of—open, uncomputable, negentropic, irreversible, non-equilibrium thermodynamic, naturally creative systems, incorporating the echt-arrow of real or organic time. As regards this sixth part of my counterproposal, there could be several formally different but nomologically equivalent methods for carrying out these systematic abstractions. For example, it's arguable that the theory of *quantum decoherence*—i.e., the theory of quantum systems in which the wave-particle complementarity or duality, the entanglement of particles, and/or the nonlocality of wave/particle causation, are all systematically suppressed (see, e.g., Bacciagaluppi, 2020)—is one such method.

If my six-part counterproposal is indeed true, then it would *competely avoid* the big and mega-big explanatory mysteries of the emergence and existence of organismic life and rational, conscious, intentional, caring, self-conscious, freely-willed human life, by *explanatorily inverting* natural creativity and natural mechanism, and by *systematically embedding* all closed and equilibrium, reversible, entropic and computable, naturally mechanical systems inside the comprehensively open and non-equilibrium, irreversible, negentropic and uncomputable, naturally creative natural universe, for which The Second Law of Thermodynamics is only a special natural law, instead of *arbitrarily cramming* all open and non-equilibrium, irreversible, negentropic and uncomputable, naturally creative systems into the comprehensively closed and equilibrium, reversible, entropic and computable, naturally-mechanical natural universe, under the assumption that The Second Law of Thermodynamics is a universal natural law.

Of course, this would mean *revolutionizing* the Standard Models of cosmology and particle physics, and also *revolutionizing* contemporary mainstream professional academic biology and philosophy of mind: but so what? For all sorts of

reasons I've been exploring in this book, *it's high time that they were all revolutionized anyhow*. So, in view of the fact that, following on from Schrödinger, but never getting any further than he did, virtually every theory in physics, biology, and philosophy about the emergence and existence of organismic life and rational, conscious, intentional, self-conscious, freely-willed human life that has been developed over the last 70 years (leaving aside Prigogine, Lee Smolin, and a few others, as exceptions to the general rule) all of which assume that The Second Law of Thermodynamics is a universal law of nature, inevitably encounters Schrödinger's two-part explanatory hard problem—the big mystery of organismic life and the mega-big mystery of rational, conscious, intentional, caring, self-conscious, free-willed human life—*whereas* my six-part counterproposal has *neither* of these explanatory mysteries, and indeed has *no* explanatory mysteries whatsoever, I conclude that my six-part counterproposal, especially my thesis to the effect that The Second Law of Thermodynamics is only a *special* law of nature, and *not* a universal law, is *explanatorily superior* to all those other theories, no matter how good in other theoretical respects they happen to be, and therefore should be *accepted*, by inference-to-the-best-and-simplest-explanation.

13.4 An Illuminatingly Different and Highly Compact Five-Step Argument That the Second Law of Thermodynamics Is Not a Universal Law of Nature

One good argument deserves another. So now I'll provide an illuminatingly different and highly compact five-step argument that The Second Law of Thermodynamics is not a universal law of nature.

1. If it's true that The Second Law of Thermodynamics is a universal law of nature, then eventually the manifestly real natural universe will exist in a total equilibrium state, i.e., the state of *heat death*.
2. But if it's true The Second Law of Thermodynamics is a universal law of nature, then why doesn't the manifestly real natural universe *already* exist in a total equilibrium state, "in spite of billions of years of apparent opportunity to do just that" (Smolin, 2013: p. 203)?
3. It's self-evident that the manifestly real natural universe *doesn't* already exist in a total equilibrium state, because it's equally self-evident that I, R.H., a rational, conscious, intentional, caring, self-conscious human minded living organism in the manifestly real natural universe, exist, and also self-consciously know that I exist.
4. Now, consider the immense amount of cosmological fine-tuning, with respect to fixing the initial conditions of the natural universe in all their fine-grained detail, and correspondingly also the immense number of "other laws of physics" (Schrödinger, 1944/1967: p. 73), that are jointly required in order to explain how it's self-evident that the manifestly real natural universe doesn't already exist in

a total equilibrium state and that I, R.H., a rational, conscious, intentional, caring, sensible, self-conscious human minded living organism in the manifestly real natural universe, exist, and also self-consciously know that I exist, all under the assumption that it's true that The Second Law of Thermodynamics is a universal law of nature

5. Then, by inference to *the best and simplest explanation*, I conclude that it's *false* that The Second Law of Thermodynamic is a universal law of nature, i.e., The Second Law of Thermodynamics is *not* a universal law of nature. QED

13.5 Conclusion

As indicated by the fifth epigraph at the head of this chapter, there are also strong hints of the highly compact five-step argument I formulated in Sect. 13.4, in Smolin's *Time Reborn*, even despite, as per the first epigraph, Eddington's stern warning about attempts to deny the universality of the Second Law (Eddington, 1929: p. 74). As we saw in Sect. 13.3, this challenge was actually later taken up, for the specific purpose of explaining the prima facie negentropy of organismic life, and also of conscious mind insofar as it's realized in our living organismic bodies, in Schrödinger's *What is Life?*, although not ultimately in such a way as to deny the universality of The Second Law, hence ultimately for the purpose of *explaining away* the prima facie negentropy of organismic life and conscious mind. But Smolin is pushing that challenge one radical step further, and so am I.²

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²Nevertheless, Smolin's conception of conscious mind (see, e.g., Smolin, 2013: pp. 268–270) is sharply different from mine. See (Hanna & Maiese, 2009; Hanna, 2011; and Chap. 2 above).

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Chapter 14

The Epiphenomenality of Natural Mechanical Systems and the Salvation of Everyday Objects



Abstract Is it plausible to hold, as I do, that natural mechanical systems have no efficacious causal powers of their own, and only inherit any and all causal powers that they do have, in a metaphysically-&-ontologically derivative, secondary, shadowy, skeletal, and therefore epiphenomenal way, from the inherently more concrete and richer organic systems in which they're necessarily embedded and from which they're derived by natural or nomological strong supervenience—i.e., *the explanatory inversion thesis*, as applied specifically to natural mechanical systems? In this chapter, I do my level best to answer that hard question affirmatively.

I have settled down to the task of writing up these lectures and have drawn up my chairs to my two tables. Two tables! Yes, there are duplicates of every object about me—two tables, two chairs, two pens.... One of them has been familiar to me from earliest years. It is a commonplace object of that environment which I call the world. How shall I describe it? It has extension; it is comparatively permanent; it is coloured; above all it is *substantial*.... Table No. 2 is my scientific table.... It does not belong to the world I previously mentioned—that world which spontaneously appears around me when I open my eyes.... My scientific table is mostly emptiness. Sparsely scattered in that emptiness are numerous electric charges rushing about with great speed; but their combined bulk amounts to less than a billionth of the bulk of the table itself.... There is nothing substantial about my second table[.] It is nearly all empty space—space pervaded, it is true by fields of force, but these are assigned to the category of “influences,” not of “things.”.... I will not stress further here the non-substantiality of electrons.... Conceive them as substantially as you like, there is a vast difference between my scientific table with its substance (if any) thinly scattered in specks in a region mostly empty and the table everyday conception which we regard as the type of solid reality—an incarnate protest against Berkeleian subjectivism.... I need not tell you that modern [mechanistic] physics has by delicate test and remorseless logic assured me that my second scientific table is the only one which is really there—wherever “there” may be. On the other hand I need not tell you that modern [mechanistic] physics will never succeed in exorcising that first table—strange compound of external nature, mental imagery and inherited prejudice—which lies visible to my eyes and tangible to my grasp.... “You speak paradoxically of two worlds. Are they not really two aspects or interpretations of one and the same world?” Yes, no doubt they are ultimately to be identified after some fashion. But the process by which the external world of [mechanistic] physics is transformed into a world of familiar acquaintance in human consciousness is outside the scope of this study. (Eddington, 1929: pp. xi–xiv)

14.1 Introduction: The Epiphenomenality of Natural Mechanical Systems

Is it plausible to hold, as I do, that natural mechanical systems *have no efficacious causal powers of their own*, and only *inherit* any and all causal powers that they *do* have, in a metaphysically-&-ontologically derivative, secondary, shadowy, skeletal, and therefore *epiphenomenal* way, from the inherently more concrete and richer *organic systems* in which they're necessarily embedded and from which they're derived by natural or nomological strong supervenience?¹ Let's call that hard question **Q1**. More generally, I'm saying that the explanatory inversion thesis applies not only to mega-scale cosmological processes like galaxies or black holes, meso-scale processes like the weather, and micro-scale quantum processes of all kinds, anywhere in the natural universe, but *also* applies, for example, to clocks, steam engines, automobiles, and to all other natural mechanical systems, including everyday objects like tables. This is *the explanatory inversion thesis*, as applied specifically to natural mechanical systems, and as such, it precisely flips upside down the classical modern materialist or physicalist and mechanistic explanation of organismic life and conscious minds in terms of either logical strong supervenience, or else natural or nomological strong supervenience, on fundamentally physical properties and natural mechanical systems. In what follows in this chapter, I'll do my level best to answer **Q1 affirmatively**.

14.2 My Answer to Q1, in a Nutshell

My answer to **Q1**, in a nutshell, is: *Yes*, if we remember that, according to neo-organicism, the explanatory and metaphysical-&-ontological function of mechanical systems is indeed nothing more and nothing less than to provide a relatively fixed, rigid, and static *skeleton* for channelling, distributing, focusing, framing, and more generally supporting the essentially richer causal powers of organic systems, just as the relatively fixed, rigid, and static skeleton inside a living animal channels, distributes, focuses, frames, and more generally supports the essentially richer causal powers of the organism itself. Therefore, just as the skeleton of a living animal has no efficacious causal powers of its own, but instead only inherits whatever causal powers it has, from the inherently more concrete and essentially richer organismic system of the living animal whose skeleton it is and in which that skeleton is necessarily embedded, so too natural mechanical systems have no efficacious causal powers of their own, and only inherit any and all causal powers that they do have, in a metaphysically-&-ontologically derivative, secondary, shadowy, skeletal, and therefore epiphenomenal way, from the inherently more concrete and richer organic systems in which they're necessarily embedded and from which they're derived by natural or nomological strong supervenience.

¹For an explicit definition of natural or nomological strong supervenience, see Sect. 8.2 above.

Moreover, we can also think of the necessary embedding of the mechanical in the organic as exactly analogous to the embedding of the sets and systems of natural and rational numbers within the set and system of the real numbers. The natural numbers and the rational numbers are indeed *epistemically and historically prior* to the real numbers—i.e., they're known first in the order of knowing when we learn mathematics as children in school, and were discovered by mathematicians first in the order of history—but also *metaphysically-&-ontologically posterior to and derivative from* the real numbers—i.e., they're proper subsets and sub-structures within the set and system of real numbers. The mathematical properties of the natural numbers and the rational numbers *are nothing over and above* the mathematical properties of the real numbers.

This then leads to hard question **Q2**: But what's *disanalogous* to this in the *purported* cases of the natural or nomological strong supervenience of organismic life and conscious mind on the fundamentally physical, inherently mechanical world, according to the mechanistic worldview? Answer: In the two cases of organismic life and conscious mind, something purportedly superveniently emerges that's *in fact*, as a matter of manifest reality, uncomputable, negentropic, irreversible, processual, purposive, self-organizing, time-unidirectional or time-asymmetric, and non-equilibrium, and thereby *non-mechanical*, and therefore its basic structural properties *violate* the defining or essential structural properties of its fundamentally physical and inherently mechanical purported supervenience base.

In the cases of necessarily embedding the natural numbers and rational numbers within the real numbers, however, their basic structural properties are simply *an abstractive selection* from the defining or essential structural properties of the real numbers—the basic structural properties of the natural numbers and rational numbers are identical to *some* of the defining or essential structural properties of their supervenience base, the real numbers, although *not* identical to the full range of such properties—and therefore the natural numbers and the rational numbers automatically *inherit* those properties, although only in a derivative, secondary, shadowy, skeletal, and therefore epiphenomenal way. There's *nothing* that the natural numbers and rational numbers *can* “mathematically do,” that the real numbers *cannot already* “mathematically do.” By a diametric contrast to that, however, the purportedly supervening organismic or mental properties of organismic life and conscious mind, seemingly, *cannot* “causally do” *anything* that their fundamentally physical, inherently mechanical supervenience base *can already* “causally do.” Insofar as organismic life and conscious mind purportedly naturally or nomologically strongly supervene on their fundamentally physical, inherently mechanical supervenience base, then they're *drained* or *eviscerated* of any and all of their manifestly real causally efficacious basic structural properties, just as if one had substituted the calcified post-mortem skeleton of a living animal for the living animal itself.

But, let's now consider hard question **Q3**: *Why* is that the case? Answer: Again, it's just like confusing a living animal with its skeleton. In the two cases of organismic life and conscious mind purportedly naturally or nomologically supervening on their fundamentally physical, inherently mechanical supervenience base, in fact, as a matter of manifest reality, they've *actually* got *inherently more concrete and richer*

basic structures than their purported supervenience base; and then somehow or another, mysteriously, they're supposed to emerge from, or superveniently "pop out of," the inherently *more abstract and sparse* structure of their purported supervenience base. Nevertheless, it's self-evident that what is inherently more concrete and richer in its basic structure *cannot* be derived from what is inherently more abstract and sparse in its basic structure—on the contrary, necessarily, whatever is inherently more abstract and sparse in its basic structure must be derived *only* from what is inherently more concrete and richer in its basic structure.

And, I'm saying, *that's* precisely how natural mechanical systems are derived from the organic systems in which they're embedded and from which they're derived by natural or nomological strong supervenience: by systematic abstraction from what has an essentially richer basic structure. Moreover, to hold the contrary—namely, to hold that what is inherently more concrete and richer in its basic structure (for example, the living animal/conscious mind/the set and system of real numbers) is somehow or another mysteriously derived from, or superveniently "pop out of," what is inherently more abstract and sparse in its basic structure (e.g., the skeleton of that living animal/what is fundamentally physical and inherently mechanical/the sets and systems of natural and rational numbers)—is just to commit the fallacy of misplaced concreteness (Whitehead, 1927/1967: p. 51).

14.3 A Real-World Example: How a Steam Engine Works

Now let's look at a real-world example. Here's a simple explanation of how a steam engine works. A steam engine is a heat-driven mechanism that employs steam as an effective fluid, by building up sufficient steam pressure in order to push cylinder-encased pistons back-&-forth, and then using that pushing force, by means of a rod and crank, to produce rotational force for work. By virtue of separating the effective fluid from the products of combustion, steam engines are external combustion engines. The process by which a steam engine works is described by an *ideal* or *non-real-world* thermodynamic cycle, called *the Rankine cycle*, which is *isentropic*, i.e., *it doesn't create entropy*, i.e., *its entropy remains the same*, and it's also thermodynamically *reversible* or temporally symmetric. There are four processes in the Rankine cycle, which run between mechanical states identified by numbers 1, 2, 3 and 4 inside the two axes in the *T-s diagram*—i.e., *temperature-entropy diagram*—displayed in Fig. 14.1 two paragraphs below.

By means of *process 1–2*, the effective fluid is pumped from low to high pressure. Because the fluid is a liquid, the pump requires only a small amount of input energy, hence process 1–2 is isentropic compression. By means of *process 2–3*, the liquid under high pressure goes into a boiler, where it is heated at constant pressure by an external heat source, thereby producing a dry saturated vapor. By means of process 3–4, which is also isentropic, the dry saturated vapour is forced through a turbine and produces power. This decreases the temperature and pressure of the vapor, and some condensation might occur. Finally, by means of process 4–1, the

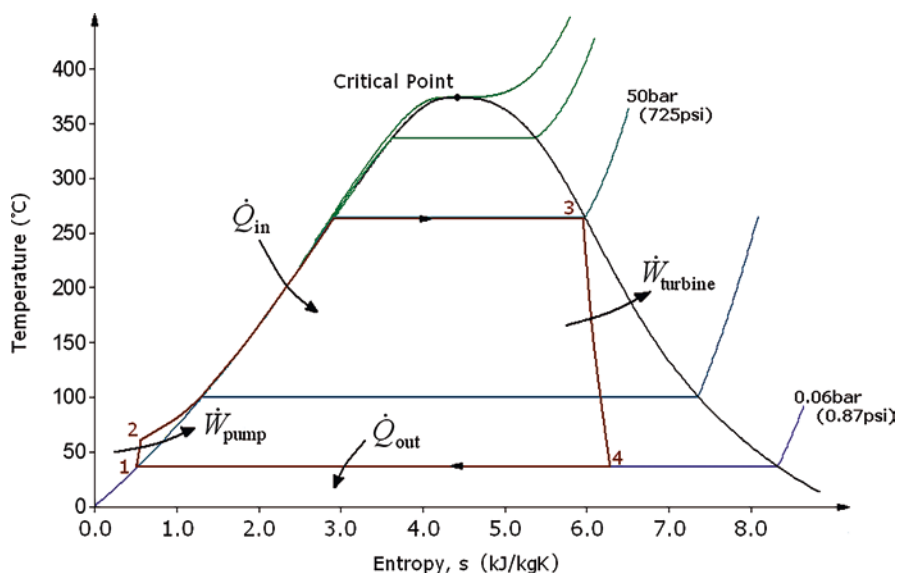


Fig. 14.1 T-s (Temperature vs. Specific Entropy) Diagram of a Basic Rankine Cycle Using Water/Steam in SI Units. (Ainsworth, 2007)

wet vapor then enters a condenser, where it is condensed at a constant pressure in order to become a saturated liquid.

The ideal Rankine cycle would be isentropic, i.e., the pump and turbine would generate no entropy and thereby maximize the net work output. Then, processes 1–2 and 3–4 would be represented by vertical lines in the T–s diagram. The Rankine cycle shown in Fig. 14.1 above prevents the state of the working fluid from ending up in the superheated vapor region after the expansion in the turbine, which reduces the energy removed by the condensers. It’s crucial to recognize, however, that an actual-world vapor power cycle is different from the ideal Rankine cycle, by virtue of irreversibilities in the inherent components caused by fluid friction and heat loss to the surroundings, in at least two ways. **First**, fluid friction brings about reductions in pressure inside the boiler, the condenser, and the pipes that run between the various elements of the engine, and as a consequence, the steam leaves the boiler at a lower pressure. And **second**, heat loss reduces the net work output, hence heat must be added to the steam in the boiler in order to maintain the same level of net work output. In these ways, the *non-ideal*, or *real-world*, Rankine-like thermodynamic cycle of a steam engine is non-isentropic and *entropic*, i.e., it *increases entropy*, and also it’s also thermodynamically *irreversible* or temporally unidirectional and asymmetric.

