Elements of the Philosophy of Immanuel Kant

Kant's Natural Philosophy

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Abstract

This Element analyzes Kant's metaphysics and epistemology of the exact science of nature. It explains his theory of true motion and ontology of matter. In addition, it reconstructs the patterns of evidential reasoning behind Kant's foundational doctrines.

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Introduction

This is a study of Kant's doctrine of laws, matter, motion, quantification, and their epistemology.

He wrote on these themes into the late Enlightenment, but they were quite old—they go back to Descartes' 1644 *Principles of Philosophy*. That book inaugurated a program of research, and a conceptual framework for it that aimed to replace Aristotle. The Cartesian program rested on a few commitments that most figures then saw as non-negotiable, on pain of regressing to the pre-modern world.

First, natural science must be anchored in a theory of *matter:* an account of its nature, primitive causal powers, and generic modes of action. Second, it required a theory of *motion:* a philosophical analysis of the motion species that science (mechanics, really) singles out for exact treatment. Third, genuine science of nature is *quantitative:* it results from applying the various branches of mathematics to the behavior of matter in motion. Fourth, that science was based in *laws:* universal principles (of matter in motion) that govern all of nature inexorably, and determine its states at every instant. Lastly, proper science must rest on a basis that has the greatest *evidence* this side of first philosophy. After 1700, consensus on these five commitments was practically universal. For Kant it would have counted as the received view.

However, agreement on these commitments went hand-in-hand with much dissent about the details of making good on them. There was protracted discussion about the real nature of body, the ontology of true motion, and the status of fundamental laws; the application of mathematics to nature; and the epistemology of exact science—its sources of evidence and patterns of confirmation.[1]

And so, his engagement with the commitments above frames my account in this volume. I present and assess his metaphysics of matter and motion, his picture of how mathematics applies to them, and the epistemology behind his doctrines. For reasons of space, I leave out of account

[1] Shabel 2005 is a lucid survey of the applicability of mathematics as an early-modern theme. For Kant's relationist stance about motion, see also Messina 2018. For the other themes, see Brading and Stan 2023.

the fifth commitment (laws of nature), which Watkins 2019 has treated exhaustively.

Against this backdrop, I defend below four theses. On the issue of true motion, Kant was a *relationist:* he analyzed motion as a special relation of body to other bodies, not to space. On the nature of *matter*, he changed his mind radically: from a discrete picture to a theory of matter as continuous. In regard to *quantification*, he relied tacitly on certain empirical premises, whose place in metaphysics is uncertain. His *epistemology* of foundations for exact science was quite diverse: he used patterns of a priori inference that go well beyond his canon of transcendental argument.

Quantification deserves special notice here. From his natural philosophy, it is the part we know least well, but also the most problematic, or so I argue below. In particular, he has two problems. His preferred representational framework for science—geometric concepts and methods—is too weak for the task it had to discharge. And, his quantitative pictures of matter and motion are in tension; they do not fit smoothly together.

Territory. My title hints at a broad range, but this book treats just the main parts of Kant's doctrine. He defended them in three canonical texts, which I survey in brief now, with their titles serviceably abridged as *Monads*, *Motion*, and *Foundations*. The first two are youthful papers from the 1750s, and the last is a medium-size tract from 1786.[2]

Officially, *Monads* deals with a problem in metaphysics. Genuine substance must be 'simple,' or partless, hence not divisible. Material substance, however, is in space, which is divisible to infinity. Then so is material substance, and so its concept appears incoherent. Kant solves this conundrum elegantly, by finding a type of substance that is partless, extended, and yet indivisible, conceptually not just physically. He calls it 'physical monad,' an entity at the core of a powerful, versatile theory of matter. I explain its makeup and how it solves his problem in Section II.

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[2] Their full titles are *The Employment in Natural Philosophy of Metaphysics combined with Geometry, of which Sample I contains the Physical Monadology* (1756); *New Doctrine of Motion and Rest* (1758); and *Metaphysical Foundations of Natural Science*. Details and translations are in Kant (1992: 51-66), Kant (2012: 396-408), and Kant 2004. Hereafter, numbers from 467 to 567 refer to page numbers in vol. IV of Kant 1903–. For the rest, I follow convention and cite Kant by volume and page number in the Academy's edition.

