Book Reviews

Space from Zeno to Einstein: Classic Readings with a Contemporary Commentary
EDITED AND WITH A COMMENTARY BY NICK HUGGETT
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There has long been an empty niche for an anthology of classic works on space and motion from the history of Western philosophy, suitable for use in an introductory philosophy of science course. This book fills that niche. Although suitable for students with little or no background in philosophy, the book could also be used in more advanced courses in which the texts included are given a more careful reading. The commentary provides help for the uninitiated in understanding the issues involved, questions for further research or discussion, and pointers to the secondary literature. One goal of the book is to provide background for philosophical discussion of the special and general theories of relativity. Thus, there is a lucid discussion of spacetime and of Galilean relativity, and also of non-Euclidean geometry. The commentary does not, however, provide an introduction to either the Special Theory or the General Theory of Relativity; its purpose is rather to pave the way for a philosophical introduction to these topics.

The selections are well-chosen. There is an excerpt from Plato's *Timaeus*, and one from *The Elements* of Euclid. Zeno, whose own writings have not survived, is represented by a passage from Plato's *Parmenides* in which he appears as a character, and by the critical exposition of Aristotle, interleaved with the commentary of Simplicius. Aristotle's own theory of place and motion is presented in excerpts from the *Physics* and *On the Heavens*. From Descartes we have excerpts from *The Principles of Philosophy*, including his definition of the true motion of an object as its motion with respect to contiguous bodies, which definition is necessary for understanding Newton's Scholium on space, time, and motion in the *Principia*. The Scholium is, of course, included in this anthology, together with an excerpt from Newton's preface to the first edition, and his laws of motion. What is not a matter of course (though it should be) is the inclusion of Newton's *De Gravitone et aequipondo fluidorum* ("On the Gravity and Equilibrium of Fluids"), familiarly known as *De Grav.*, which provides a useful supplement to the Scholium. This essay is not as well known to philosophers as it should be, and for this reason its presence in this anthology is particularly welcome. Perhaps this anthology will aid in bringing it to the attention of the wider philosophical community.

Relationism is defended against the Newtonian threat by Leibniz (Leibniz–Clarke correspondence), by Berkeley (from *De Motu*), and by Mach (the criticisms of Newton from *The Science of Mechanics*). From Kant, in addition to the expected excerpts from the *Transcendental Aesthetic*, we have his "*Von dem ersten Grunde des Unterschiedes der Gegenden im Raume*," translated as "Concerning the Ultimate Foundation of the

Differentiation of Regions in Space" by G. B. Kerferd and D. E. Walford. We then have two selections from Poincaré's *Science and Hypothesis*, containing the well-known parable about beings enclosed in a finite sphere who, because of law-like deformations of their measurement instruments, measure their world as an infinite space of constant negative curvature. The anthology finishes off with "The Problem of Space, Ether, and the Field in Physics," by Albert Einstein.

It is unfortunate that the Kerferd–Walford translation of "Concerning the Ultimate Foundation of the Differentiation of Regions in Space" was used (perhaps for copyright reasons) instead of the newer translation by Walford and Ralf Meerbote in the Cambridge series of Kant's works. In the older translation, the key term "*Gegenden*" is mistranslated as "regions," when in fact, in this context, it means "directions," as in the newer translation. The re-translation of the key term makes a considerable difference in clarity. For example, where the Kerferd–Walford translation has, "Even our judgements on terrestrial regions are subordinated to the concept we have of regions in general, in so far as they are determined, in relation to the sides of our bodies," which is hard to interpret, Walford and Meerbote have, "Even our judgements relating to the cardinal points of the compass are, in so far as they are determined in relation to the sides of our body, subject to the concept which we have of directions in general."