As we know from Chap. 13 above, entropy is the unavailability of thermal energy for conversion into causal (aka “mechanical”) action or work. And as we also know from Chap. 13, according to the Standard Models of cosmology and particle physics, and more specifically, according to The Second Law of Thermodynamics, (i) in

the spontaneous evolution of a closed or isolated natural system, entropy is never negated or reversed (negentropy), but only ever either stays the same (isentropic) or increases—although it is possible to reduce the rate of its increase, for example, by eliminating friction or lowering temperature—and (ii) the natural universe is a closed or isolated system, hence (iii) in the natural universe, entropy is never negated or reversed, but only ever either stays the same or increases (allowing for reductions of the rate of increase), i.e., The Second Law is a universal natural law.

But, according to the highly non-standard view of entropy and The Second Law of Thermodynamics that I've proposed, all closed or isolated, equilibrium, computable, entropic, reversible, naturally mechanical systems, incorporating the pseudo-arrow of bidirectional or symmetric unreal or mechanical time, for which The Second Law of Thermodynamics is a special natural law, are nothing but degenerate cases, fragments, or limiting cases of—hence, systematic abstractions from—open, non-equilibrium, uncomputable, negentropic, irreversible, naturally creative systems, incorporating the echt-arrow of unidirectional or asymmetric real or organic time. In the specific case of the steam engine, this means that *not only* the ideal or non-real-world Rankine thermodynamic cycle of the steam engine, *but also* the non-ideal or real-world Rankine-like thermodynamic cycle of the steam engine, are degenerate cases, fragments, or limiting cases of—hence, systematic abstractions from, skeletons of—open, non-equilibrium, uncomputable, negentropic, irreversible, naturally creative systems, incorporating the echt-arrow of unidirectional or asymmetric real or organic time.

14.4 Proving My View

How can this highly non-standard view be proved? As regards organismic life and essentially embodied conscious mind, in Chap. 13 above I've argued that my view provides an overall better and simpler explanation of them than any explanation that assumes the truth of the Standard Models of cosmology and particle physics and the universal truth of The Second Law of Thermodynamics. So in view of that, we can now raise **Q4**: What's the sufficient reason for the *manifestly real irreversibility* of the non-ideal or real Rankine-like thermodynamic cycle of the steam engine, if the natural universe is *fundamentally* mechanical, hence *fundamentally reversible*? How could a manifestly real irreversible thermodynamic system ever *originally arise* in an essentially *reversible* mechanical natural universe?

Of course, mere *reducible* and *temporary* irreversibility is fully consistent with the Standard Models of cosmology and particle physics and the universal truth of The Second Law of Thermodynamics, provided that (i) in principle, a thermodynamic system's temporary irreversibility is able to be reduced indefinitely towards the isentropic, reversible state of an ideal or non-real-world isolated or closed system operating under The Second Law of Thermodynamics, and (ii) the natural universe eventually reaches maximum entropy and exists in a reversible state of total equilibrium. In view of that, then here's my answer to **Q4**: I'm talking about

manifestly real thermodynamic irreversibility, *echt*-irreversibility, and *not* about mere reducible and temporary reducibility, *pseudo*-irreversibility. As J.L. Austin put it in a somewhat different context—namely, an epistemological context—in *Sense and Sensibilia* (Austin, 1962), it's just like the difference between *real ducks* and *decoy ducks*. Just as decoy ducks are *not* some special kind of ducks, instead *they're not ducks at all*, except by an extended and merely rhetorical use of the term “duck,” so too pseudo-irreversibility in thermodynamic systems is not some special kind of thermodynamic irreversibility, instead *it's not irreversibility at all*, except by an extended and merely rhetorical use of the term “irreversible.”

So once again, with gusto: If the natural universe is fundamentally mechanical, then how did manifestly real thermodynamic irreversibility, *echt*-irreversibility, ever originally arise? Answer: *Nohow*. That is: If the natural universe is fundamentally mechanical, then there's no sufficient reason for manifestly real thermodynamic irreversibility, *echt*-irreversibility, ever originally to arise. If you say, “It arises randomly from reversible processes,” or “It arises from random fluctuations in ensembles of interacting atoms whose micro-states are in elementary disorder,” then that's no more than pseudo-explaining what's a mystery on your theory, by appealing to another mystery. And in fact, that's precisely what Planck *does* say:

The micro-observer needs only to assimilate in his theory the physical hypothesis that the micro-states [of interacting atoms] are in elementary disorder. Then the uniqueness of the macroscopic process is assured and with it, also, the fulfillment of the principle of increase of entropy in all directions. Therefore, it is not the atomic distribution, but rather the hypothesis of elementary disorder, which forms the real kernel of the principle of increase of entropy and, therefore, the preliminary condition for the existence of entropy. Without elementary disorder there is neither entropy nor irreversible process. (Planck, 1915: p. 74)

[W]ith the aid of the calculus of probability and with the introduction of the hypothesis of elementary disorder, we have seen that all irreversible processes may be considered as reversible elementary processes: in other words, that irreversibility does not depend upon an elementary property of a physical process, but rather depends upon the ensemble of numerous disordered elementary processes of the same kind, each one of which individually is completely reversible, and upon the introduction of the macroscopic method of treatment. From this standpoint one can say quite correctly that in the final analysis all processes in nature are reversible. (Planck, 1915: p. 134)

So Planck's “hypothesis of elementary disorder” (Planck, 1915: pp. 74, 134) strikes me as no more rationally justified than appealing to an *occult quality*.

On the contrary, what *I* say, and now highly non-standardly inverting the modern classical materialist or physicalist and mechanistic order of explanation, is that the sufficient reason for any mechanical system's manifestly real irreversibility, now specifically applied to the non-ideal or real-world Rankine-like thermodynamic cycle of the steam engine, is that its manifestly real irreversibility is modal-metaphysically derived by *originally inheriting it* from the essentially richer structure of an essentially negentropic *irreversible* organic natural universe, by systematic abstraction from fundamentally organic thermodynamic processes, according to the natural or nomological strong supervenience of the mechanical on the organic. And

then, in turn, the isentropic reversibility of the ideal or non-real-world Rankine thermodynamic cycle of the steam engine is derived by a *further* or *second* step of systematic abstraction from the non-ideal or real-world Rankine-like thermodynamic cycle of the steam engine, again according to the natural or nomological strong supervenience of the mechanical on the organic. This explanation, I'm claiming, provides an overall better and simpler explanation of how a steam engine (and, by generalization, any natural mechanical system) works *and* of organismic life and conscious mind, than any explanation that assumes the truth of the Standard Models of cosmology and particle physics and the universal truth of The Second Law of Thermodynamics.

14.5 Another Real-World Example: Eddington's Three Tables

In the Introduction to his 1927 Gifford Lectures, published in 1929 as *The Nature of the Physical World*, as per the first epigraph at the top of this chapter, A.S. Eddington world-famously introduced us to his two tables.

Table #1, the “commonplace object of that environment which I call the world” (Eddington, 1929: p. xi), is *phenomenologically robust*, in the sense that it's *directly presented* to us as a single, substantial *macroscopic object* via our capacity for sense perception; and equally importantly and more generally, it also fully belongs to the everyday intersubjective “lifeworld” (*Lebenswelt*) that's filled to the brim with “human, all-too-human” aesthetic, artistic, and affective-emotional attitudes and values of all kinds, and intentional agency of all kinds, including instrumental action, morality, social institutions, and politics (Husserl, 1954/1970; Moran, 2012; Hanna, 2014). Hence Table #1 is *manifestly real*, or in other words, it's an *objective or veridical appearance*, i.e., something that appears to us in the way or ways it does, *precisely because that's what it really and truly is*.

But although Table #1 is manifestly real, nevertheless, according to materialist or physicalist metaphysics and mechanistic science, *it's not noumenally or “really” real*. By sharp contrast, Table #2, the “scientific table,” is *microphysical*, in the sense that it's made up out of a plurality of inherently unperceivable *microscopic objects*, including particles, waves, and “fields of force,” and thus it cannot be directly presented to our capacity for sense perception. Hence Table #2 is *not* manifestly real, although it's also *indirectly detected* by us via macroscopic experimental measuring devices. But despite the fact that Table #2 is microphysical, inherently unperceivable, not manifestly real, and only ever indirectly detected by us, nevertheless, according to materialist or physicalist metaphysics and mechanistic science, it's noumenally or “really” real, and the one and only writing table actually existing in Eddington's study:

I need not tell you that modern physics has by delicate test and remorseless logic assured me that my second scientific table is the only one which is really there—wherever “there” may be. (Eddington, 1929: p. xiv)

Therefore, by accepting this claim, Eddington has unintentionally converted Table #1 into a merely *phenomenal* object, a subjective or falsidical appearance—an illusion.

Now according to me, there is one and only one writing table actually existing in Eddington's study, i.e., the very table that Eddington is sitting at and using for writing his lectures: let's call it *Eddington's Table #3*. Table #3 just *is* Table #1, but *only insofar as* it's phenomenologically robust, manifestly real, living in the lifeworld, directly cognized by us, directly detected by us via macroscopic experimental measuring devices, and *not* a merely phenomenal object and subjective/falsidical appearance or illusion. Moreover, and above all fundamentally, Table #3 is *an organic system*, and it necessarily embeds within itself a natural mechanical system that's naturally or nomologically supervenient on Table #3. I'll come back to that crucial point shortly.

In the meantime, I want to stress that in the context of this book, the term *organic* means *non-mechanical*, not specifically *organismic*: all organisms are organic systems, but not all organic systems are organisms. To take a paradigmatic example, Table #3 is fundamentally an organic—hence non-mechanical—system that's also *not* an organism. As I've said many times already, by *a mechanical system* I mean any natural system such that it's Turing-computable, entropic, reversible, time-bidirectional or time-symmetric, and equilibrium thermodynamic, and by *an organic system*, I mean any natural system such that it's essentially or fundamentally uncomputable, negentropic, irreversible, processual, purposive, self-organizing, time-unidirectional or time-asymmetric, and non-equilibrium thermodynamic. But more specifically, by *an organismic system*, I mean any organic system that satisfies, **first**, the *Oxford Encyclopedic English Dictionary's* non-scientific or non-technical definition of “organism,” namely,

1 a living individual consisting of a single cell or of a group of interdependent parts sharing the life processes. 2a an individual live plant or animal. 2b the material structure of this. 3 a whole with interdependent parts compared to a living being. (Hawkins & Allen, 1991: p. 1024),

and **second**, this scientific or technical definition:

When the lipids in the primordial oceans generated micelles, they spontaneously separated the internal environment of the cell from the external environment That gave rise to intracellular negative entropy [Schrödinger, 1944/1967], circumventing the Second Law of Thermodynamics, energized by chemiosmosis and regulated by homeostasis. These... are “The First Principles of Physiology” (FPP).... The organism complies with these FPPs by monitoring the environment based on the principle of homeostasis. There is a range of conditions that homeostasis can tolerate, beyond which remodeling of the cellular niches formed by developmental causal-processual mechanisms occur.... Such auto-engineering underpins evolution.... The organism must ascribe to The FPPs to survive, making this fact a necessary feature of its nature. Conversely, homeostasis monitors the environment, providing freedom for the internal environment to vary around its set-point. If the limits of homeostatic control are violated, the organism will remodel itself by reverting to its

previous phylogenetically determined set-point to maintain homeostasis. (Torday & Miller Jr, 2020: pp. 6–7; see also Varela et al., 1974; Varela, 1979; square-bracketted material added)

Granting all that, then on grounds of metaphysical-&-ontological parsimony alone, my theory of everyday objects like tables is *metaphysically-&-ontologically* superior to any *dualistic theory* like the one that Eddington accepts, namely, the theory asserted by materialist or physicalist metaphysics and mechanistic science, which postulates that scientific Table #2 is noumenally real and that phenomenal Table #1 is nothing but a subjective falsidical appearance and an illusion. Moreover, since I also hold that Table #3 is directly perceived by us, as a manifestly real, objective veridical appearance, which entails direct realism and anti-skepticism, then my theory of everyday objects like tables is also *epistemically* superior to the dualistic theory accepted by Eddington and asserted by materialist or physicalist metaphysics and mechanistic science, which holds that what we directly perceive is only ever a subjective or falsidical appearance and illusion, and which is therefore an *indirect realist, skeptical* theory of human sense perception.

Now as I mentioned above, even though, according to me, there's one and only one writing table in Eddington's room, namely, the directly perceivable, objectively veridically apparent, manifestly real organic system that's Table #3, there's *also* a mechanical system that's necessarily embedded within Table #3, as a degenerate case, fragment, limiting case, or skeleton, of Table #3, that's derivable by systematic abstraction from Table #3, and that's naturally or nomologically strongly supervenient on Table #3, with no efficacious causal powers of its own because it inherits whatever causal powers it has from the fundamentally organic system that is Table #3. For convenience, let's call the natural mechanical system that's embedded within Table #3, "NMS^{T3}." Insofar as Eddington uses Table #3 *as* a writing table, he's *also* using NMS^{T3} and therefore NMS^{T3} *also* belongs to the everyday world of humanly usable, instrumentally valuable objects that the existential phenomenologist Martin Heidegger aptly calls the world of *Zuhandenheit*, or "readiness-to-hand" (Heidegger, 1927/1962: esp. sections 14–24).

From a metaphysical-&-ontological point of view, however, it's crucial to recognize two things.

First, NMS^{T3} is *not* a table that's *ontologically distinct* from Table #3, because on the contrary, NMS^{T3} is a skeletal structure that's necessary embedded within the basic structure of Table #3, and therefore NMS^{T3} is *a proper part* of the basic structure of Table #3, and *not* something over and above Table #3.

This crucial point raises some tricky metaphysical-&-ontological issues about the nature of *dualism* that merit a brief excursus.

Let's say that any two things are *different* if and only if they *don't* share all the same properties. That follows by modus tollens from Leibniz's Law, which says that two things are *identical* if and only if they *do* share all the same properties. Correspondingly, any *two kinds of things* are *different* if and only if one of them can be instantiated in something without the other being co-instantiated in that thing. Building on those working definitions, let's then say that any two kinds of things are

categorically different if and only if (i) they're different and (ii) they have different *necessary and sufficient inherent defining characters*, i.e., different *essences*. Then, two kinds of things are *dualistically different*—that is, their difference is an *ontological dualism*—if and only if (i) they're categorically different, (ii) *none* of their co-instantiations is such that it has a *dual essence* consisting of those two kinds of things standing in a *synthetic a priori relation of mutual or symmetric necessitation*, which is what we'll call a relation of *necessary complementarity*, and (iii) they *mutually exclude each other* in every instance of either kind of thing. If two kinds of things are dualistically different, then it's always conceivable and therefore logically or analytically possible that instances of the one kind of thing can occur without instances of the other kinds of thing and also conversely, *even if* they're either contingently or nomologically co-instantiated *in the actual world*, which is *property dualism*. But, supposing that two kinds of things indeed *are* either contingently or nomologically co-instantiated in the actual world, then because they're so connected in all of those actual co-instantiations, then they *don't* mutually exclude each other in every instance of either kind of thing. Therefore, although ontological dualism entails property dualism, property dualism doesn't in and of itself entail ontological dualism.

The most famous example of ontological dualism is of course *classical Cartesian interactionist substance dualism* in the philosophy of mind, which holds that the human mind and the human body are essentially distinct substances: one of them fundamentally non-material or non-physical, and the other one fundamentally material or physical, hence fundamentally non-mental. These essentially distinct substances are held together by metaphysically mysterious contingent causal relations, including both mind-to-body or mind-to-mind causal relations (aka “mental causation”) and body-to-mind causal relations. By sharp contrast, as I pointed out in Chap. 2, I reject classical Cartesian interactionist substance dualism and claim that the mental-physical relation in minded living organisms like us is nothing more and nothing less than (i) a synthetic a priori two-way necessary complementarity relation, and also (ii) a neo-Aristotelian hylomorphic relation, that is, a mental-to-physical and also physical-to-mental entangled necessary equivalence of “fused” inherently activating irreducible formal or morphetic mental properties on the one hand, and complex non-equilibrium thermodynamic material or hyletic biological physical properties on the other—or as Aristotle puts it in his own terminology: “the soul (anima) is the first actuality of a natural body that has life potentially” (Aristotle, 1968: II.i.412a22). This, again, is what Michelle Maiese and I call *the essential embodiment theory* of the mind-body relation (Hanna & Maiese, 2009; see also Hanna, 2011).

Because, according to the essential embodiment theory, the complementarity relation between mental properties and organismic physical properties is synthetic a priori necessary, but *not* analytic a priori necessary, there will be logically possible worlds in which mental and physical organismic properties come apart. But these are not really possible worlds. According to my modal dualist semantics, analytic a priori truths are conceptually necessary truths, and synthetic a priori truths are non-conceptually necessary truths; analytic a priori falsehoods are conceptually

necessary falsehoods, and synthetic a priori falsehoods are non-conceptually necessary falsehoods; analytic a priori possibilities are conceptual possibilities, and synthetic a priori possibilities are non-conceptual possibilities; analytic a priori impossibilities are conceptual impossibilities, and synthetic a priori impossibilities are non-conceptual impossibilities (see Hanna, 2015: esp. chs. 2 and 4). More specifically, the modal scopes of analytic a priori or conceptual necessity and of synthetic a priori or non-conceptual necessity are categorically distinct and mutually exclusive: analytic a priori or conceptually necessary truths obtain in every logically possible world, but synthetic a priori or non-conceptually necessary truths obtain in all and only humanly-experienceable, manifestly real worlds, and are never false otherwise, because they're without a truth-value in all the logically possible worlds that aren't humanly experienceable and manifestly real. Therefore, given my modal dualist semantics, propositions or statements postulating mental without organismic physical properties, or conversely, are "truth-value gaps" or truth-valueless.

Correspondingly, two different kinds of thing, or two different properties, can have different inherent defining characters or essences, even though they're *never instantiated without the other in any humanly-experienceable, manifestly real world*: for example, particles and waves; or two entangled, nonlocally-related particles; or the form and matter of the same thermodynamic process; or right-handedness and left-handedness; or natural numbers and real numbers; or being inner and being outer; and so-on. The core thought here is that both kinds of things or properties belong to an *essentially more comprehensive or inclusive structure and system* that makes them necessarily complementary to each other, while *also* preserving their categorical difference from one another.

According to my view, then, mental properties and organismic physical properties are precisely like that. They both belong to the essentially more comprehensive or inclusive structure and system of *the human minded animal*, or, when the human minded animal is also self-conscious and rational, of *the human person* (Hanna, 2018: chs. 6 and 7). In other words, mental and organismic physical properties are categorically distinct because each has a different inherent defining character or essence, but the essentially more comprehensive or inclusive larger structure and system that contains them both is *dual*, hence they're *dual aspects* of the human minded animal or person. To make this conception more concrete, consider the complementarity of the properties of *being inner* and *being outer*—nicely iconically imaged in 2D space by the concave and convex sides of the same curving line—phenomenologically understood as capturing the first-person perspective of a human minded animal or person, *egocentrically centered in orientable space*, who simultaneously experiences, by means of *feelings of vitality*, both the inside and the outside of their *Leib*, or living, lived body (Hanna & Thompson, 2003).