Motion solves another puzzle in metaphysics. Many then took causal action to reduce to collision, or impact. Now in collision one body gains as much motion as the other loses. Impact thus seems to consist in a communication of motion, and many philosophers called it as such. Still, that cannot be literally true: motion is a property (of some moving body), and properties cannot migrate from one substance to another. Kant again finds a solution. He argues for a theory of motion as a mutual relation between interacting bodies. From it, he explains impact as being a 'conflict' of forces, not a (metaphysically absurd) transfer of attributes.[3]

He reprised both themes in his mature opus, *Foundations*, a four-chapter account that he called synonymously 'general doctrine of body' and 'rational physics.' Each chapter expounds the metaphysical foundations of a sub-discipline, viz. 'phoronomy,' 'dynamics,' 'mechanics,' and 'phenomenology.' In real English, they denote respectively: a geometric kinematics of particle translation, a picture of matter, a theory of particle interactions, and a concept of objective motion. To keep my account fluent, I introduce here more terminology, as follows: by '*Phoronomy*' I mean his chapter 'Metaphysical Foundations of Phoronomy,' and by 'Phoronomy' the discipline that he so denoted; mutatis mutandis for the other three parts of *Foundations.*

Kant kept reflecting on natural philosophy throughout the 1790s, in unpublished fragments nowadays called *Opus postumum.* Apparently, his views evolved so much that some exegetes speak of a 'post-Critical' Kant. I leave the *Opus* out of account here, which Stephen Howard recently clarified with much skill.[4]

Achievements. Kant's mature natural philosophy stands out from the respective doctrines of his predecessors. Unlike them, his grounding is *comprehensive:* he worked out detailed pictures for all the key components of a philosophical basis for the science of nature: matter, motion, laws of nature, and mathematization. In the period between Galileo and the Late Enlightenment, Kant's foundational project exceeds all others in scope.

[3] Brading & Stan 2023 present exhaustively the background and Kant's solution to the problem of collisions.

[4] See Howard 2023. For the long-term reception of Kant's *Opus*, see Basile 2013.

And, there is a great deal of *unity* to his resulting picture, overall. In line with his transcendental approach, that unity depends on two sources: space and time qua sensible forms, and the twelve categories as concepts for all physical knowledge.

Space is a source of unity in two ways. First, all physical objects are 'in' space: they take up places, which are proper parts of space as a whole; and they are connected to each other by a metric relation, viz. relative distance. Second, space as *Ganzheitsform* ensures that all objects have certain spatial features: size, shape, position, and the space curves they describe as they move. Hence geometry, the science of space, ipso facto applies to all objects. In effect, space being a form (of sense) entails that we can have geometric knowledge—quantitative and exact—of every material body we may encounter in sensible experience. As to the categories, the four groups, or headings, into which Kant grouped them guarantee that all objects have certain generic properties: quantitative, qualitative, and relational. And, the modal categories unify the motion behaviors of all bodies. They justify a research program aimed at referring their individual motion-states to a single descriptive standard: absolute space as *he* means it.

His strategy above yielded a picture (of physical knowledge and its metaphysics) that is considerably unified. At the same time, deep below the surface of that picture lie certain *tensions*. By that I mean descriptive mismatches, not logical contradictions. One tension is between his laws of motion and his matter theory. The laws are fit for discrete particles, whereas Kant thinks that matter is continuous, not discrete. Another tension is between descriptive language and the needs of quantitative theory. He believed that exact science must use the concepts and methods of synthetic geometry; but mathematized mechanics in his time had come to require a different descriptive framework, built from algebraic resources. We must not fault him for those tensions. Virtually everyone then who tried to ground physical science in a theory of matter *and also* in general laws of motion ended up with significant tensions in their foundational

picture. In fact, to this day it is not clear that we *can* have a unified foundation for all classical mechanics.[5]

I suggest a genetic explanation for his tensions. In the Critical decade, Kant *recycled* crucial doctrines from his philosophical youth. He took those doctrines and sought to retrofit them to a conceptual architectonic supplied by the First Critique.[6] But in the 1750s he had not checked that his doctrines were mutually compatible; and in the 1780s his chief priority was to unify them from the outside, as it were—by way of his categories—not to check them for internal compatibility. In the long run, however, it turns out that his mature doctrines were not entirely compatible, their outer appearance of unity notwithstanding. I hope my longer expositions below will lend more plausibility to this conjecture.

[5] On the first tension, see Stan 2014; on the second, cf. Stan (forthcoming). For discussion of the general problem, see Brading & Stan 2023.

[6] The four most important pre-Critical doctrines are: that matter has two essential forces (attractive and repulsive); that two laws of motion (inertial and the action-reaction principle) are a priori and explanatorily privileged; that action by contact (collision) requires grounding from these two laws; and that true motion is a privileged relation between interacting bodies.