Michael Friedman, *Kant's Construction of Nature*

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What can science teach us about the natural world? Philosophers have long argued over this simple question. One well-established proposal is that science can inform us about the objective constituents of reality and the necessary relations between entities and events. Science aims to satisfy our Faustian ambition to "detect the inmost force, which binds the world, and guides its course". On an alternative and equally popular conception, science is in the business of formulating generalisations that help us navigate the world. It does not uncover the ultimate structure of reality but describes the practically useful regularities it finds. Each proposal has its shortcomings. The former encounters traditional scruples about the limits of our knowledge. As Hume warned, experience of nature can tell us what there is but never what must be. How, then, can we ever discover natural necessities? But the latter disappoints our best hopes for science, for it seems close to giving up on the search for a genuine understanding of nature.

Kant's philosophy promises to steer a course out of this quarrel. The dilemma arises, Kant argues, because philosophers have assumed that truths about nature and the laws that govern it hold independently of the human perspective. Once we reject this assumption, we can see that such truths are within our epistemic reach. Scientific knowledge is achievable insofar as natural phenomena are ordered by concepts and principles of human understanding. We can discover natural laws, since their necessity is grounded in what Kant called "a priori" principles. Kant's answer is radical and poses a new challenge: what are these principles?

Kant develops the basis for his answer in his famous *Critique of Pure Reason*. There he sets out what he claims are the universal concepts and principles necessary for any experience of the world. In addition, Kant wrote a small treatise, the *Metaphysical Foundations of Natural Science*, which presents the principles that are specifically required for experience of material nature. These principles include what Kant calls the "laws of mechanics", which determine how a material body communicates motion to another by means of its moving force.

These laws turn out to have a striking similarity to Newton's laws of motion. A common interpretation is that Kant here tried to establish philosophically what Newton proved empirically. In the wake of recent physics, Kant's treatise – quaintly structured as a list of numbered explications, remarks and propositions – might appear to be at best an historical curiosity.

Michael Friedman sets out to rescue the *Metaphysical Foundations* from the shadow of the *Critique*. His original and deeply informed reading – the result of over thirty years of intellectual labour and six times the size of the text it elucidates – adds significant weight to Kant's little book. Friedman presents an historically and exegetically insightful correction of the popular interpretation: he argues that Kant did not attempt to deduce purely by reason what Newton had proved experimentally. Instead, Kant's distinctive and invaluable contribution was to understand the conceptual presuppositions of Newtonian science. Friedman shows how Kant analyses the mathematical and metaphysical principles that provide the basis for Newton's physics. The ingenuity and lasting importance of Kant's project, according to Friedman, thus lies in probing the foundations of Newton's laws, and identifying the conditions that need to be in place in order for Newton's theory to give a mathematical description of the material world.

Friedman explains, for example, how Kant problematises Newton's absolute conceptions of time as an objective magnitude, and space as an empty container, relative to which motion and rest can be determined. Friedman shows that on Kant's account, time and space are not simply given to us as objects in experience but must first be constructed in a reference frame. What this means is that we need certain principles in order objectively to measure and compare time, space and motion. These principles are specific instantiations of the universal conditions of experience, and include the laws of mechanics. We need these laws in order to judge, for instance, whether a perceived event really lasted an hour or took only twenty minutes and whether an observed body was really in motion or at rest. Kant thus shows, on Friedman's account, that the laws of matter conservation, inertia and the equality of action and reaction – especially as applied to action at a distance in universal gravitation – are not discovered by observing matter in motion but are required for objectively specifying the motion of bodies in the first place. They are conditions for applying Newton's theory to the world.

As an attempt to defend Kant's philosophy of science against the charge of historical redundancy, Friedman's reading may look a little surprising. For on his reading, Kant's project turns out to be contingent on empirical features of the dynamical conception of matter, which Kant adopted against the backdrop of Newton's theory. The nature "constructed" by Kant is the nature described by Newtonian physics. Nonetheless, Friedman's reading of Kant is a profound contribution to the debate about what science can teach us about the world. Friedman spells out how, given the Newtonian starting point, Kant's analysis yields the laws of mechanics as necessary principles, showing how Kant's argument provides an instance of a more general insight. Focusing on Kant's book in its historical and scientific context, Friedman shows not only that this small treatise presents an important addition to the well-known *Critique*. He also offers an example of how philosophical investigation can help us understand the architecture of scientific theories and their contribution to our understanding of the natural world.