By virtue of all that, then the organic (especially including the organismic) and the mechanical that's necessarily embedded within the organic, are different and categorically different, but they're *neither* dualistically different, i.e., the difference between the organic and the mechanical is not an ontological dualism, *nor* do they stand in a relation of property dualism, precisely because (i) the mechanical is naturally or nomologically strongly supervenient on the organic, hence there's a

necessary dependency of the mechanical on the organic, which violates the third condition of ontological dualism, and (ii) that necessary dependency is *asymmetric*, hence the relation between the organic and the mechanical is also *not* one of complementarity, and also (iii) it's *inconceivable* and therefore logically or analytically impossible that anything could be mechanical without *also* being organic, since mechanical natural systems are nothing more and nothing less than systematic abstractions from essentially richer organic natural systems, just as it's inconceivable and therefore logically or analytically impossible that anything could be a natural number without *also* belonging to the set of real numbers, since the set and system of natural numbers is nothing more and nothing less than a systematic abstraction from the essentially richer set and system of real numbers, hence the relation between the organic and the mechanical is *not* one of property dualism. End of the excursus.

Second, NMS^{T3} is *not* Eddington's "scientific" Table #2, because on the contrary, even though Table #2 is a natural mechanical system according to the Standard Models of particle physics and cosmology, it's *also* taken by the Standard Models, in view of their metaphysical materialism or physicalism and their mechanistic worldview, to be a causally efficacious, noumenal, and naturally mechanical *non-manifest* object, whereas NMS^{T3} is a *manifestly real* object. Eddington's "scientific" Table #2, for example, is subject to the Fitzgerald-Lorentz contraction (Einstein et al., 1923/1952: esp. pp. 3–71; Eddington, 1929: ch. 1; Born, 1962: pp. 218–224), but Table #3 *isn't*—which is perfectly consistent with the Michelson-Morley experiment if we're shooting beams of light from one end of Table #3 to the other end in the direction of the Earth's spin and also at right angles to it, which take essentially the same amount of time—hence NMS^{T3} isn't *either*.

Indeed, the Fitzgerald-Lorentz contraction is only a deduction from Maxwell's atomic-electromagnetic theory of matter, together with the static aether theory and the null result of the Michelson-Morley experiment,² and *not* directly observable, hence noumenal, whereas NMS^{T3}, like Table #3, *is* directly observable, hence manifestly real. According to organicism, the mechanical is derived from the organic by means of a natural-law-governed abstractive selection from the essentially richer domain of properties and efficacious causal powers of organic systems, and therefore the mechanical is nothing more and nothing less than a special sub-domain within the organic, namely, a relatively fixed, rigid, and static skeleton that's necessarily embedded in essentially richer natural organic systems. In a precisely analogous way, as I've said, the computable, only-denumerable set and system of natural numbers is derived from the uncomputable, non-denumerable set and system of real numbers by a logical-and-mathematical-law-governed abstractive selection from the essentially richer domain of the real numbers, and therefore the set of natural numbers is nothing more and nothing less than a special sub-domain that's necessarily embedded within the set and system of real numbers, namely, a relatively

²Indeed, a version of the static aether theory was actually held by Lorentz at the time, from 1895 to 1904, but eventually dropped by him—and everyone else—after the appearance of Einstein's special theory of relativity in 1905.

rigid and static logico-mathematical skeleton that's necessarily embedded in essentially richer logico-mathematical organic systems (see Chap. 8 above).³ And in both cases, *the essentially richer organic domain continues to exist in all its richness, even as we "zoom in" on the narrowly selected mechanical sub-domain.*

14.6 Conclusion: The Salvation of Everyday Objects

In view of all that, I conclude that it is *indeed* plausible to hold that natural mechanical systems have no efficacious causal powers of their own, and only inherit any and all causal powers that they do have, in a metaphysically-&-ontologically derivative, secondary, shadowy, skeletal, and therefore epiphenomenal way, from the inherently more concrete and richer organic systems in which they're necessarily embedded and from which they're derived by natural or nomological strong supervenience.

But there's importantly more. As I mentioned in Sect. 14.5, the natural mechanical system that's necessarily embedded within the organic system that is Table #3, NMS^{T3}, is also what makes Table #3 humanly usable as a *tool* for sitting at and writing upon, and therefore it has everyday human instrumental value and belongs to the world of what Heidegger calls *Zuhandenheit* or "readiness-to-hand" (Heidegger, 1927/1962: esp. sections 14–24). As Heidegger also points out in the same text, it's *also* possible to regard and treat a table, or any other ready-to-hand object in the lifeworld, *either* as nothing but a merely phenomenal object, a subjectively ideal falsidical illusion, *or* as a noumenally "really real" scientific object like Eddington's Table #2, and therefore in both cases it belongs to the world of what Heidegger calls *Vorhandenheit* or "presence-at-hand." This not only metaphysically-&-ontologically and epistemically *falsifies* Table #3 or any other ready-to-hand object, but also *strips it of its readiness-to-hand and its everyday human instrumental value.* Heidegger's student, the Frankfurt School critical theorist Herbert Marcuse, pushed this analysis one step further and also identified the falsified and everyday-human-value-stripped present-at-hand table and other everyday objects as nothing but *commodities* in the global system of advanced or late capitalist production (Marcuse, 1964). Or as I'll reformulate it in the terminology I've been using in this book, this materialist/physicalist and mechanistic falsification, and this advanced or late capitalist commodification, of Table#3 or any other ready-to-hand everyday object, are

³Correspondingly, essentially the same skeletal embedding relation that holds between the real numbers and the natural numbers, also holds between the natural numbers and the prime numbers. According to *the fundamental theorem of arithmetic*, every positive integer greater than one can be represented as the product of a unique list of prime numbers, i.e., its prime factors. But the mathematical properties of the natural numbers can't be reduced to the mathematical properties of the prime numbers, just as the mathematical properties of the real numbers can't be reduced to the mathematical properties of the natural numbers. Hence prime numbers provide a necessary skeletal frame for the essentially richer system of natural numbers, just as the natural numbers provide a necessary skeletal frame for the essentially richer system of real numbers.

simply two different sociocultural modes of the fallacy of misplaced concreteness (Whitehead, 1927/1967: p. 51).

But suppose that someone—a “one dimensional man” (Marcuse, 1964)—has been profoundly wrongly convinced by materialist or physicalist metaphysics and mechanistic science, and/or by the hegemonic ideology of the global system of advanced or late capitalism, into regarding and treating Table #3 as nothing but a present-at-hand phenomenal object standing in for a noumenal scientific Table #2, and as a mere commodity stripped of its everyday human instrumental value? What could possibly *ever* liberate and rescue that “one-dimensional man” from his disastrously false theoretical beliefs and/or his disastrously commodifying ideology?

Well, here’s another, radically different way of thinking about, regarding, and treating Table #3 and the natural mechanical system that’s necessarily embedded within Table #3, NMS^{T3}, that fully avoids theoretical falsification, ideological commodification, and the fallacy of misplaced concreteness, alike, and that I’ve been exploring in this chapter: namely, *the neo-organicist approach* according to which Table #3 is fundamentally an organic system. Of course, I’ve been arguing for the neo-organicist approach throughout this book, which to say, *conceptually* and *theoretically*. But how can we convey the same idea *non-conceptually* and *non-theoretically*, in such a way as to enable the “one-dimensional man,” and all the other one-dimensional people in the contemporary world, to liberate himself and themselves from his doubly-disastrous theoretical and ideological predicament?

My proposal is that we seriously aesthetically consider the table so beautifully and sublimely represented in a detail from Van Gogh’s famous painting, “Bedroom at Arles”: the bedside table. What Van Gogh’s bedside table conveys to me, as a philosophically-minded aesthetic viewer of that painting, is an exceptionally vivid sense of that table’s *essentially rich metaphysical-&-ontological structure* and also its *absolute, non-denumerably infinite, intrinsic, objective, and irreducibly non-instrumental value*. Let’s call this the table’s metaphysical-&-ontological and axiological *depth*. Or in other words, by artistically conveying his bedroom table’s metaphysical-&-ontological and axiological depth, what Van Gogh has shown us is *the fundamentally organic system* that’s the table in his bedroom at Arles. By the same token, namely, by means of our *aesthetic experience of the beautiful and the sublime anywhere in the natural universe, including the world of everyday objects* I want to say, we can *also* recognize the fundamentally organic system that is Eddington’s table #3, with its essentially rich metaphysical-&-ontological structure, and also its absolute, non-denumerably infinite, intrinsic, objective, and irreducibly non-instrumental value.

So perhaps surprisingly, what Van Gogh is non-conceptually and non-theoretically teaching us is that the epiphenomenality of everyday mechanical systems like MNS^{T3} is *also* their axiological salvation. Therefore, and now fully generalizing, by showing us how the mechanical is necessarily embedded in the organic, the neo-organicist explanatory inversion thesis enables us to recover the essentially rich metaphysical-&-ontological organic structure and the absolute, non-denumerably infinite, intrinsic, objective, and irreducibly non-instrumental organic value, of the

natural universe as a whole and in all its proper parts, including everyday objects, aka *the cosmos*. It's precisely this latter thesis—the absolute, non-denumerably infinite, intrinsic, objective, and irreducibly non-instrumental organic value of the cosmos—that I'll present and defend in the next chapter. As other philosophers of science have done before me (see, e.g., Kuhn, 1970), I'll conclude that the formal and natural sciences aren't value-*neutral*, they're value-*laden*: committed to various kinds of value, including aesthetic, artistic, moral, and political value. But unlike most other philosophers of science, I'll also conclude that this value is fundamentally *non-instrumental* and *a priori* or non-empirical, and not merely instrumental and *a posteriori* or empirical.

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Chapter 15

The Attunement Thesis and Cosmic Dignitarianism



Abstract What I call *the attunement thesis* says that all the formal and natural sciences are grounded in the metaphysics of weak or counterfactual transcendental idealism, and that the primary source of epistemic evidence for this grounding is our essentially non-conceptual, disinterested, and pure aesthetic experience of natural beauty. In Sects. 15.2 and 15.3, I argue (i) that the attunement thesis is true, and (ii) that unless the formal sciences and the natural sciences—principally, logic, mathematics, physics, and biology—(ii.a) were to acknowledge the truth of the attunement thesis and also (ii.b) were to incorporate the attunement thesis into their respective repertoires of foundational a priori principles, then those sciences would be metaphysically alienated from manifest natural reality, with nothing for those sciences to be either meaningful *about* or true *of*. Then in Sect. 15.4, building on the attunement thesis, I argue for a second thesis I call *cosmic dignitarianism*.

That object the form of which (not the material aspect of its representation, as sensation) in mere reflection on it (without any intention of acquiring a concept of it) is judged as the ground of a pleasure in the representation of such an object—with its representation this pleasure is also judged to be necessarily combined, consequently not merely for the subject who apprehends this form but for anyone who judges at all. This object is then called beautiful; and the faculty for judging through such a pleasure (consequently also with universal validity) is called taste.... An individual judgment of experience, e.g., one made by someone who perceived a mobile water droplet in a rock crystal, rightly demands that anyone else must also find it so, since he has made his judgment, in accordance with the general conditions of the determining power of judgment, under the laws of a possible experience in general. In just the same way, someone who feels pleasure in mere reflection on the form of an object, without regard to a concept, rightly makes this claim to the assent of everyone else, even though this judgment is empirical and is an individual judgment, since the ground of this pleasure is to be found in the universal though subjective condition of reflecting judgments, namely the purposive correspondence of an object (be it a product of nature or of art) with the relationship of the cognitive faculties among themselves (of the imagination and the understanding) that is required for every empirical cognition.... Although our concept of a subjective purposiveness of nature in all its forms, in accordance with empirical laws, is not a concept of the object at all, but only a principle of the power of judgment for providing concepts in the face of this excessive multiplicity in nature (in order to be able to be oriented in it), we nevertheless hereby ascribe to it as it were a regard for our faculty of cognition, in accordance with the analogy of an end; and thus we can regard **natural beauty** as the **presentation** of the concept of formal (merely subjective) purposivenesswhich we judge through taste (aesthetically, by means of the feeling of pleasure). (CPJ Ak 5: 190–193; boldfacing in the original)

How exquisitely the individual Mind
 (And the progressive powers perhaps no less
 Of the whole species) to the external World
 Is fitted:—and how exquisitely, too—
 Theme this but little heard of among men—
 The external World is fitted to the Mind. (Wordsworth, 1888: ll. 816–821)

15.1 Introduction

Aren't the late afternoon cloud formations depicted in the photographic image I've displayed at the top of this chapter beautiful? (Fig. 15.1) I'll explain the significance of the image's unusual title at the end of Sect. 15.3. But for the moment what's philosophically important is that, perhaps surprisingly, our shared experience of this and all other kinds of natural beauty demonstrates something essential about the foundations of the formal and natural sciences.

As per the **first** epigraph directly below the image at the top, in the early 1790s Kant argued in the *Critique of the Power of Judgment* (i) that the mutual formal or structural attunement of the rational human mind with the basic forms or structures of natural reality, is directly, and veridically cognized by means of our essentially non-conceptual, disinterested, and pure aesthetic experience of natural beauty, and also (ii) that this mutual attunement, as codified in the metaphysics of transcendental idealism, is presupposed by all theoretical cognition or science whatsoever, whether by means of either “determining judgments,” including truth-evaluable propositional beliefs and statements, and logico-deductive inferences, or by means of “reflecting judgments,” including inductive inferences and abductive inferences (*CPJ* Ak 5: 179–181). In short, according to Kant, all the formal and natural sciences are grounded in the metaphysics of *transcendental idealism*, and the primary source of epistemic evidence for this grounding is *our essentially non-conceptual, disinterested, and pure aesthetic experience of natural beauty*. And as per the **second** epigraph, in the late 1790s William Wordsworth much more compactly and poetically expressed essentially the same dual thesis in “Home at Grasmere.” For convenience, let's call this *the attunement thesis*.

In Sects. 15.2 and 15.3, I'll argue (i) that the attunement thesis is true, and (ii) that unless the formal sciences and the natural sciences—principally, logic, mathematics, physics, and biology—(ii.a) were to acknowledge the truth of the attunement thesis and also (ii.b) were to incorporate the attunement thesis into their respective repertoires of foundational a priori principles, then those sciences would be metaphysically alienated from manifest natural reality, with nothing for those sciences to be either meaningful *about* or true *of*. Then in Sect. 15.4, building on the attunement thesis, I'll argue for a second thesis I call *cosmic dignitarianism*.



Fig. 15.1 “It is not both true and false that there at least 5 distinct cloud formations visible above hills or mountains in the distance, viewed across a snowy field with pine trees in the foreground, looking westward, on a late afternoon in February 2018.” (Author’s photograph, 2018)

15.2 Manifest Realism and the Non-Isomorphism Problem

For the purposes of my argument here, I’m going to assume the truth the thesis of *manifest realism*, which, as you’ll recall, says that the natural universe is, at least in principle, *directly accessible* to rational human pure or a priori intuition and human sense perception alike, precisely because the natural universe consists of a complete, unified, structuralist system of *objective veridical appearances*, such that, anything X appears to be F (or G, or whatever) to us if and only if (i) X *really and truly is* F (or G, or whatever), and (ii) the fact of X’s being F (or G, or whatever) is, at least in principle, *intersubjectively directly accessible* to all actual or possible

rational human animals, and *not* idiosyncratically restricted to any single rational human individual or to any particular rational human community/social institution or special set of such communities/social institutions.

Correspondingly, by *manifest natural reality* I mean *the natural universe* all around us, in which we live, and move, and have our being, insofar as it appears to be F (or G, or whatever) to us, precisely because it actually and truly is F (or G, or whatever), and is therefore is an *objective veridical appearance*.

In this way, manifest natural reality is categorically *not* that world insofar either (i) it appears to rational human animals only in an illusory or subjectively idiosyncratic way (i.e., “mere appearances,” “mere phenomena,” “subjective appearances,” “subjective phenomena,” “the veil of appearances,” etc.), or (ii) it’s essentially hidden, humanly-unknowable, and therefore is constituted by “things-in-themselves” or *noumena*. Indeed, my two-part view about things-in-themselves or noumena is (ii.a) that it’s a priori knowable that *neither* the nature *nor* the existence or non-existence of things-in-themselves or noumena are knowable or provable, which is what I call *radical agnosticism*, and also (ii.b) that for the purposes of any real (i.e., humanly meaningful) metaphysics, we should simply eliminate such objects and the concepts of such objects by bracketing them out of our metaphysical theorizing, which is what I call *methodological eliminativism about things-in-themselves or noumena* (Hanna, 2017).

Assuming the truth of manifest realism, then we must also adopt a broadly-speaking *realistic* view of the formal and natural sciences, and therefore reject any sort of *anti-realism* from the outset. So, (i) insofar as the formal and natural sciences are meaningful, and therefore true or false, then *they’re really about some things and/or kinds of things*, and (ii) insofar as the formal and natural sciences are actually true, then not only must they actually apply to manifest natural reality, they must also actually *line up with* manifest natural reality, which is to say that they must also *be isomorphic with* manifest natural reality: that is, the basic forms and structures truly represented by the formal and natural sciences must be *exactly the same* basic forms and structures that are immanent or inherent in manifest natural reality.

For, suppose that the formal and natural science *weren’t* isomorphic with manifest natural reality. Then, either (i) it’s the case that although the basic forms and structures of manifest natural reality are *maximally lawlike and maximally well-ordered*, yet at the same time they’re *so overwhelmingly complex* that our rational human minds and therefore even our best formal and natural sciences cannot accurately represent those basic forms or structures, not even in principle, or (ii) it’s the case that although the basic forms and structures of manifest natural reality are *somewhat lawless and somewhat disorderly*, nevertheless they’re *at least minimally lawlike and at least minimally well-ordered*, yet at the same time they’re still *so overwhelmingly complex* that our rational human minds and therefore even our best formal and natural sciences cannot accurately represent those basic forms or structures, not even in principle, or else (iii) it’s the case that manifest natural reality is *maximally lawless and maximally disorderly* so that, yet again, our rational human minds and therefore even our best formal and natural sciences, cannot accurately represent the basic forms and structures of natural reality, not even in principle,

precisely because manifest natural reality has no immanent or inherent form or structure whatsoever.

Let's call this general problem for the sciences—whether it's due to the possible overwhelming complexity, or the possible maximal lawlessness and disorderliness, of manifest natural reality—the *non-isomorphism problem*. If any of the skeptical scenarios described by the non-isomorphism problem were true, then the formal and natural sciences would be metaphysically alienated from manifest natural reality, with nothing for those sciences to be either meaningful about or true of.