The commentary is clear and written in a style that will be accessible to all students, with the exception of occasional more technical material that has been set off from the remainder of the text in boxes, to be skipped by students with less preparation. Particularly valuable is discussion (Chapter 10) of spacetime and Galilean invariance in the framework of Newtonian dynamics. (Warning: what Huggett calls "Newtonian space-time" possesses a privileged notion of rest; the structure identified by Howard Stein (1967) as "the structure of space-time according to Newtonian dynamics" and called "Newtonian space-time" by Stein is called "Galilean space-time" by Huggett.)

In his introduction, Huggett says that "this volume follows the lead of John Earman, Michael Friedman, Lawrence Sklar, and Howard Stein in giving a more sympathetic hearing to various 'absolutisms' than they received during the heyday of logical empiricism." This is certainly true, and Huggett's treatment of Newton comes closer to doing justice to Newton's arguments than has often been customary in the literature addressed to non-specialists, and indeed, than has been usual in the philosophical literature. In one respect, however, Huggett's treatment falls short of doing justice to Newton. This respect is his advocacy of the notion, advanced by Einstein, that Newton posits absolute space as a *cause* of inertial effects, and hence that Newton's argument has the form of an inference from observed phenomena to an unobservable cause as best explanation for these phenomena (see Stein, 1967; DiSalle, 1995, for criticisms of this view). According to Huggett, Newton's absolute space is posited as an explanation for inertial effects (p. 139); this space, says Huggett "acts on matter, keeping it on the 'straight and narrow,' but there is no reciprocal effect: matter can have no effect on space, because it is always 'similar and immovable'" (p. 140). Newton does not, however, say that absolute space *explains* why bodies on which no forces act undergo uniform motion, nor does he say that it *causes* them to move uniformly; rather, the inertial effects are the empirical means of distinguishing true motions from the merely apparent. Or, as Huggett himself puts it, when I stir the tea in a teacup, "the tea is moving in circles inside the cup, and circular motions are not straight. The curvature of the water reveals the forces that produce this nonuniform motion" (p. 134). The conclusion of the bucket argument is, not that in the curvature of the surface of the water we see the effect of an invisible object, absolute space, acting on the water; rather,

the conclusion, as Huggett himself points out, is that "there seem to be detectable motions that are not comprehensible as relative motions" (p. 139). That is, the bucket argument is meant to show that, contrary to what may seem, absolute rotation is not unobservable. For Newton, we can actually *measure* the true rate of rotation of an object, and hence, because it can be measured, "there is only one real circular motion of any one revolving body." Newton does not say that absolute space acts on inertial bodies to keep them moving in straight lines with constant speed; in a Newtonian context, such action could only occur via a force exerted by space on the objects, and forces are responsible for *deviations* from inertial motion.

There are a few places in which the commentary requires amplification. For instance, in an introductory section (§ 1.3) on "scientific theories," in which a brief introduction is given to hypothetico-deductivism (with no mention of other approaches to scientific methodology), the rule presented by Huggett for theory acceptance is, "if the consequences of a theory are correct then we accept the theory because it explains the phenomena predicted" (p. 11). This rule is inadequate, as it would have us accept a multitude of mutually incompatible theories. Any account of hypothetico-deductivism requires some notion that not all verified consequences of a theory lend equal support to the theory, and that observations jointly predicted by two different theories need not support the two theories equally.

On the whole, however, the commentary is excellent. The style manages to be lively and readable, without sacrificing accuracy. This book is a welcome addition to our pedagogical repertoire.

References

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Philosophy and Memory Traces: Descartes to Connectionism
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For about the last 15 years, cognitive science has been embroiled in a sometimes-bitter debate about the nature of mental representation. Very roughly speaking, the traditional view is that cognitive processing is the serial manipulation of physical "symbols", each of which locally represents a particular concept or other unit of propositional attitudes. As a result, this position variously goes by the names of symbol(ic)ism, serialism, and localism, among others. The newer view is that cognition involves parallel computation over multiple interconnected "nodes" that individually are semantically uninterpretable, but that collectively constitute distributed mental representations. Such networks go by the names of parallel distributed processing (PDP), connectionism, and neural net-