Notice that although the non-isomorphism problem is indeed a serious skeptical problem, it's *not* any one of the many skeptical problems in the classical Cartesian sense (dream skepticism, evil demon skepticism, brain-in-the-vat skepticism, new evil demon skepticism, etc.), all of which presuppose (i) the possibility that only “mere appearances,” “mere phenomena,” “subjective appearances,” “subjective phenomena,” “the veil of appearances,” etc., exist inside our conscious states, and (ii) the corresponding possibilities that either (ii.a) manifest natural reality simply does not exist or (ii.b) manifest natural reality exists, but it's wholly constituted by unknowable things-in-themselves or noumena, which are entirely different from what they merely appear to be. For all such skeptical problems in the classical Cartesian sense *are ruled out from the get-go by my working assumption that manifest realism is true*.

15.3 How to Solve the Non-Isomorphism Problem: The Attunement Thesis

My solution for the non-isomorphism problem—namely, the attunement thesis—has three parts: **first**, we accept *weak or counterfactual transcendental idealism*, **second**, we accept *strong non-conceptualism*, and **third**, harking back to Kant and Wordsworth, we accept the idea that the mutual formal or structural attunement of the rational human mind with the basic forms or structures of natural reality is directly and veridically cognized by means of our disinterested and pure aesthetic experience of natural beauty, *thereby providing phenomenologically necessitating evidence for our sufficiently justified non-empirical true belief about—i.e., our a priori knowledge of—our attunement with nature*.

I'll now spell out those three steps in more detail.

First, we accept *weak or counterfactual transcendental idealism*, as I defined it in Chap. 7 above.

Second, we accept *strong non-conceptualism*, which says the following:

The theory of rational human cognition, content, and knowledge that I am proposing ... is, in part, a “bottom-up” theory about the nature of minded animals that anchors conceptual content in the primitive fact of essentially non-conceptual content. Essentially non-conceptual content ... is a kind of mental content that is categorically different from conceptual content, in the sense that both its underlying semantic structure and also its

characteristic psychological function or role are inherently distinct from those of conceptual content. Furthermore, essentially non-conceptual content is a kind of mental content that rational human animals or real human persons share with non-rational minded animals, whether non-human (e.g., cats) or human (e.g., infants), who, it seems, do not possess conceptual capacities. So essentially non-conceptual content epitomizes the specifically non-intellectual or *sensible*, embodied, perception-based, phenomenally conscious side of human mindedness, whereas conceptual content epitomizes the specifically *intellectual* or discursive, reflective, judgment-based, self-conscious side of human mindedness.... [B]y way of a preliminary or working characterization to have in front of us, I will say that essentially non-conceptual content is mental content that necessarily includes essentially indexical formal spatiotemporal and dynamic representations that are fully sensitive to complex thermodynamic asymmetries in perceptually manifest natural objects and processes, and also that the primary psychological function or role of essentially non-conceptual content is to account for directly referential cognition, and to guide and mediate the sensorimotor processes constitutive of finegrained intentional body movements in rational minded [human] animals. (Hanna, 2015: p. 25)

Third, let's assume that weak transcendental idealism and strong nonconceptualism are both true, and also (i) that by "disinterested" we mean that the mode of cognition is *non-practical*, in that it's *not primarily or solely motivated by self-interested, purely consequentialist, or even purely moral aims*, and (ii) that by "pure" we mean that the mode of cognition is *primarily focused on the formal or structural features of aesthetic objects insofar as they immanently inform or structure the specific qualitative characters of those objects, and not primarily or solely focused on those specific qualitative characters themselves*. Granting those definitions, then it's clearly and distinctly the case that our disinterested and pure aesthetic experience of natural beauty—consider, for example, the photographic image of late afternoon sun over mountains and a small lake, displayed in Fig. 15.2 below—as a special mode of essentially non-conceptual cognition, *self-evidently shows us* that there's a mutual formal or structural attunement of the rational human mind with the basic forms or structures of manifest natural reality, thereby providing phenomenologically necessitating evidence for our sufficiently justified non-empirical true belief in our attunement with nature.

I've just argued that the attunement thesis is true. But unless the formal sciences and the natural sciences—especially logic, mathematics, physics, and biology—were to acknowledge the truth of the attunement thesis and also were to incorporate the attunement thesis into their respective repertoires of foundational a priori principles, then they would be metaphysically alienated from natural reality, with nothing for those sciences to be either meaningful about or true of. In order to recognize this, we need only consider the sentence quoted in the title of Fig. 15.1, displayed at the beginning of this chapter, in relation to the slice of manifest natural reality that's depicted in the photograph. The sentence is this:

It is not both true and false that there at least 5 distinct cloud formations visible above hills or mountains in the distance, viewed across a snowy field with pine trees in the foreground, looking westward, on a late afternoon in February 2018.

Now, as it actually happens, not only is it the case that the embedded sub-sentence occurring after "It is not both true and false that..." namely



Fig. 15.2 Late afternoon sun over mountains and a small lake. (Author's photograph, 2022)

[T]here at least 5 distinct cloud formations visible above hills or mountains in the distance, viewed across a snowy field with pine trees in the foreground, looking westward, on a late afternoon in February 2018.

is in fact meaningful and true, but also the whole sentence is *necessarily logically a priori true*, under the universally and necessarily logically a priori true minimal principle of non-contradiction: *not every sentence is both true and false* (Hanna, 2006a, 2015: ch. 5). Now, in order for the embedded sub-sentence to be meaningful and true, and also for the whole sentence to be meaningful and necessarily logically a priori true, then not only the logical forms of that whole sentence and of its embedded sub-sentence, but also the semantic forms of the mathematical, spatial, temporal, physical, and biological categorematic terms occurring in both of those sentences, have to be isomorphic with manifest natural reality. For if that *were not true*—if any of the skeptical scenarios in the non-isomorphism problem *were true*—then logic, mathematics, physics, and biology would be metaphysically alienated

from natural reality, with nothing for them to be either meaningful about or true of. Nevertheless, we know that *none* of these skeptical scenarios is actually true, and therefore we know that the attunement thesis *is* true, precisely because *we've already essentially non-conceptually, disinterestedly, and purely aesthetically experienced the natural beauty of the scene depicted in that photograph* (i.e., Fig. 15.1) in order to be able to assent to the first sentence of the chapter that immediately follows it.

15.4 The Incredible Shrinking Thinking Man, Or, Cosmic Dignitarianism

Let's now assume that the attunement thesis is true. In Chaps. 4, 6, and 7, I argued that contemporary physics following on from early twentieth century the STR-GTR/QM revolution and according to the Standard models of cosmology and particle physics, is explanatorily, metaphysically-&-ontologically, and epistemically incomplete. But it's incomplete not only in those three senses: it's also *aesthetically, ecologically, and existential-spiritually incomplete*. Nevertheless *no*, and this needs to be emphasized, re-emphasized, and re-re-emphasized, I'm *not* talking about supplementing contemporary formal or natural science, and especially physics, by appealing to natural theology or indeed to any kind of "God-talk" (see, e.g., Barrow & Tipler, 1986). Let me explain.

Not so very long ago, in a land not so very far away, I re-watched Jack Arnold's 1957 B-film masterpiece, *The Incredible Shrinking Man*, one of the best Cold War/McCarthy era science fiction movies. In addition to expressing—effectively and subtly—that all-too-familiar anxiety about nuclear annihilation and the inherently alienating character of mechanistic, technocratic Big Science, it's also an ingenious philosophical thought-experiment about physical, biological, and mental *scale and size*:

If, while preserving our conscious minds, we were somehow reduced to the scale and size of the most basic elements and structure of the all-inclusive natural or physical universe, i.e., the cosmos, *then what would it be like for "human, all-too-human" rational animals like us?*

Correspondingly, here's the final voice-over monologue in the movie:

I was continuing to shrink, to become... What? The infinitesimal? What was I? Still a human being? Or was I the man of the future? If there were other bursts of radiation, other clouds drifting across seas and continents, would other beings follow me into this vast new world? So close, the infinitesimal and the infinite. But suddenly I knew they were really the two ends of the same concept. The unbelievably small and the unbelievably vast eventually meet, like the closing of a gigantic circle. I looked up, as if somehow I would grasp the heavens, the universe, worlds beyond number. [Nature]'s silver tapestry spread across the night. And in that moment I knew the answer to the riddle of the infinite. I had thought in terms of Man's own limited dimension. I had presumed upon Nature. That existence begins and ends is Man's conception, not Nature's. And I felt my body dwindling, melting,

becoming nothing. My fears melted away and in their place came acceptance. All this vast majesty of creation, it had to mean something. And then I meant something too. Yes, smaller than the smallest, I meant something too. To [Nature], there is no zero. *I still exist*.¹ (Author's transcript)

Just to give this striking view a handy philosophical label, I'll call it *cosmic dignitarianism*. More specifically, my take on *The Incredible Shrinking Man*'s thought-experiment is that it demonstrates (i) the inherent mutual attunement, complementarity, and integration of conscious minds like ours—that is, the conscious (i.e., subjectively experiencing), intentional (i.e., act- or object-directed), caring (i.e., desiring, emoting, and feeling), sensible (i.e., perceiving, remembering, and imagining), self-conscious minds of rational human animals, or human real persons, capable of free agency (see also Hanna, 2018)—with the underlying elements and structure of the cosmos, together with (ii) the profound further recognition that this cosmic mutual attunement, complementarity, and integration of our conscious rational human minds with the cosmos *also* fully preserves our *human dignity*. Hence the movie could *also* have been called *The Incredible Shrinking Thinking Man*.

Reflecting further on *The Incredible Shrinking Man*, however, I realized that the *other* striking thing about the-incredible-shrinking-thinking-man thought experiment is that it's the precise *directional inverse* of the set of conscious-mind-to-cosmos relationships described by Kant's famous remarks at the end of the *Critique of Practical Reason*:

[T]wo things fill the mind with ever new and increasing admiration and reverence (*Ehrfurcht*), the more often and more steadily one reflects on them: *the starry heavens above me and the moral law within me*. I do not need to search for them and merely conjecture them as though they were veiled in obscurity or in the transcendent region beyond my horizon; I see them before me and connect them immediately with the consciousness of my existence. (*CPPr* 5: 161–162)

What is Kant getting at here? He discovered the metaphysics of *weak or counterfactual transcendental idealism* between the publication of his seminal proto-Critical essay of 1768, “Concerning the Ground of the Ultimate Differentiation of Directions in Space” (*DDS* 2: 375–383), and 1772. Indeed, the philosophical implications of Kant's “Directions in Space” essay almost certainly triggered the major proto-Critical philosophical break though that he famously reports when he says in one of the *Reflexionen* that “the year '69 gave me great light” (*R* 5037, 18: 69). More precisely, what Kant had discovered between 1768 and 1772 is what I've called *weak or counterfactual transcendental idealism for sensibility* (Hanna, 2016). In 1772, Kant told Marcus Herz that if the human mind conformed to the world, whether merely phenomenal or transcendently noumenal, then a priori knowledge would be impossible (*C* 10: 130–131); but by 1770 Kant already also held that a priori knowledge of the manifestly real world is actual and therefore really possible in

¹ In this quotation, I've replaced two occurrences of “God” by “Nature.” I'm sure that this God-talk was inserted by Jack Arnold and/or his scriptwriters only in order to satisfy Cold War/McCarthy era religious-fundamentalist censors.

mathematics, hence the manifestly real world must conform to the non-empirical sensible structure of the human mind, and more specifically must conform to our a priori representations of space and time, since that is what makes mathematics really possible (*ID* 2: 398–406). So weak or counterfactual transcendental idealism for sensibility says that the manifestly real world fundamentally conforms to the essentially non-conceptual a priori forms of human sensibility, our representations of space and time.

Kant worked out explicit proofs for weak or counterfactual transcendental idealism for sensibility in the Inaugural Dissertation and again in the Transcendental Aesthetic in the *Critique of Pure Reason*. The simplest version of the proof, provided in the Transcendental Aesthetic, is the following:

Argument 1: Weak or Counterfactual Transcendental Idealism for Sensibility

1. Space and time are either (i) things-in-themselves (aka noumena), or (ii) properties of/relations between things-in-themselves, or (iii) transcendently ideal.
2. If space and time were either things-in-themselves or properties of/relations between things-in-themselves, then a priori mathematical knowledge would be impossible.
3. But mathematical knowledge is actual, via our pure intuitions of space and time, and therefore really possible.
4. Therefore, space and time are transcendently ideal. (*CPR* A 23/B37–38, A38–41/B55–58)

Briefly put, Kant's thesis of weak or counterfactual transcendental idealism says that the basic structure of the manifestly real natural universe necessarily conforms to the pure or non-empirical (hence a priori) structure of the rational human mind, and not the converse (*CPR* B xvi–xviii). Or in other words, Kant is saying that the manifestly real natural universe fundamentally conforms to the a priori structure of the rational human mind, and it's also *not* the case that the rational human mind fundamentally conforms to any non-apparent “really real” or noumenal world, as per classical Rationalism, or to any merely phenomenal and subjectively ideal, contingent, empirical, sensory objects, as per classical Empiricism. So if Kant is right about this, then he's correctly saying that the manifestly real natural universe in which we live, move, and have our being, is fundamentally dependent on *our* rational “human, all-too-human” minded nature, and not the converse. If weak or counterfactual transcendental idealism is true, then we cannot be inherently alienated from the world we are trying to know, as global epistemic skeptics, whether classical Cartesian evil demon skeptics, or new evil demon skeptics (Cohen, 1984) claim, and rational human knowledge—not only a priori knowledge, but also a posteriori knowledge—is therefore really possible (Hanna, 2015: esp. chs. 3 and 6–8).

Kantian weak or counterfactual transcendental idealism for sensibility, when taken together with some central claims of Kantian aesthetics and some self-evident Kantian phenomenology, conjointly provide an argument for this thesis:

The all-inclusive natural universe, aka, *the cosmos*, together with what I'll call its *proto-dignity*, is the metaphysical ground of all rational human animals, especially including our consciousness, our self-consciousness, our free agency, and our dignity.

This is the very same thesis of *cosmic dignitarianism* that was yielded by the incredible-shrinking-thinking-man thought experiment, but demonstrated now by inverting the directionality of the set of conscious-mind-to-cosmos relationships. So Kant's inverted but equally ingenious philosophical thought-experiment in the famous text at the end of the *Critique of Practical Reason* is what I'll call *the-incredible-expanding-thinking-man*.

Correspondingly, I'm now going to present a 12-step argument for the cosmic dignitarianism thesis, that fuses (i) the basic line of argument in the Transcendental Aesthetic of the first *Critique* (Hanna, 2006b: section 6.1) with (ii) a Kant-inspired aesthetics of the beautiful and the sublime, insofar as we experience them in the natural environment, as presented in the third *Critique*, aka the *Critique of the Power of Judgment*, and also (iii) a Kant-inspired self-evident phenomenology of our experience of "reverence" (*Ehrfurcht*) for the manifestly real cosmos and for our rational human animal nature, especially including our consciousness, our self-consciousness, our free agency, and our dignity, at the very end of the second *Critique*.

Argument 2: Cosmic Dignitarianism

1. Given the truth of weak or counterfactual transcendental idealism for sensibility, then we can take fully seriously the sensibility-grounded, conscious evidence provided by the aesthetic experience of beauty and sublimity in the cosmos, as veridically tracking natural purposive form, without a purpose, in a way that is inherently disinterested and therefore divorced from all possible self-interest (*CPJ* 5: 204–211).
2. In short, our experience of beauty and sublimity in the cosmos shows us that the cosmos cannot be and ought not to be regarded or treated purely instrumentally, that is, merely as a means or as a mere thing, and thereby exploited.
3. Given the truth of weak or counterfactual transcendental idealism for sensibility, and our experience of beauty and sublimity in the cosmos, then we can also take fully seriously the reverential experience of what Kant calls "the mathematically sublime in nature," for example, "the starry heavens above me."
4. To make this kind of reverential experience phenomenologically vivid to yourself, either stand outside on a clear, moonless night at 2:00 am in a place without too many nearby city lights and then look straight up; or stay indoors, and contemplate, for example, Vincent Van Gogh's 1889 masterpiece, "Starry Night."
5. Now since, according to Kant, via the human experience of the mathematically sublime in nature, the cosmos is thereby experienced as having a specific character and normative value that is expressible only as a transfinite, or non-denumerably infinite, quantity, it follows that the specific character and normative value of the cosmos cannot be reduced to any denumerable quantity, no matter how great (*CPJ* 5: 244–260).
6. Hence the cosmos, experienced as mathematically sublime, cannot have a "market price" and is experienced as beyond price, or priceless, since all "market prices," or exchangeable economic values (say, monetary values) "related to general human interests and needs" (*GMM* 4: 434), are expressible only as denumerable (natural number, rational number) quantities, even infinite ones.

7. Otherwise put, the specific character and normative value of the cosmos, experienced by us as mathematically sublime, inherently transcends any economic or otherwise strictly instrumental calculus.
8. Steps 1–7 jointly entail what I call *the proto-dignity of the cosmos*: what do I mean by that?
9. Human dignity, according to Kant, and also to me, is the absolute, non-denumerably infinite, intrinsic, objective, irreducibly non-instrumental value of *human real persons* (Hanna, 2018: chs. 7–8), i.e., rational human animals; now the cosmos isn't itself a *real person*, and more specifically it isn't itself a *human real person*, and therefore it doesn't have human dignity per se, since human dignity per se attaches inherently only to human real persons, i.e., rational human animals; nevertheless, the cosmos, reverentially experienced by us as beautiful and sublime, inherently cannot be (without eco-disaster) and inherently ought not to be (without moral scandal) exploited, merely bought or sold, or otherwise treated as a mere advanced or late capitalist commodity (Marcuse, 1964).
10. Nevertheless, our rational human animal nature, including our human dignity, itself *necessarily belongs to the cosmos*.
11. Therefore, weak or counterfactual transcendental idealism for sensibility, plus the self-evident phenomenology of our reverential experience of beauty and sublimity in the cosmos, ("the starry heavens above me"), plus our equally reverential experience of respect for human dignity ("the moral law within me"), conjointly prove that the cosmos, together with its proto-dignity, is the metaphysical ground of all rational human animals, especially including our consciousness, our self-consciousness, our free agency, and our dignity.
12. That is: cosmic dignitarianism is true.

15.5 Conclusion

Therefore, whether we're incredibly shrinking people or incredibly expanding people, *provided that we're thinking animals*, then the truly important philosophical upshots of Jack Arnold's and Kant's thought-experiments are identical: the cosmos is *not* metaphysically alien to us, as rational human animals with innately-specified capacities for consciousness, intentionality, caring, sensibility, self-consciousness, and free agency, and above all, as rational human animals with dignity. On the contrary, for better or worse, *the cosmos is our metaphysical home*, which is why *we must sufficiently respect its proto-dignity*. And in this way, the natural sciences including physics and biology, the formal sciences including logic and mathematics, philosophy of mind, philosophy of science, metaphysics-&-ontology, moral philosophy, social and political philosophy, philosophical aesthetics, eco-philosophy, and existential spirituality *all coherently converge*. Therefore, "science for humans" means not only the *humanization* of all the sciences, but also the *unification* of all the sciences.

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Chapter 16

Human Rationality, Consciousness, and Cosmology



Abstract In this final chapter, I return to where I began in Chap. 2, with the metaphysical continuity of mind and life, and show how human rationality, consciousness, and free agency are not only (i) metaphysically continuous with organismic life and with non-living uncomputable, negentropic, irreversible, processual, purposive, self-organizing, and time-unidirectional or time-asymmetric, non-equilibrium thermodynamic organic systems, from the Big Bang forward, but also (ii) primitive, irreducible facts about the natural universe, just like the four fundamental forces—gravitation, electromagnetism, strong nuclear force, and weak nuclear force. Indeed, I even claim that consciousness is a fifth fundamental force. Then I conclude the book by showing how the neo-organicist approach to cosmology has an essential elective affinity with what Stephen Hawking and Thomas Hertog call *top-down cosmology*.

16.1 Introduction

In this final chapter, I return to where I began in Chap. 2, with the metaphysical continuity of mind and life, and show how human rationality, consciousness, and free agency are not only (i) metaphysically continuous with organismic life and with non-living uncomputable, negentropic, irreversible, processual, purposive, self-organizing, and time-unidirectional or time-asymmetric, non-equilibrium thermodynamic organic systems, from the Big Bang forward, but also (ii) primitive, irreducible facts about the natural universe, just like the four fundamental forces—gravitation, electromagnetism, strong nuclear force, and weak nuclear force. Indeed, I'll even claim that consciousness is *a fifth fundamental force*. Then I'll conclude the book by showing how the neo-organicist approach to cosmology has an essential elective affinity with what Stephen Hawking and Thomas Hertog call *top-down cosmology*.

16.2 The Circularity of Human Rationality

16.2.1 Human Rationality and Its Problems

By “human rationality,” I mean *the innate capacity, faculty, or power of a human animal for cognition, caring, and action according to instrumental or non-instrumental principles*. By “principle,” I mean *a normative rule that’s either conditionally obligatory (i.e., “hypothetically imperative” in Kant’s sense) or unconditionally obligatory (i.e., “categorically imperative” in Kant’s sense)*. By “instrumental,” I mean *something that’s undertaken for the sake of self-interested or public utilitarian ends or values*. By “non-instrumental,” I mean *something that’s undertaken either solely for its own sake or for the sake of ends or values that transcend mere self-interest or mere public utility*. For example, *human dignity*, i.e., what I’ll call *the primitive happy fact* of the absolute, non-denumerably infinite, intrinsic, and objective worth of each and every rational human animal, is not only valuable for its own sake, but also is an end or value that transcends all mere self-interest or mere public utility. Therefore, all principles flowing from the primitive happy fact of human dignity are *non-instrumental and categorically imperative*. By “cognition,” I mean either *sensible cognition*, i.e., consciousness, sense perception, imagination, and episodic memory, or *intellectual cognition*, i.e., self-consciousness, conceptualization, semantic memory, logical argument and inference, and theorizing. By “caring,” I mean *desire, emotion, or feeling*. And by “action” I mean *choice, free will, and practical agency*: in other words, action is whatever a rational human animal *performs*, whether spontaneously or deliberately, as opposed to *what merely happens to them*. Finally—for the purposes of this initial, in-a-nutshell-style, synoptic sketch of human rationality, that is—human rationality is also *essentially embodied in the human animal*, by which I mean *that it’s necessarily and completely realized in and throughout the healthy, normal living human organism* (see Hanna, 2006a, b, 2011, 2015a, 2018a, b; Hanna & Maiese, 2009).

Now, to be sure, as rational human *animals*, there is also what I’ll call *the primitive unhappy fact* that we’re “human, all-too-human,” which means that *we’re finite, fallible, and thoroughly normatively imperfect in every way*. In short, we’re always falling short of our own highest ideals, principles, and values, and constantly royally screwing up. Nevertheless, human rationality is *manifestly real*: by which I mean that it’s *all and only what it shows itself to be in actual or possible human experience*, and not some other thing. Most importantly of all, the primitive happy fact of our human dignity *isn’t in any way lessened or undermined* by the primitive unhappy fact of the finitude, fallibility, and thoroughgoing normative imperfection of our “human, all-too-human” rationality (Hanna, 2023).

Nevertheless, the primitive unhappy fact isn’t the *only* source of problems about human rationality. Perhaps even more problematically, human rationality is also such that *every attempt to explain it or justify it, already presupposes and uses unreduced human rationality*. In other words, human rationality is inherently *circular*. But is the circularity of human rationality (i) *bad* or *vicious*—i.e., such that it expresses a fundamental contradiction, incoherence, or self-undermining flaw in

human rationality—or (ii) *good* or *virtuous*—i.e., such that it expresses the fundamental nature, meaning, and purpose of human rationality?¹ In this sub-section and the next, I'll try to provide a definitive answer to that question, by critically addressing two predicaments of human rationality: what's been called *the logocentric predicament*, presented here in its fully generalized and strengthened form, and what I call *the axiocentric predicament*.

16.2.2 *The Fully Generalized and Strengthened Logocentric Predicament, and What to Do About It*

The attempt to formulate the foundations of logic is rendered arduous by a ... “logocentric” predicament. In order to give an account of logic, we must presuppose and employ logic. (Sheffer, 1926: p. 228)

Logic is not a theory but a reflexion of the world. Logic is transcendental. (Wittgenstein, 1921/1981: p. 169, prop. 6.13)

The most fundamental problem in the philosophy of logic is what, in 1926, Harry M. Sheffer (discoverer or inventor of the “Sheffer stroke function,” which reduces all of the truth-functional operations to one) aptly called “the logocentric predicament,” as per the first epigraph of this section, which I'll reformulate thus:

in order either to justify or explain logic, logic must be presupposed and used, hence logic is unjustifiable and inexplicable.

In fact, the logocentric predicament has several interestingly different specific sub-versions, including Lewis Carroll's famous “What-the-Tortoise-Said-to-Achilles” syllogistic regress problem (Carroll, 1895), W.V.O. Quine's equally famous argument against the conventionalist theory of logical truth (Quine, 1976), and the particularly interesting *problem of justifying deduction* (Dummett, 1973/1978; Haack, 1976), which I'll reformulate as follows:

1. Logical deduction can be justified either deductively or non-deductively.
2. But on the one hand, a deductive justification of logical deduction is circular.
3. And on the other hand, a non-deductive justification of logical deduction—for example, an inductive, holistic, intuitive, pragmatic, etc., justification—is insufficient.
4. Therefore, logical deduction is unjustifiable.

In his pre-Tractarian 1913 “Notes on Logic,” written 13 years before Sheffer's article and 60 years before Dummett's and Haack's articles, Ludwig Wittgenstein brilliantly and presciently recognized the logocentric predicament and its specific sub-problem of justifying deduction:

¹ It's of course logically possible that the circularity of human rationality is neither bad/vicious nor good/virtuous. But that third option isn't particularly interesting; so I'll leave it aside for the purposes of this book. In any case, I think that there's sufficient reason for affirming one of the original two options.

Deductions only proceed according to the laws of deduction but these laws cannot justify deduction. (Wittgenstein, 1913/1979: p. 93^e)

Indeed, the most illuminating way of construing Wittgenstein's theory of the nature of logic in the *Tractatus Logico-Philosophicus*, is that it's essentially an extended attempt to solve the logocentric predicament and also its specific sub-problem of justifying deduction, the pair of which can now, a century later, be understood as sub-species and sub-sub-species respectively, of what I'll call *the fully generalized and strengthened logocentric predicament*. But what, more precisely, *is* the fully generalized and strengthened logocentric predicament, and *can it be adequately solved*? In the rest of this sub-section, I'll answer both of those questions decisively and unequivocally, in **19** short steps.

1. In order either to justify or explain logic, logic must be presupposed and used.
2. Therefore, every attempted justification or explanation of logic is circular.
3. Due to this circularity, logic is unjustifiable and inexplicable.
4. Now, step 3 is a variety of *skepticism about logic*.
5. Like step 3, every actual or possible variety of skepticism about logic *whatsoever* must be justified by arguments and supported by reasons.
6. But, every actual or possible justification *whatsoever* of any claim or theory by means of arguments and reasons, presupposes and uses logic.
7. Therefore, every actual or possible variety of skepticism about logic, including step 3, is *self-refuting*.
8. The classical thesis of *logical psychologism* says that logic can be either (i) *subjectively* reduced to purely mentalistic facts about individual human mental states, or (ii) *materialistically* reduced to purely physical facts, or (iii) *relativistically* reduced to purely conventional and social facts about human communities, or (iv) *non-cognitively* reduced to purely instrumental practical facts about humanity and its interests (Hanna, 2006a: ch. 1, 2008, 2015b).
9. But, every actual or possible attempted reduction of logic is an attempted reductive *explanation* of logic.
10. Now, every actual or possible explanation of anything *whatsoever* presupposes and uses logic.
11. Therefore, every actual or possible attempted reduction of logic presupposes and uses *pre-reduced, un-reduced* logic.
12. Therefore, every actual or possible attempted reduction of logic is *self-refuting*.
13. Therefore, logic is (i) presupposed and used by every actual or possible justification or explanation *whatsoever*, (ii) absolutely *skepticism-resistant*, and (iii) mentalistically, materialistically, relativistically, and non-cognitively *irreducible*.
14. Steps 1–13 jointly constitute the fully generalized and strengthened logocentric predicament, which can also be briefly reformulated thus:

there is no actual or possible theoretical or purely instrumental practical standpoint on logic that can be *rationally external* to logic itself, which is the same as to say that every actual or possible theoretical or purely instrumental practical standpoint on logic must be *rationally internal* to logic itself.

15. Because Analytic philosophy, whether classical (pre-1950) or post-classical (post-1950), is either *platonistic* or *empiricistic*, but in any case *scientistic* and *logic-valorizing*, it's not only thoroughly ensnared by the fully generalized and strengthened logocentric predicament, but also self-refuted by it (Hanna, 2006a: esp. chs. 1 and 3, 2015a: esp. chs. 4 and 5, 2021a: esp. chs. I and XVI–XVII).
16. Because Postmodernist philosophy is either *relativistic*, *skeptical*, or *both*, but in any case *anti-science* and *logic-hating*, ironically enough just like Analytic philosophy, but in an equal and opposite way, it's also not only thoroughly ensnared by the fully generalized and strengthened logocentric predicament, but also self-refuted by it (Hanna, 2006a: esp. chs. 1 and 7, 2021a: esp. chs. I and XVI).
17. In fact, there is *one and only one adequate solution* to the fully generalized and strengthened logocentric predicament:

logic is nothing more and nothing less than a strictly a priori, universal, and non-instrumentally practical, innately-specified structure of the human capacity for theoretical and practical rationality, in the *Ur*-format of a *proto-logic* that's presupposed and used in the construction of every other other logic whatsoever, every scientific or non-scientific theory whatsoever, every justification whatsoever, and every explanation whatsoever. (Hanna, 2006a, b, 2015a: esp. ch. 5)

18. This unique adequate solution to the fully generalized and strengthened logocentric predicament, in turn, is committed to the metaphysical and ontological thesis of *weak or counterfactual transcendental idealism*, which says that (i) necessarily, the basic metaphysical and ontological structures of the manifestly real world conform to the basic innate structures of our rational human cognitive and practical capacities, especially including our *sensible* capacities for first-order consciousness, affect or caring (including desire, emotion, feeling, and passion), sense-perception, memory, and imagination, and also our *discursive* capacities for conceptualization, thinking, self-consciousness, theoretical rationality, and practical rationality, (ii) necessarily, if the manifestly real natural universe exists, then if sensible, discursive, conscious, and self-conscious rational human cognizers *were* to exist, they *would be* able to cognize that world veridically to some salient extent, which in turn is fully consistent with sensible, discursive, conscious, and self-conscious rational human cognizers *not* actually existing at any given time, and (iii) the existence of the manifestly real natural universe necessitates *the real possibility* of sensible, discursive, conscious, and self-conscious rational human cognizers, but *not* their actual existence at any given time (Hanna, 2015a: section 7.3; see also Chap. 7 above).
19. In short—and now in the format of a three-word slogan that approvingly and indeed wholeheartedly echoes Wittgenstein's *Tractatus*, as per the second epigraph of this sub-section—the unique adequate solution of the fully generalized and strengthened logocentric predicament is that *logic is transcendental* (Hanna, 2006a, 2008, 2021b).

16.2.3 *The Axiocentric Predicament, and What to Do About It*

As we saw in Sect. 16.2.2, according to the classical hard problem in philosophical logic known as *the logocentric predicament*, as formulated in 1926 by Harry Sheffer,

[i]n order to give an account of logic, we must presuppose and employ logic. (Sheffer, 1926: p. 228)

As we also saw, it follows directly from the logocentric predicament that any attempt to *explain* or *justify* logic must presuppose and use logic. So, due to that inherent circularity, apparently or *prima facie*, logic is inexplicable and unjustifiable.

But, exactly analogously to the logocentric predicament, there's also *another* hard problem that I'll call *the axiocentric predicament*. I've created the neologism "axiocentric" by using the Greek root *axios*, meaning "worthy," which is also the root of the term "axiology," meaning of course "the theory of value." The axiocentric predicament focuses on *normativity*. By *normativity*, I mean the following irreducible two-part fact (i) that all rational human animals or real persons have aims, commitments, ends, goals, ideals, and values, aka *norms*, and (ii) that these rational human animals naturally treat their aims, commitments, ends, goals, ideals, and values—or norms, (ii.a) as rules or principles for guiding theoretical inquiry, especially including explanation, and also for guiding practical enterprises, especially including deliberation and choice, (ii.b) as reasons for justifying beliefs and intentional actions, and also (ii.c) as standards for critical evaluation and judgment. Furthermore, normativity in this sense can be either (i) *instrumental*, that is, conditional, hypothetical, desired for the sake of some further desired end, and either self-interested or public utilitarian, or (ii) *non-instrumental*, that is, unconditional, non-hypothetical or categorical, desired for its own sake as an end-in-itself, non-self-interested, non-public-utilitarian, and obtaining no-matter-what-the-consequences. Here, then, is the axiocentric predicament: in order to evaluate, explain, or justify any kind of normativity, normativity must be presupposed and used: for obviously, evaluation, explanation, and justification are, paradigmatically, *normative activities*. So, due to that inherent circularity, apparently or *prima facie*, normativity is unevaluable, inexplicable, and unjustifiable.

And it gets even worse (or actually, even better) than that. For it's demonstrable that there exists a *categorical* normativity or a *highest* value. By "a categorical normativity" or "a highest value" I mean a value that's a transfinite cardinal quantity in relation to all denumerable or countable, economic, or otherwise instrumental kinds of value, for example psychological pleasure or preference-satisfaction. It seems clear that however we measure such things, whether in terms of market value or monetary price, degrees of psychological pleasure, degrees of preference-satisfaction, degrees of betting behavior, etc., or comparative rankings of such things, nevertheless every actual or possible economic or otherwise instrumental value is expressible as *some rational number quantity or another*, including denumerably infinite rational number quantities. Then, by essentially the same method that Georg Cantor used to show the existence of transfinite numbers (Cantor, 1891,

2019), at least in principle, we can create a vertical and denumerably infinite list of every actual or possible economic or otherwise instrumental value, then draw a diagonal across it, and discover another value *that's essentially higher than any economic or otherwise instrumental value*. Or, equivalently, we can take the complete denumerably infinite set of every actual or possible economic or otherwise instrumental value, then form its *power set* (i.e., the set of all its subsets), and thereby find a transfinite value quantity that's essentially higher than any economic or otherwise instrumental value.

So this transfinite value quantity is the prime example of what—following Cantor's alternative term for transfinite numbers, *transcendental numbers*—I've called *transcendental normativity* (Hanna, 2015b). Correspondingly, it's what I'll call *transcendental value*, by which I mean either a *single* transcendental value or else a *unified system* of several distinct but essentially complementary or interlocking transcendental values. Kant called the unified system of all transcendental values *the highest good* (CPrR 5: 110–119), and for the purposes of this book, I will too. Then, what I'll call *the supercharged axiocentric predicament* says this: in order to evaluate, explain, or justify any kind of normativity, the highest good must be presupposed and used; so, due to that inherent circularity, apparently or *prima facie*, the highest good itself is unevaluable, inexplicable, and unjustifiable.

The supercharged axiocentric predicament, in turn, is closely related to G.E. Moore's famous argument in *Principia Ethica* against *the naturalistic fallacy*—i.e., the failed reduction of “ought” to “is,” which is David Hume's version (Hume, 1739/1978: pp. 469–470, book I, part I, section I), or equivalently, in Moore's own formulation, the failed analytic reduction of The Good to any fact or property that's purely natural—*the open question argument*:

[T]he naturalistic fallacy ... [is] the fallacy which consists in identifying the simple notion which we mean by “good” with some other notion. (Moore, 1903: p. 58)

[The naturalistic] fallacy, I explained, consists in the contention that good *means* nothing but some simple or complex notion, that can defined in terms of natural qualities. (Moore, 1903: p. 73)

The hypothesis that disagreement about the meaning of good is disagreement with regard to the correct analysis of a given whole, may be most plainly seen to be incorrect by consideration of the fact that, whatever definition be offered, it may always be asked, with significance, of the complex so defined, whether it is itself good. (Moore, 1903: p. 15)

We must not, therefore, be frightened by the assertion that a thing is natural into the admission that it is good: good does not, by definition, mean anything that is natural; and it is always an open question whether what is natural is good. (Moore, 1903: p. 44)

Rationally reconstructed for my purposes in this book, here is Moore's open question argument:

1. Consider any reductive analysis of the form: “The Good is identical to the natural fact or property XYZ.”

2. For any such reductive analysis, it can always be self-consistently and intelligibly asked: But is XYZ itself good, or not?, hence XYZ is possibly *not* good, and therefore XYZ cannot be identical to The Good.
3. Therefore, The Good is an irreducible, primitive, and unanalyzable fact or property, and it's always viciously circular and self-undermining to attempt to give a reductive analysis of it.

Now, it's well known that there are some important problems in Moore's own formulation of the open question argument, so in my 2018 book, *Kantian Ethics and Human Existence* (Hanna, 2018b: section 1.5), and more recently, in a companion-piece to that section of that book (Hanna, 2022), I've worked out a cleaned-up and explicitly *modal metaphysical* version of Moore's argument, as the failure of any and all attempts to show the logical or nomological strong supervenience of The Good on some or another natural supervenience base. In any case, again for my purposes here, we can identify Moore's fact or property of The Good with what I've been calling "the highest good," and thereby recognize that Moore was at least implicitly aware of the supercharged axiocentric predicament.

Moreover, there's at least one other logically distinct argument for the existence of the highest good—indeed, this one is an *argument-by-cases*, hence it doesn't have maximum rational demonstrative force, even though it's fairly compelling and philosophically quite illuminating—from the standard exposition of any normative ethical or moral theory. So, for example, how does one give the standard exposition of utilitarianism? Utilitarianism says that the highest good is happiness, hence we all ought to choose and act in such a way as always to bring about as much happiness as possible for as many people as possible. Or, the standard exposition of hedonism? Hedonism says that the highest good is pleasurable experiences, so we all ought to choose and act in such a way as always to experience as much pleasure as humanly possible. Or, the standard exposition of egoism? Egoism says that the highest good is the pursuit and satisfaction of individual self-interest, hence we all ought to choose and act in such a way as always to pursue and satisfy our individual self-interest. And so-on, through all the actual and possible normative ethical or moral theories—although of course, *precisely how one is able to close the set of all such cases*, is an inherent challenge for *any* argument-by-cases, which I won't attempt for the purposes of this book.

Nevertheless, assuming that such a closure is *somehow* really possible, then we can conclude that the highest good is *also* presupposed and used in the standard exposition of every normative ethical or moral theory. So, for all those reasons, the supercharged axiocentric predicament stands.

Now, supposing all that to be the case, then what is to be done? In my 2006 book *Rationality and Logic*, in an article from the same year called "Rationality and the Ethics of Logic," and in my 2015 book, *Cognition, Content, and the A Priori*, I argued that every actual and possible logic is cognitively constructed by rational (human) animals, and that logic itself is the set of categorically normative, innately specified first principles of human theoretical rationality—a universal a priori minimally non-contradictory proto-logic—when taken together with all the

supplementary humanly-constructed *ceteris paribus* principles of an open-ended plurality of logical systems, just as morality is the set of categorically normative, innately specified first principles of human practical rationality—a universal a priori dignitarian proto-morality—when taken together with all the supplementary humanly-constructed *ceteris paribus* principles of an open-ended plurality of moral systems (Hanna, 2006a, b, 2015a: ch. 5). Let's call this *the morality-of-logic thesis*. So, using the morality-of-logic thesis, my proposed way out of the logocentric predicament is to postulate the existence of an innately-specified universal a priori proto-logic in all rational human animals—featuring the strictly universal and a priori minimal principle of non-contradiction (see also Putnam, 1983)—that we presuppose and use in order to construct any actual or possible logic, by using various different axioms, operators, inference-rules, and so-on. Or in short, and more colloquially put, I've proposed that the way out of the logocentric predicament is to recognize that the inherent circularity of logic, which apparently or *prima facie* presents us with a hard problem about the nature of logic, is in reality nothing more and nothing less than a *good and virtuous circularity*, since it simply *shows us precisely how* logic is built into the rational human condition from the get-go.

And, again in view of the morality-of-logic thesis, which postulates an exact analogy between the nature of logic and the nature of morality, then we can find a rational segue to an exactly analogous way out of the axiocentric predicament and the supercharged axiocentric predicament alike. More precisely, I want to postulate the existence of an innately specified universal a priori proto-morality, *featuring a capacity for essentially non-conceptual awareness of the highest good, and also a further capacity for generating the higher-order desire for moral self-transcendence*—i.e., the higher-order desire to be moved by all and only first-order desires that are non-utilitarian, non-hedonistic, non-egoistic, etc. (see Hanna, 2018a: ch. 3, 2021c)—*which is inherently guided by and for the sake of the highest good*, that we presuppose and use in order to construct every actual and possible normative ethical or moral theory, by using various different, and perhaps culturally and historically specific, axiomatic assumptions about human nature and what should count as the highest good, and so-on (see Hanna, 2018b: ch. 2).

Moreover, and perhaps most importantly, direct evidence for the existence of this essentially non-conceptual awareness of the highest good, and for the existence of the higher-order desire for moral self-transcendence, which is inherently guided by and for the sake of the highest good, is to be found in (i) the experience of *the moral emotion of respect for human dignity* (Hanna, 2023), (ii) *existential-spiritual* experience, including *religious* experience (Hanna, 2018c: part 1), and (iii) *the phenomenological aesthetics of the sublime*, as directed to what I call the *proto-dignity* of the natural cosmos (Hanna, 2018c: section 3.14; and Chap. 15 above).

So in other and more colloquial words, I'm proposing that the way out of the axiocentric and supercharged axiocentric predicaments alike is to recognize that the inherent circularities of normativity and of the highest good, which apparently or *prima facie* present us with respectively hard and superhard problems about the nature of normativity, are, just like the inherent circularity of logic, nothing more and nothing less than *good and virtuous circularities*, since they simply *show us*

precisely how, just like logic, normativity and the highest good are built into the rational human condition from the get-go.

Moreover, it follows directly from this way out of the axiocentric predicament, that the all-too-familiar naturalistic thesis that normativity can be explained in terms of essentially non-normative—for example, purely material, physical or otherwise natural—facts or properties, is not only false but also viciously circular and self-undermining. For if normativity and the highest good are inherent in human rationality itself, then it's clearly self-stultifying to assert, as rational human animals inherently capable of asserting or denying such things, that we can somehow take up an explanatory standpoint *outside* normativity in order to explain it in terms of something else.

16.2.4 The Good or Virtuous Circularity of Human Rationality

In view of my solutions to the fully generalized and strengthened logocentric predicament, the axiocentric predicament, and the supercharged axiocentric predicament, I conclude that the definitive answer to the question I raised in Sect. 16.2.1 is that *the inherent circularity of human rationality is a good or virtuous circularity, and not a bad or vicious circularity*. So now you can rest more easily philosophically, even if this definitive answer probably won't make the primitive unhappy fact that we're finite, fallible, and thoroughly normative imperfect in every way, much easier to live with in a day-by-day, existential, real-world sense. But at least there are two grounds for hope—i.e., the primitive happy fact of human dignity, and the good or virtuous circularity of human rationality—and lots of room for self-improvement. That's the rational human condition.

16.3 The Psychocentric Predicament, the Impossibility of Any and Every Hard Science of Consciousness, and Soft Sciences of the Mind

16.3.1 The Ratiocentric Predicament and the Psychocentric Predicament

In Sect. 16.2, I pointed out the profoundly significant fact that any and every attempt to *explain* or *justify* human rationality—and also, equally significantly, any and every attempt to *criticize* or *debunk* human rationality—must already *presuppose* and *use* our unreduced innate capacity for human rationality. For all explanation and justification—and also all critical arguments and debunking arguments—are, by their very nature, human rational activities. So human rationality is inherently circular. For convenience, henceforth I'll call that *the ratiocentric predicament*. In that section, I also argued that the ratiocentric predicament expresses a

logico-philosophically *good* or *virtuous* circularity, not a logico-philosophically *bad* or *vicious* circularity.

Now, an extremely important implication of the ratiocentric predicament is that what holds for our innate capacity for human rationality as such, *also* holds for each and every innate *sub*-capacity of human rationality—for example, consciousness. That such a sub-capacity actually exists, follows directly and self-evidently from the fact that you, the reader of this very sentence, are now consciously reading this very sentence (Hanna, 2024). Therefore, any and every attempt to explain consciousness or justify a theory of consciousness, must already presuppose and use our unreduced innate capacity for consciousness. Again for convenience, let's call this *the psychocentric predicament*. In this section, I want to deploy the psychocentric predicament as a critical weapon against *any and every hard science of consciousness*—by which I mean any and every science of consciousness that's either *materialist or physicalist*, or *naturally mechanistic*, or in any other way reductive: for example, any *computational or informational* theory of consciousness. Correspondingly, it's important to recognize from the outset that my critical argument, if sound, also fully leaves open the real possibility of a *soft* science of consciousness—by which I mean any science of consciousness that's *neither* materialist nor physicalist, *nor* naturally mechanistic, *nor* in any other way reductive, for example, computational or informational (see, e.g., Hanna & Maiese, 2009; Hanna, 2011).

16.3.2 Cognitive Neuroscience and Pseudoscience

On 17 September 2023, a large group of high-status, hardnosed professional academic cognitive neuroscientists published an open letter not only criticizing but also decrying The Integrated Information Theory of Consciousness, aka IIT (see, e.g., Tononi et al., 2016), even going so far as to call it “pseudoscience” (Fleming et al., 2023). And for hardnosed scientists, *them's fightin' words*. Without naming any names, here's the basic content of the letter:

The media, including news articles in both *Nature* and *Science*, have recently celebrated the Integrated Information Theory (IIT) as a “leading” and empirically tested theory of consciousness. We are writing as researchers with some relevant expertise to express our concerns.

The media coverage sprang from a public event where the authors of a large-scale adversarial collaboration shared their findings, which were reported as empirically testing and partially supporting. This message was communicated directly to journalists and the general public prior to the preprint being available, and hence, prior to peer-review. The experiments seem very skillfully executed by a large group of trainees across different labs. However, by design the studies only tested some idiosyncratic predictions made by certain theorists, which are not really logically related to the core ideas of IIT, as one of the authors himself also acknowledges. The findings therefore do not support the claims that the theory itself was actually meaningfully tested, or that it holds a “dominant,” “well-established,” or “leading” status. This important nuance was unfortunately lost in the media coverage. These claims of dominance have also been questioned in the scientific community, yet they have been repeatedly broadcast to the public by proponents of IIT over the years.

IIT is an ambitious theory, but some scientists have labeled it as pseudoscience. According to IIT, an inactive grid of connected logic gates that are not performing any useful computation can be conscious—possibly even more so than humans; organoids created out of petri-dishes, as well as human fetuses at very early stages of development, are likely conscious according to the theory; on some interpretations, even plants may be conscious. These claims have been widely considered untestable, unscientific, “magicalist,” or a “departure from science as we know it.” Given its panpsychist commitments, until the theory as a whole—not just some hand-picked auxiliary components trivially shared by many others or already known to be true—is empirically testable, we feel that the pseudoscience label should indeed apply. Regrettably, given the recent events and heightened public interest, it has become especially necessary to rectify this matter. If IIT is either proven or perceived by the public as such, it will not only have a direct impact on clinical practice concerning coma patients, but also a wide array of ethical issues ranging from current debates on AI sentience and its regulation, to stem cell research, animal and organoid testing, and abortion. Our consensus is not that IIT and its variants decidedly lack intellectual merit. But with so much at stake, it is essential to provide a fair and truthful perspective on the status of the theory. As researchers, we have a duty to protect the public from scientific misinformation.

Therefore, we hope to make clear that despite its significant media attention, IIT requires meaningful empirical tests before being heralded as a “leading” or “well-established” theory. Its idiosyncratic claims and potentially far-reaching ethical implications necessitate a measured representation. (Fleming et al., 2023: pp. 1–2)

To be sure, this highly polemical open letter is interesting from the standpoints of not only (i) *the metaphysics of mind*, especially as focused on the mind-body relation and mental causation (see, e.g., Hanna & Maiese, 2009; Hanna, 2011), but also (ii) *the political philosophy of mind* (see, e.g., Maiese & Hanna, 2019), especially as focused on the social-institutional profile and structure of contemporary professional academic cognitive neuroscience. Moreover and most importantly, however, the letter is also unintentionally absurd and therefore amusingly ironic, because, if I’m correct, *then there simply cannot be a hard science of consciousness, not even in principle*. If that’s right, then for *any* large group of high-status hardnosed contemporary professional academic cognitive neuroscientists to gang up on a much smaller group of some *other* high-status hardnosed contemporary neuroscientists and call *those people’s* hard science of consciousness—for example, IIT—“pseudoscience,” is just like *any* large and aggressive tribe of hardnosed pseudo-mathematicians living on some as-yet-undiscovered tropical island, all of whom share a magical core belief that $1 = 0$, gang-ing up on a much smaller group of some *other* hardnosed pseudo-mathematicians, one of whose magical core beliefs is also that $1 = 0$, and then calling *those people’s* theory of arithmetic “pseudo-mathematics.” Or to riff on a highly relevant text from the King James version of the Bible (Matthew, 7:3): “Thou hypocrites, first cast out the *beam* out of thine own pseudoscientific eyes; and then shalt thou see clearly to cast out *the mote* out of thy brother’s pseudoscientific eye.”

16.3.3 *On the Impossibility of Any and Every Hard Science of Consciousness*

In this sub-section, I'll present a seven-step argument for the impossibility of any and every hard science of consciousness—that is, for the impossibility of any and every materialist or physicalist, naturally mechanistic, or otherwise reductive (for example, computational or informational) science of consciousness.

Step 1 By *consciousness*, I mean *subjective experience*, which is to say that consciousness inherently involves (i) a first-person or self that's (ii) egocentrically-centered in orientable space and unidirectional time, (iii) relatively unified, and (iv) immanently reflexive or immediately aware of itself without further ado and without implicitly or explicitly forming judgments or propositional thoughts about itself (= *subjectivity*, aka “consciousness-in”), and also that (v) this self spontaneously and freely enacts or engages in mental acts, states, or processes of various kinds that also inherently possess not only (vi) some or another qualitative specific character, which tells us “what it's like,” but also (vii) some or another semantic content, which tells us “what it's about” (= *experience*, aka “consciousness-of”).

Step 2 By *universal materialism or physicalism*, I mean the doctrine that everything in the world is grounded on contingent, fundamentally physical facts and either *logically strongly supervenient* on those facts (= reductive materialism) or *naturally or nomologically strongly supervenient* on those facts (= non-reductive materialism) (see Chap. 8, Sect. 8.2 above). As a specification of universal materialism or physicalism, *materialism or physicalism about the mind-body relation and mental causation* says that all facts (i.e., instantiated properties or states) about the human mind are constitutively determined by contingent, fundamentally physical facts, according to three interestingly different varieties: (i) *reductive* materialism or physicalism, (ii) *eliminative* materialism or physicalism, and (iii) *non-reductive* materialism or physicalism (see Chap. 2, Sect. 2.2 above).

Step 3 By the thesis of *universal natural mechanism*, I mean the doctrine which says (i) that everything in the world either just is or is a sub-part of natural or physical processes that are either deterministic, indeterministic, or some mixture of both (say, macroscopically deterministic but microscopically indeterministic at the quantum level), and (ii) that all the causal and quantitative characteristics of those happenings are not only (ii.a) strictly fixed by the general causal laws of nature and/or the mathematical laws of probability, especially those laws governing the conservation of quantities of matter or energy, together with all the settled facts about the past, especially including The Big Bang, but also (ii.b) calculable from those laws and facts on a Turing machine, i.e. a digital computer (see, for example, Boolos & Jeffrey, 1989).

In turn, the thesis of universal natural mechanism properly belongs to a larger conception I call *the mechanistic worldview*, which says that

everything in the world is fundamentally either a formal automaton or a natural automaton, operating strictly according to Turing-computable algorithms and/or time-reversible or time-symmetric deterministic or indeterministic laws of nature, especially the Conservation Laws (including the First Law of Thermodynamics) and the Second Law of Thermodynamics, which also imposes always-increasing entropy—i.e., the always-increasing unavailability of any system's thermal energy for conversion into causal (aka "mechanical") action or work—on all natural mechanisms, until a total equilibrium state of the natural universe is finally reached. (Chaps. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15 above; see also Hanna & Paans, 2020; Torday et al., 2020)

Step 4 *Neither materialism or physicalism, whether reductive or non-reductive, nor the mechanistic worldview, can explain or justify logic, mathematics, or even natural science itself, because materialism or physicalism says that everything is ultimately grounded on contingent, fundamentally physical facts known only a posteriori, and also because the mechanistic worldview says that everything in the world works according to Turing-computable algorithms, whereas logic, mathematics, and even natural science all include not only (i) many irreducibly necessary facts known only a priori about truth, falsity, logical connectives, logical operations, logical consistency and inconsistency, logical validity, logical soundness, logical proofs, numbers, other mathematical objects, mathematical operations, mathematical laws, mathematical proofs, the non-mechanical causal powers and operations of living organisms, and the non-mechanistic laws of nature that govern those causal powers and operations (Hanna, 2015a; Prigogine, 1997; and Chap. 3 above), but also (ii) many irreducibly uncomputable functions applying to truth, falsity, logical connectives, logical operations, logical consistency and inconsistency, logical validity, logical soundness, logical proofs, numbers, other mathematical objects, mathematical operations, mathematical laws, mathematical proofs, the non-mechanical causal powers and operations of living organisms, and the non-mechanistic laws of nature that govern those causal powers and operations (Torday et al., 2020; Prigogine, 1997; and Chap. 8, Sects. 8.4 and 8.5 above).*

Step 5 *Any attempt to explain the nature of consciousness or justify a theory of consciousness must presuppose and use our unreduced non-materialistic or non-physicalistic, non-mechanical, and more specifically uncomputable innate capacity for human rationality (Sect. 16.2 above), which in turn necessarily includes our unreduced non-materialistic or non-physicalistic, non-mechanical, and more specifically uncomputable innate sub-capacity for consciousness-of not only (i) all irreducibly necessary facts known only a priori about truth, falsity, logical connectives, logical operations, logical consistency and inconsistency, logical validity, logical soundness, numbers, other mathematical objects, mathematical operations, mathematical laws, mathematical proofs, the causal powers and operations of living organisms, and the laws of nature that govern those causal powers and operations (Hanna, 2015a; Prigogine, 1997; and Chap. 3 above), but also (ii) many irreducibly uncomputable functions applying to truth, falsity, logical connectives, logical operations, logical consistency and inconsistency, logical validity, logical soundness, logical proofs, numbers, other mathematical objects, mathematical operations,*

mathematical laws, mathematical proofs, the causal powers and operations of living organisms, and the laws of nature that govern those causal powers and operations (Torday et al., 2020; Prigogine, 1997; and Chap. 8, Sects. 8.3 and 8.4 above). For example, insofar as you read and understand logic texts, mathematics texts, physics texts, biology texts, chemistry texts, and so-on through all the formal and natural sciences, or philosophy texts—including this very one—then you *consciously* read and understand them.

Above all, in order to be able to write any legible text in *cognitive neuroscience*, we must already presuppose and use our unreduced non-materialistic or non-physicalistic, non-mechanical, and more specifically uncomputable innate capacity to read and understand that text consciously (Hanna, 2024).

Step 6 Therefore, any and every attempt to explain consciousness or justify a theory of consciousness must already presuppose and use our unreduced non-materialistic or non-physicalistic, non-mechanical, and more specifically uncomputable innate capacity for consciousness. Or in other words: *the psychocentric predicament*.

Step 7 Given the psychocentric predicament, any and every materialist or physicalist, naturally mechanistic, or otherwise reductive (e.g., computational or informational) science of consciousness whatsoever must already presuppose and use *that which is the exact denial of what it's attempting to prove*, and therefore any and every such science is self-refuting. Or in other words: any and every hard science of consciousness is impossible. **QED**

16.3.4 Cognitive Neuroscience Within Its Proper Bounds

Since, by virtue of the psychocentric predicament, any and every hard science of consciousness is impossible, but at the same time, as per Sect. 16.3.2 above, contemporary professional academic cognitive neuroscience is dogmatically and uncritically committed to, and indeed predicated upon, the very idea of a hard science of consciousness, then it follows that contemporary professional academic cognitive neuroscience is in fact a pseudoscientific enterprise *par excellence*.

By a diametric contrast, a *soft* science of consciousness can fully accept, accommodate, and indeed affirm the psychocentric predicament, by directly incorporating our unreduced non-materialistic or non-physicalistic, non-mechanical, and more specifically uncomputable innate capacity for consciousness *as a primitive datum for the theory* (see, e.g., Hanna & Maiese, 2009; Hanna, 2011; and Chap. 2 above).

Therefore, in order for contemporary professional academic cognitive neuroscience to become authentically scientific and progress beyond its present sorry state of being, in effect, *nothing but a large and aggressive tribe of high-status hardnosed pseudoscientists*, then it must accept, accommodate, and affirm the psychocentric predicament, give up the very idea of a hard science of consciousness, and

resolutely face the soft scientific music. Let's call this deflationary thesis *cognitive neuroscience within its proper bounds*.²

16.3.5 On Soft Sciences of the Mind

Of course, that thesis leaves several important questions unanswered. What, more precisely, *is* a soft science of the mind? In particular, what would be the role of *reformed cognitive neuroscience*—cognitive neuroscience within its proper bounds—in such a science; and which *contemporary approaches to the philosophy of mind*, if any, could adequately support soft sciences of the mind? Here are some preliminary answers to those important questions.

By definition, a soft science of the mind is any science of the mind that's *neither* materialist nor physicalist, *nor* naturally mechanistic, *nor* in any other way reductive. But more specifically, a soft science of the mind is the holistic result of systematically triangulating (i) evidence from empirical psychology, including evidence from cognitive neuroscience, along with evidence from other formal or natural sciences, (ii) phenomenological evidence (Hanna, 2013, 2020), and (iii) classical philosophical evidence, including the results of conceptual analysis, rational intuition, and transcendental argument: analytic a priori truths and knowledge, and synthetic a priori truths and knowledge (Hanna, 2015a: esp. chs. 4–8). Let's call this *the triangulation method* (Hanna & Maiese, 2009: pp. 26–27). Most specifically, then, something X is a soft science of the mind if and only if

1. X is a science, i.e., an organized body of knowledge aimed at a posteriori and/or a priori truth, and constrained and guided by basic logical and mathematical principles, that also generates testable empirical or non-empirical predictions,
2. X fully accepts, accommodates, and affirms the psychocentric predicament,
3. X fully accepts, accommodates, and affirms the ratiocentric predicament, and
4. X fully accepts, accommodates, and affirms the triangulation method.

In this way, by virtue of the psychocentric predicament and the ratiocentric predicament, every soft science of the mind must directly incorporate phenomenological evidence about our innate mental capacities as *primitive data* for that science, along with primitive data from empirical science and from classical philosophical investigation. Therefore, any account of psychological causal mechanisms, operations, or structures that's provided by cognitive neuroscience for that soft science of the mind, will also have to be fully consistent and coherent with the primitive data provided by phenomenology and by classical philosophical investigation, and thus, by virtue of the triangulation method, it will also have to play an inherently *collaborative* role in that soft science of the mind. And so it would be for the soft science of consciousness in particular.

²Here I'm ironically riffing on the title of (Machery, 2017).

Since soft sciences of the mind are by definition, neither materialist or physicalist, nor naturally mechanistic, nor in any other way reductive, then it follows immediately that no philosophy of mind that's either materialist or physicalist, naturally mechanistic, or in any other way reductive, could adequately support a soft science of the mind. Having screened out materialist or physicalist theories, naturally mechanistic theories, and any other reductive theories, then that leaves only some *dualist* theories, some *panpsychist* theories, some *idealist* theories, and the theory I favor, *the essential embodiment theory*, which says (i) that physically irreducible minds like ours are necessarily and completely embodied, (ii) that physically irreducible minds like ours are complex dynamic global structures of our living organismic bodies, i.e., forms of life, (iii) that physically irreducible minds like ours are therefore inherently alive, (iv) that physically irreducible minds like ours are therefore also inherently causally efficacious, just like all forms of organismic life, and (v) that physically irreducible minds like ours emerge over time and in space in all and only certain kinds of living organisms (Hanna & Maiese, 2009; Hanna, 2011; and Chap. 2 above). So my working proposal is that *only* the essential embodiment theory can adequately support soft sciences of the mind.

Supposing that this working proposal is correct, then the next step forward towards the development of a set of true soft sciences of the mind, including of course a true soft science of consciousness, would be to bring about a collaboration between the essential embodiment theory and empirical psychology, especially including reformed cognitive neuroscience. But what are the real-world prospects for this? Although I'm hopeful, frankly, I'm far from optimistic. For, again as per Sect. 16.3.2 above, I think it's likely that the large and aggressive tribe of high-status hardnosed contemporary professional academic cognitive neuroscientists and other cognitive scientists, together with their philosophical kith-&-kin (see, e.g., Machery, 2009), will be fairly unhappy about playing *only* an inherently collaborative role in the creation and development of soft sciences of the mind, and also about *not* being permitted to go on pretending to be Masters of the Mental Universe. If so, then *cry us a river*: they need to wake up and smell the coffee.

—And speaking of coffee, Dear Reader, if you like coffee, San Francisco, or both, then no doubt you'll appreciate the photographic image displayed at the beginning of the next section.

16.4 Is Consciousness a Fifth Fundamental Force?

According to the Standard Models of cosmology and particle physics, there are four fundamental forces in the natural universe, ordered from strongest to weakest: strong nuclear force, electromagnetism, weak nuclear force, and gravitation (Fig. 16.1). Ordered in terms of their range, the weak nuclear force has the most limited range, operationally restricted to 10^{-17} m; and the strong force is operationally restricted to 10^{-15} m, roughly the diameter of a proton. Both forces are

Fig. 16.1 My favorite San Francisco coffee mug.
(Author's photograph, 2023)



microphysical. By contrast, electromagnetism and gravitation operate not only macrophysically as well as microphysically, but also at infinite range:

gravity acts between all objects of the universe, no matter how far apart they are, and an electromagnetic wave, such as the light from a distant star, travels undiminished through space until it encounters some particle capable of absorbing it. (EB, 2024)

Against that theoretical backdrop, in this section I want to raise the following hard question: is there a real and not merely metaphorical sense in which *consciousness* is a fifth fundamental force in the natural universe? My answer will be: *yes*.

Unfortunately, different philosophers, scientists, and non-philosophers or non-scientists mean many different things by the term “consciousness.” For example, in *Embodied Minds in Action*, Michelle Maiese and I identify ten different basic types of consciousness (Hanna & Maiese, 2009: pp. 60–73). And in the *Stanford Encyclopedia of Philosophy* article on “Consciousness,” Robert Van Gulick lists 13 different concepts of consciousness and also explicitly notes that this list is open-ended (Van Gulick, 2022).

So in order to be as clear and distinct as possible, here’s what I mean by *consciousness*, projected against the metaphysical backdrop of the essential

embodiment theory of the mind-body relation and mental causation, as directly quoted from *Embodied Minds in Action*:³

[T]he two core ideas of the Essential Embodiment Theory, reformulated now as a general philosophical claim or proposition, are that: Intentional agency is possible if and only if (i) creatures with irreducible conscious, intentional minds are essentially embodied minds and self-organizing thermodynamic systems, and (ii) minds are basically causally efficacious because they are alive and organismic life is basically causally efficacious.

More precisely stated, however, the Essential Embodiment Theory has six central theses:

1. **The Essential Embodiment Thesis:** Creatures with conscious, intentional minds are necessarily and completely neurobiologically embodied.
2. **The Essentially Embodied Agency Thesis:** Basic acts (e.g., raising one's arm) are intentional body movements caused by an essentially embodied mind's synchronous *trying* to make those very movements and its active *guidance* of them.
3. **The Emotive Causation Thesis:** Trying and its active guidance, as the cause of basic intentional actions, is primarily a pre-reflective, desire-based emotive mental activity and only derivatively a self-conscious or self-reflective, deliberative intellectual mental activity.
4. **The Mind-Body Animalism Thesis:** The fundamental mental properties of conscious, intentional minds *lo* are (a) non-logically or strongly metaphysically a priori necessarily reciprocally intrinsically connected to corresponding fundamental physical properties in a living animal's body (mental-physical property fusion), and (b) irreducible truly global or inherently dominating intrinsic structures of motile, suitably neurobiologically complex, egocentrically-centered and spatially oriented, thermodynamically irreversible living organisms (neo-Aristotelian hylomorphism).
5. **The Dynamic Emergence Thesis:** The natural world itself is neither fundamentally physical nor fundamentally mental, but is instead essentially a causal-dynamic totality of forces, processes, and patterned movements and changes in real space and real time, all of which exemplify fundamental physical properties (e.g., molecular, atomic, and quantum properties). Some, but not all, of those physical events *also* exemplify irreducible biological properties (e.g., being a living organism), and some but not all of those biological events *also* exemplify irreducible fundamental mental properties (e.g., consciousness or intentionality). And both biological properties and fundamental mental properties are *dynamically emergent* properties of those events.
6. **The Intentional Causation Thesis:** A mental cause is an event or process involving both consciousness and intentionality, such that it is a necessary proper part of a nomologically jointly sufficient essentially mental-and-physical cause of intentional body movements. In so being, it is a dynamically emergent structuring cause of those movements. Then, under the appropriate endogenous and exogenous conditions, by virtue of synchronous trying and its active guidance, conscious intentional essentially embodied minds are mental causes of basic acts from their inception in neurobiological processes to their completion in overt intentional body movements.

[T]he primary manifestation of our essential embodiment is the subjective experience of *desire-based emotion*, which in turn is originally given in *primitive bodily awareness*. In other words, creatures with consciousness are, essentially, *desiring*

³In that book, in order to emphasize that the kinds of minds, consciousness, and intentionality we were discussing weren't *merely conceivable* kinds of minds, consciousness, and intentionality (including, e.g., angelic, cosmic, divine, or mechanical/robotic minds, consciousness, and intentionality), but instead all and only actual or really possible minds and consciousness *like ours*, we consistently used the italicized subscript "*lo*" after "minds," "consciousness," and "intentionality." But I'll dispense with that convention for the purposes of quoting these texts here.

minded animals. If true, then this entails what we will dub the Essentially Embodied Cogito: *I desire, therefore I am*.

Consciousness is *the subjective experience of a suitably neurobiologically complex living organism*. This formulation has three distinct but also complementary components:

1. the subjective component,
2. the experiential component,
- and
3. the neurobiological component....

First, to say that consciousness is *subjective* is to say that it necessarily involves an egocentrically-centered and spatially oriented embodiment of consciousness, that it necessarily includes a single point of view, that it is necessarily a pre-reflectively conscious sensorimotor subjectivity, and also that it necessarily is “immanently reflexive”—by which we mean that it *intrinsically contains an immedicate sense of self*.... By virtue of its being subjective, a consciousness also *can*, but need not necessarily, include capacities for meta-representation and self-consciousness or self-reflection. On our view, all and only the *rational* animals with consciousness/o also possess such capacities.

Second, to say that consciousness is *experiential* is to say that it necessarily involves some or another kind of conatively affective content (based on primitive bodily awareness), sensory content (based on sense perception of the world and acts of thought), and representational content (also based on sense perception of the world and acts of thought). So consciousness entails intentionality....

Finally, and most importantly, to say that consciousness *belongs to a suitably neurobiologically complex living organism* is to say that our mental properties are necessarily instantiated in all the vital neurobiological systems, organs, and processes of our living bodies—including the higher brain, brain stem, limbic system, nervous system, endocrine system, immune system, and cardiovascular system—right out to the skin. This is what we call the *Essential Embodiment Thesis*, and it is important to note that it has two logically distinct parts:

1. the *necessary* embodiment of conscious, intentional mind in a living organism (the Necessity Thesis),
- and
2. the *complete* neurobiological embodiment of conscious, intentional minds in all the vital systems, vital organs, and vital processes of our living bodies (the Completeness Thesis).

The Necessity Thesis says that necessarily, minds are alive. Negatively formulated, it says that minds cannot be dead, disembodied, or purely mechanical.

By contrast, the Completeness Thesis says that minds are fully spread out into our living bodies, necessarily including the brain, but also necessarily not *restricted* to the brain. Please note that we are *not* saying that our brains, hearts, livers, or stomachs are either conscious or intentionally directed! On the contrary, according to our view it is only complete *minded animals*, including all *real human persons*, that are conscious or intentionally directed, not their body parts alone, and not even their brains alone. So what we are saying by asserting the Completeness Thesis is that every minded animal, including every real human person, is conscious or intentional *with*, or *in-and-through*, its brain, heart, liver, stomach, or whatever, right out to the skin.

One could, at least in principle, assert the Necessity Thesis and also reject the Completeness Thesis. But we want to assert both of them together. So we hold that the

supposed consciousness of a causally detached brain—say, a living brain floating listlessly in a vat, as in Hilary Putnam’s famous thought-experiment—even though it seems both conceivable and logically possible, necessarily would not be a consciousness *like ours*. On our view, a consciousness [like ours] necessarily involves a brain that is causal-dynamically coupled with all the other vital systems, organs, and processes of our living body. (Hanna & Maiese, 2009: pp. 15–16, 21 and 34–36)

In many fewer words, according to my view, consciousness is nothing more and nothing less than an inherently relational, irreducible, causally efficacious form of biological life. Taken from the *inside*, *internally*, or *endogenously*, minded animals are *conscious*; taken from the *outside*, *externally*, or *exogenously*, minded animals are *causally efficacious non-equilibrium thermodynamic systems*. But taken *as such and as a whole*, minded animals simply are what they are, and not some other thing. The natural universe is fundamentally composed of processual, purposive, self-organizing, causally efficacious, non-equilibrium, non-mechanical thermodynamic systems of various kinds—including, of course, minded animals—in orientable 3-D space and asymmetric, forward-directed time; and everything else is grounded in those non-mechanical systems, including mechanical systems. Therefore, my view of the nature of the mind-body relation, mental causation, and consciousness is neither dualist, nor idealist/panpsychist, nor materialist or physicalist, but is instead a biologically-oriented version of *dual aspect monism*.

This brings me back to the psychocentric predicament, as per Sect. 16.3. As we’ve seen, the psychocentric predicament says that any attempt to explain consciousness or justify a theory of consciousness, already presupposes and uses our unreduced innate capacity for consciousness. Not altogether coincidentally, the only other philosopher or scientist who also seems to have noticed (something like) the psychocentric predicament is Schrödinger, who wrote in *Mind and Matter* that the reason physicists and materialist or physicalist philosophers can’t find the conscious mind within their scientific worldview, is that every worldview is *itself* the work of the conscious mind:

The reason why our sentient, percipient and thinking ego is met nowhere within our scientific world picture can easily be indicated in seven words: because it is itself that world picture. It is identical with that whole and therefore cannot be contained in it as a part of it. (Schrödinger, 1956/1967: p. 138)

In other words, Schrödinger is saying that our unreduced innate capacity for consciousness—“our sentient, percipient and thinking ego”—is already presupposed and used in order to give a reductive explanation or theory of consciousness in terms of the “scientific world picture.” So he’s predelineating the psychocentric predicament, which of course directly entails that every reductive explanation or theory of consciousness in terms of “the scientific world picture” is self-undermining and false.

Nevertheless, any *non*-reductive theory of consciousness is consistent with the psychocentric predicament. Therefore, any theory which says that consciousness is a primitive and not merely *unreduced*, but also *irreducible*, inherently relational, causally efficacious natural fact—just like the four fundamental forces—is fully consistent with the psychocentric predicament. In particular, the essential

embodiment theory of the mind-body relation, mental causation, and consciousness, as per the texts quoted above from *Embodied Minds in Action*, is fully consistent with the psychocentric predicament.

The next relevant question is then whether consciousness is omnipresent and operationally infinite in its range like gravitation, or at least operationally infinite in its range like electromagnetism, or instead limited in range like the strong nuclear force and the weak nuclear force. Panpsychism says that consciousness, like gravitation, is omnipresent (see, e.g., Goff, 2017, 2023). That's what I've called panpsychism's *ubiquity thesis*. But as I've pointed out twice already, **first**, the ubiquity thesis is much too strong a thesis, because it's highly implausible that literally everything in the cosmos, including shoes, and ships, and sealing wax, is actually sentient or proto-sentient, and **second**, the ubiquity thesis mistakenly attributes consciousness to mechanical systems (see Chap. 2, Sect. 2.4 above).

Instead, therefore, let's postulate that consciousness has a *limited* range, like the strong nuclear force and the weak nuclear force. As we've seen, according to my view, consciousness is essentially embodied in all and only causally efficacious living organisms of a certain level of complexity. Then, consciousness exerts its force on macrophysical objects, within a limited range—a range that falls definitely between those of the strong and weak nuclear forces on the one hand, and those of electromagnetism and gravitation on the other—by means of *essentially embodied agency* (Hanna & Maiese, 2009: chs. 3–8; see also Hanna, 2018a, 2020). For example, by means of essentially embodied agency, I consciously move my favorite San Francisco coffee mug from here to there—see Figure 16.1 above—by freely performing the intentional body movement of grasping my coffee mug over here and then putting it down over there. The strong nuclear force didn't move my favorite San Francisco coffee mug from over here to over there; the weak nuclear force didn't move it from over here to over there; electromagnetism didn't move it from over here to over there, and gravitation didn't move it from over here to over there. Nor did the Big Bang. To be sure, all of those forces and that cosmological singularity directly *affected*, *constrained*, and *shaped* precisely *how* I consciously moved my favorite San Francisco coffee mug from over here to over there. But in fact *I* did it, by means of my essentially embodied agency. So on the basis of that, let's postulate that *consciousness is a fifth fundamental force*.

We've already seen that the range of consciousness falls definitely between those of the strong and weak nuclear forces on the one hand, and those of electromagnetism and gravitation on the other. In terms of strength, it also seems clear and distinct that consciousness falls definitely between those of the strong nuclear force and electromagnetism on the one hand, and those of the weak nuclear force and gravitation on the other. In this way, consciousness is the *meso-force*—i.e., the definitely middle-range-and-middle-strength force—among the five fundamental forces.

Notice, moreover, that all experimental detection devices and experimental measuring devices, insofar as they're intentionally designed, constructed, and operated by *physicists*, must *already presuppose and use unreduced consciousness*. In turn, the operations of those experimental detection devices and experimental measuring devices directly affect, constrain, and shape the operations of the other four

fundamental forces: that's what general relativity theory and quantum mechanics are all about. Furthermore, as I worked it out in Chap. 7 above, there's a strong argument for what I call *The Moderate Anthropic Principle*, or MAP, which says that

the manifestly real natural universe, from The Big Bang forward, structurally contains our real possibility as rational “human, all-too-human” minded animals.

And all physicists are rational “human, all-too-human” minded animals. Therefore, *by virtue of physicists doing experimental physics, when taken together with MAP*, it follows that the operational range of consciousness is also as wide and as deep as the scientifically known and knowable natural universe according to the Standard models of cosmology and particle physics. As such, consciousness literally *pulls* the known and knowable natural universe from its determinate cosmological origins into the actual present and onwards forever into the infinite cosmological future.

16.5 Consciousness and Top-Down Cosmology

As I've been arguing in this chapter, and indeed throughout this book, in order to understand the nature of conscious mind in general and rational “human, all-too-human” conscious mind in particular, we need radically to re-think our *concept of nature* itself, as Whitehead urged in 1920 (Whitehead, 1920/1971), radically re-conceiving nature as inherently processual and purposive, running from the Big Bang singularity forward, via negentropic, non-equilibrium thermodynamic, self-organizing temporally asymmetric or unidirectional energy flows, to organismic life, and then on to conscious mind in general and to rational “human, all-too-human” conscious mind in particular, which in turn entails including radically re-conceiving the mind-body relation and free agency. In a nutshell, my two-part thesis is (i) that there's a single, unbroken metaphysical continuity running from the Big Bang singularity, via negentropic, non-equilibrium thermodynamic, self-organizing temporally asymmetric or unidirectional energy flows, to organismic life, conscious mind, human rationality, and free agency, and (ii) that all and only living organisms are actually sentient or proto-sentient (Thompson, 2007; Hanna & Maiese, 2009: chs. 6–8, esp. pp. 300–301, 321–323; Deacon, 2011; Torday et al., 2020; Kauffman & Roli, 2023). In other words, rational “human, all-too-human” conscious mind and free agency are *forms of life*. For convenience and simplicity's sake, I'll call this *the forms-of-life thesis*, or the FoL thesis for short.

In turn, the metaphysics of the mind-body relation that directly answers to the FoL thesis is that the mental-physical relation is a *two-way necessary complementarity*, that is, a mental-to-physical and physical-to-mental synthetic a priori necessary equivalence that captures the manifest essence of minded animals like us, i.e., the essential embodiment theory of the mind-body relation and mental causation, or EET for short (Hanna & Maiese, 2009; Hanna, 2011). Again, according to EET, minds are the essentially embodied, causally efficacious global dynamic forms of all living organisms, from proto-sentient unicellular and complex non-animal

organisms, to fully sentient non-rational non-human minded animals, to highly complex rational “human, all-too-human” minded animals like us. In rational “human, all-too-human” animals like us, mind takes the specific form of *consciousness*, i.e., subjective experience, which is either (i) *immanently reflexive consciousness*—what it’s like *being* a subjectively experiencing animal—and thereby non-self-consciously or pre-reflectively conscious (aka first-order consciousness), or (ii) *apperceptively reflexive consciousness*—what it’s like *to think about* oneself as a subjectively experiencing animal—and thereby self-consciously or self-reflectively conscious (aka higher-order consciousness).

Now, motion, in general, is continuous change in the position or configuration of a physical system in space, including four basic sub-types: uniform motion, translational motion, oscillation, and rotation. The human body is a living organism, hence it’s always in motion in one or more of the four basic sub-types. Therefore, consciousness is *the immanently reflexive or apperceptively reflexive, causally efficacious, endogenous, inner, or internal standpoint of the living organism on its own life, controlling and guiding its living organismic motion*, as the organism achieves and maintains homeostasis with its larger natural and social world (Thompson, 2007; Hanna & Maiese, 2009; Deacon, 2011; Torday et al., 2020; Kauffman & Roli, 2023). According to my view, consciousness is necessarily also *intentionality*, i.e., mental conation and directedness, fundamentally manifest as affective or caring-driven primitive bodily awareness and desire, just as intentionality is necessarily also conscious.

My view of mental causation is that it *isn’t* efficient, mechanical causation: instead it’s formal and/or final causation construed in an updated or neo-Aristotelian way, which autonomously and non-mechanically controls and guides that organism, consistently with the various law-governed natural parameters laid down by the other four natural forces. When this autonomous, non-mechanical control and guidance is also rational, then it’s *essentially embodied free agency*, i.e., essentially embodied free will and practical agency (Hanna, 2018a; Hanna & Maiese, 2009: chs. 3–8). For example, under ordinary conditions, I can freely move a coffee mug from here to there, just by desiring to do so and then self-consciously or self-reflectively *trying* to do so. But even when I’m just sitting quietly in a chair, in a more-or-less dozy and relaxed state, I’m still non-self-consciously or pre-reflectively consciously effortlessly trying to and succeeding in positioning myself, monitoring my breathing, monitoring my gut system, adjusting my posture, wiggling my toes, opening or closing my eyes, etc., and therefore non-mechanically and freely agentially controlling and guiding my living animal body and thereby performing *basic actions*, i.e., basic intentional body movements (Hanna, 2020). Just as our essentially embodied consciousness is nothing more and nothing less than *a form of life*, so too our essentially embodied free agency is nothing more and nothing less than *another form of life* (Hanna & Maiese, 2009; Hanna, 2018a).

Let’s now suppose that EET is true. In Sect. 16.4, I’ve argued (i) that there’s a real and not merely metaphorical sense in which *consciousness is a fifth fundamental force in the natural universe*, along with the strong nuclear force, the weak nuclear force, electromagnetism, and gravitation, and also (ii) that even though the

range of the fundamental force of consciousness is limited, in its initial exertions, to what we can efficaciously cause by means of our essentially embodied free agency—for example, freely moving a coffee mug from one place to another—nevertheless,

all experimental detection devices and experimental measuring devices, insofar as they're intentionally designed, constructed, and operated by *physicists*, must *already presuppose and use unreduced consciousness*. In turn, the operations of those experimental detection devices and experimental measuring devices directly affect, constrain, and shape the operations of the other four fundamental forces: that's what general relativity theory and quantum mechanics are all about. Furthermore, as I worked it out in Chap. 7 above, there's a strong argument for what I call *The Moderate Anthropic Principle*, or MAP, which says that

the manifestly real natural universe, from The Big Bang forward, structurally contains our real possibility as rational “human, all-too-human” minded animals.

And all physicists are rational “human, all-too-human” minded animals. Therefore, *by virtue of physicists doing experimental physics, when taken together with MAP*, it follows that the operational range of consciousness is also as wide and as deep as the scientifically known and knowable natural universe according to the Standard models of cosmology and particle physics. As such, consciousness literally *pulls* the known and knowable natural universe from its determinate cosmological origins into the actual present and onwards forever into the infinite cosmological future. (Sect. 16.4 above, last paragraph)

Let's call thesis (i) *the consciousness-is-the-fifth-fundamental-force thesis*, or the CFFF thesis for short. And let's call thesis (ii) *the consciousness-in-experimental-physics thesis*, or the CEP thesis for short.

Now, here is what the contemporary cosmologist, Thomas Hertog, building on the work of the later Stephen Hawking, calls *top-down cosmology*:

In this book I have argued that a genuine quantum outlook on the universe counters the relentless alienating forces of modern science and lets one build cosmology anew from an interior viewpoint—the essence of Hawking's final theory. In a quantum universe, a tangible past and future emerge out of a haze of possibilities by means of a continual process of questioning and observing. This observership, the interactive process at the heart of quantum theory that transforms what might be into what does happen, constantly draws the universe more firmly into existence. Observers—in this quantum sense—acquire a sort of creative role in cosmic affairs that imbues cosmology with a delicate subjective touch. Observership also introduces a subtle backward-in-time element into cosmological theory, for it is as if the act of observation today retroactively fixes the outcome of the big bang “back then.” This is why Stephen referred to his final theory as top-down cosmology; we read the fundamentals of the history of the universe backward—from the top down.... Top-down cosmology turns the riddle of the universe's apparent design in a sense upside down. It embodies the view that down at the quantum level, the universe bioengineers its own biofriendliness. Life and the universe are in some way a mutual fit, according to the theory, because, in a deeper sense, they come into existence together. In effect, I venture to claim that this view captures the true spirit of the Copernican Revolution. When Copernicus put the sun at the center, he realized all too well that from then on one would need to take the motion of the Earth around the sun into account in order to interpret astronomical observations correctly. The Copernican Revolution did not pretend that our position in the universe is irrelevant, only that it isn't privileged. Five centuries on, top-down cosmology returns to these roots. (Hertog, 2023: pp. 254–255)

In my opinion, when (i) the forms-of-life thesis, (ii) the essential embodiment theory of the mind-body relation and mental causation, (iii) The Moderate Anthropic Principle, (iv) the consciousness-is-the-fifth-fundamental-force thesis, and (v) the consciousness-in-experimental-physics thesis, are all conjoined, then *they collectively explain and rationally justify Hawking's and Hertog's top-down cosmology*.

In turn, this five-part conjunction also provides a rich metaphysical framework for Hawking's profound remark, as recalled by Hertog:

With [a] top-down [approach] we put humankind back in the center [of cosmological theory], he said. Interestingly, this is what gives us control. (Hawking, as quoted in Hertog, 2023: p. 207)

This remark captures Copernicus's original Copernican Revolution in sixteenth and seventeenth century cosmology, as refracted through Kant's eighteenth century Copernican Revolution in metaphysics in the *Critique of Pure Reason*, as refracted yet again through Hawking's and Hertog's twenty-first century top-down cosmology, finally coming home to where it always truly belonged: *science for humans*.

16.6 A Brief History of the Discovery that Consciousness Is the Fifth Fundamental Force

Fundamental forces are dynamic relational facts or properties, with varying ranges and strengths, that govern how all macrophysical and microphysical objects in the natural universe hold together, interact, and fall apart or decay (EB, 2024; Brink, 2024). In Sect. 16.4, I argued that consciousness is indeed a fifth fundamental force in the natural universe, along with gravitation, electromagnetism, the strong nuclear force, and the weak nuclear force. For the purposes of this final section, I'm going to assume that that argument is sound, in order briefly to compare-&-contrast the history of the discovery of the other four fundamental forces, with the history of the discovery that consciousness is the fifth fundamental force.

Gravitation was discovered and initially systematized by Newton in his 1867 *Philosophiae Naturalis Principia Mathematica* and then canonically systematized by Einstein in his 1916 General Theory of Relativity (Einstein, 1916/1923/1952). Electromagnetism was discovered by James Clerk Maxwell in 1865, and the strong and weak nuclear forces were discovered during the 1930s. All four forces belong to the current Standard Models of cosmology and particle physics, which were formulated in their canonical versions from the 1970s to the 1990s (Brink, 2024). What makes them fundamental forces is that they're *primitive* and *irreducible*; correspondingly all theoretical attempts to reduce them all to a single more fundamental force have failed.

Neither gravitation, nor electromagnetism, nor the strong nuclear force, nor the weak nuclear force, or all of them taken together within the theoretical framework of the Standard models of cosmology and particle physics, along with their mechanistic *equilibrium thermodynamics* as per the two basic laws of (i) the conservation

of mass and energy and (ii) the increase of entropy in spontaneously developing isolated systems, can *either* (1) explain how my coffee mug got from here to there *or* (2) explain the science of physics itself. But consciousness and its essentially embodied free agency, as a primitive, irreducible form of life, together with its *non-mechanistic, non-equilibrium* thermodynamics, explains not only both of these fine-grained facts about the natural universe, but also an infinite variety of other fine-grained facts about the natural universe that cannot be explained solely in terms of the other four forces plus their mechanistic equilibrium thermodynamics. So consciousness is the fifth fundamental force in the natural universe.

My view is that consciousness, as the fifth fundamental force, actually emerges in one sense, *diachronically* or over time, along with organismic life, but in another sense, the one that's essentially involved in Hawking's and Hertog's *top-down cosmology*, consciousness has always been in place in the structural mode of real possibility—i.e., *potentiality*—ever since the Big Bang. More precisely, in my opinion top-down cosmology operates according to what I call The Moderate Anthropic Principle, or MAP, which, as we've seen in Chap. 7 and Sect. 16.4 above, says that

the manifestly real natural universe, from The Big Bang forward, structurally contains our real possibility as rational “human, all-too-human” minded animals.

Assuming the theoretical backdrop of the essential embodiment theory of the mind-body relation and mental causation, taken together with MAP, *then by means of experimental detection devices and measuring devices, experimental physicists, as conscious observers, are constantly updating the overall development of the wave function in its operations according to the Schrödinger equation*, exemplifying wave-particle duality, all the way back to the Big Bang, and thereby controlling and guiding the natural universe in its development and expansion, towards the diachronic actual emergence of life and consciousness, and then eventually also rationality and free agency, right up to the actual present time and forever into the infinite future.

The discovery of the first four fundamental forces took roughly 300 years. But how and when was the fifth fundamental force discovered? Consciousness and intentionality, and their necessary complementarity, were discovered by the phenomenologist Edmund Husserl in the Fifth Investigation of his *Logical Investigations* in 1901 (Husserl, 1901/1970: volume II). The metaphysical continuity of mind and organismic life was predelineated by the process philosophers Bergson and Whitehead during the early twentieth century (Bergson, 1911a, b; Whitehead, 1920/1971, 1927/1967, 1929/1978), and then, building on Prigogine's work on non-equilibrium thermodynamics (Nicolis & Prigogine, 1977; Prigogine & Stengers, 1984; Prigogine, 1997), it was gradually (re)discovered by the biologist Francisco Varela and the philosopher Evan Thompson from the 1970s into the early twenty-first century (Varela et al., 1974; Varela, 1979; Thompson, 2007; see also: Deacon, 2011; Torday et al., 2020; Kauffman & Roli, 2023). The essential embodiment theory of the mind-body relation and mental causation was predelineated by the existential phenomenologist Merleau-Ponty in the mid-twentieth century (Merleau-Ponty, 1945/1962), and then (re)discovered in 2009 by Maiese and myself

in *Embodied Minds in Action* (Hanna & Maiese, 2009). The Moderate Anthropic Principle was discovered by me in 2022 (see Chap. 7 above). And the thesis that consciousness is the fifth fundamental force, together with its elective affinity with Hawking's and Hertog's top-down cosmology, were discovered by me in 2023.

Thus the discovery of the fifth fundamental force took 120 years, in the face of (i) the dominance and indeed hegemony of *the mechanistic worldview* and *mechanistic thinking* since the early twentieth century (Hanna & Paans, 2020, 2021), and (ii) a host of twentieth century and early twenty-first century errors about mind and consciousness forwarded by Cartesian dualism, idealism or panpsychism, and materialism or physicalism—whether reductive or non-reductive—and by all reductive approaches to the philosophy or science of consciousness more generally (see Sect. 16.3 above). That consciousness was *the last* of the five fundamental forces to be discovered can therefore be explained by recognizing **first**, that the discovery of a true theory of mind and consciousness had to await the slow-developing awareness of the failure of all the standard approaches to mind and consciousness, but also and above all, **second**, that the discovery of a true cosmological theory had to await the equally slow-developing awareness of the failure of the mechanistic worldview. Indeed, Hertog said in an interview in March 2023 that

“Stephen told me he now thought he had been wrong and so he and I worked, shoulder to shoulder, for the next 20 years to develop a new theory of the cosmos, one that could better account for the emergence of life,” Hertog said.... [*On the Origin of Time*] takes its title from Charles Darwin's *On the Origin of Species*. “In the end, we both came to think of physics in a way much more like how we think of biology. We have put physics and biology on the same footing.” According to Hertog, *On the Origin of Time* deals with questions about our place in the universe and what makes our universe fit for life. “These questions were always in the background in our scientific publications. What I have done for this book is to make these questions central and tell our story from that perspective.” “Stephen and I discovered how physics itself can disappear back into the big bang. Not the laws as such but their capacity to change has the final word in our theory. This sheds a new light on what cosmology is ultimately about.” According to Hertog, the new perspective that he has achieved with Hawking reverses the hierarchy between laws and reality in physics and is “profoundly Darwinian” in spirit. “It leads to a new philosophy of physics that rejects the idea that the universe is a machine governed by unconditional laws with a prior existence, and replaces it with a view of the universe as a kind of self-organising entity in which all sorts of emergent patterns appear, the most general of which we call the laws of physics.” (McKie, 2023)

Now if that isn't the explicit rejection of the mechanistic worldview by one of the top cosmologists of the twentieth century and early twenty-first century, then I'm The Man in the Moon.

16.7 Conclusion

Let's suppose that my interpretation of Hawking's and Hertog's top-down cosmology in terms of (i) the forms-of-life thesis, (ii) the essential embodiment theory of the mind-body relation and mental causation, (iii) The Moderate Anthropic

Principle, (iv) the consciousness-is-the-fifth-fundamental-force thesis, and (v) the consciousness-in-experimental-physics thesis, is correct. Then we can also neatly resolve an apparent contradiction or paradox. As I mentioned in chapter 3, section 3.0, in his 2010 book, *The Grand Design*, Hawking asserted with characteristic boldness and self-assurance, that “philosophy is dead,” by which he meant that contemporary philosophy is irrelevant to contemporary physics (Hawking & Mlodinow, 2010: p. 5). But as Hertog rightly points out in the preface to *Origin*, “for someone who had renounced philosophy, Stephen used it liberally—and creatively—in his work” (Hertog, 2023: p. xiv). This is contradictory or paradoxical only if the term “philosophy” means the same thing in every one of its occurrences. But if “philosophy” in “philosophy is dead” and also in “for someone who had renounced philosophy” means *contemporary post-classical Analytic philosophy in general, especially including Vienna Circle-driven Analytic of science in particular*, and if the meaning of “it” in “Stephen used it [i.e., philosophy] liberally—and creatively—in his work” means *speculative and value-laden philosophy of science, as per (i) the forms-of-life thesis, (ii) the essential embodiment theory of the mind-body relation and mental causation, (iii) The Moderate Anthropic Principle, (iv) the consciousness-is-the-fifth-fundamental-force thesis, and (v) the consciousness-in-experimental-physics thesis, all conjoined and capsulized as science for humans*, then not only are the following two statements perfectly consistent, they’re also both true:

1. Contemporary post-classical Analytic philosophy in general, especially including Vienna Circle-driven contemporary Analytic of science in particular, is irrelevant to contemporary physics (see also Hanna, 2021a), which is why Hawking justifiably renounced it.
2. Nevertheless, Hawking *also* used speculative and value-laden philosophy of science, as per (i) the forms-of-life thesis, (ii) the essential embodiment theory of the mind-body relation and mental causation, (iii) The Moderate Anthropic Principle, (iv) the consciousness-is-the-fifth-fundamental-force thesis, and (v) the consciousness-in-experimental-physics thesis, all conjoined and capsulized as science for humans, liberally and creatively in the collaborative work with Hertog that led to top-down cosmology.

Needless to say, *ad verecundiam* arguments—i.e., arguments that appeal to authority or expertise—are only as credible and reliable as the authority or expert appealed to, and therefore are fallacious if the putative authority or expert isn’t *actually* credible and reliable. So I leave it up to the reader to make a judgment about Hawking’s and Hertog’s scientific credibility and reliability. In any case, I’d be *very* happy to have Hawking and Hertog alongside me, all three of us mutually supporting one another, perched on the shoulders of giants (Newton, 1675).

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