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Ladislav Kvasz

Descartes on Mathematics, Method and Motion

On the Role of Cartesian Physics in the Scientific Revolution

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Preface

Descartes' scientific work is still subject to new interpretations. One of them was presented by John Schuster in *Descartes Agonistes, Physico-Mathematics, Method and Corpuscular-Mechanism 1618–1633* (Schuster 2013a). There Schuster describes the first 15 years of Descartes' career as a trajectory leading from the chimerical vision of *mathesis universalis*, through its development into an illusory universal method, to the subsequent failure of such youthful dreams when, around 1628, Descartes realized the unfeasibility of his project of basing knowledge on mathematical foundations. Thus, according to Schuster, Descartes developed from a young mathematician into the systematic philosophical system builder we know from his mature works. Something along these lines has been presented by other authors, but Schuster's book is exceptional in that it states this view clearly and distinctly, presenting detailed arguments and supporting them with quotations from Descartes' manuscripts and correspondence. It was the provocative content, the clear style, and the fact that several theses put forward in the book mirror the majority opinion of historians of science that prompted me to write a response to Schuster's book. I want to show that Descartes' vision of a universal mathematics was not a chimera and that his universal method did not fail, but was successfully completed in the form of his physics. In the spirit of the subtitle of Daniel Garber's *Descartes Embodied* (Garber 2001), "*Reading Cartesian Philosophy Through Cartesian Science*", my present book can be seen as a further step in the direction established by Garber: *Reading Cartesian Science Through Cartesian Mathematics*. Nevertheless, this monograph is not merely a polemical response to Schuster's views. The misreading of Cartesian physics, which is the central outcome of Schuster's reconstruction, seems to be one of the main obstacles standing in the way of an epistemological reconstruction of the emergence of early modern science.

Descartes' physics is perhaps the least understood part of his scientific work. It is not that detailed analyses of it are lacking—one can take William Shea's *The Magic of Numbers and Motion, The Scientific Career of René Descartes* (Shea 1991); Daniel Garber's *Descartes' Metaphysical Physics* or *Descartes Embodied, Reading Cartesian Philosophy Through Cartesian Science* (Garber 1992, 2001); Stephan Gaukroger's *Descartes' System of Natural Philosophy* (Gaukroger 2003);

Desmond Clarke's *Descartes. A Biography* (Clarke 2006); or John Schuster's *Descartes Agonistes* (Schuster 2013a), to see that Descartes' physics is a subject of constant interest. Similarly, we can take the collections *Descartes, Philosophy, Mathematics and Physics* (Gaukroger ed. 1980); *The Cambridge Companion to Descartes* (Cottingham ed. 1992); *Essays on the Philosophy of Science of René Descartes* (Voss ed. 1993); *Descartes' Natural Philosophy* (Gaukroger, Schuster, and Sutton eds. 2000); or *A Companion to Descartes* (Broughton and Carriero eds. 2008). The problem with these works, however, is that they interpret Descartes' physics as natural philosophy, i.e., as a discursive discipline standing in an alternative developmental line to mathematical physics, which is usually associated with the work of Galileo, Huygens, and Newton.[1] This interpretation of Descartes' physics is, in my view, misguided. It also affects the understanding of Descartes' method in the *Regulae ad directionem ingenii* (Descartes 1701) and his *Discours de la Methode* (Descartes 1637a) as well as of his *mathesis universalis.*

Although the interpretation of Descartes' physics as a discursive discipline is dominant today, this is not the only view. There is an alternative, represented by the pioneering work of Alan Gabbey, *Force and Inertia in the 17th Century: Descartes and Newton* (Gabbey 1980). Gabbey showed that there is a consistent mathematical model behind Descartes' rules describing the collisions of bodies, which, despite leading in some cases to erroneous results, can still be retrieved with sufficient clarity from Descartes' writings. In *The mathematization of nature and Cartesian physics* (Kvasz 2003) and *Galileo, Descartes, and Newton—Founders of the Language of Physics* (Kvasz 2012) I used Gabbey's interpretation of Descartes' collision rules as a starting point for reconstructing the whole of Cartesian physics. Gabbey's work, however, did not meet with the approval of the historians of science; they did not even find it worth refuting.[2]

Gabbey's colleagues' almost complete neglect of the alternative interpretation of Descartes' physics may be due to the fact that it was formulated without an explicit confrontation with the mainstream view. It is time to change this strategy and present the alternative interpretation of Descartes' physics as a direct challenge to that mainstream view: for such a confrontation, Schuster's *Descartes Agonistes* is an

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[1] A justification of this interpretation was given by Alan Nelson in his article, *Descartes on the limited usefulness of mathematics* (Nelson 2019). Unlike Garber, Gaukroger, and Schuster, who believe that Descartes attempted a mathematical description of physical phenomena, and failed, Nelson argues that Descartes considered mathematics inapplicable to natural phenomena. According to Nelson, when Descartes speaks of mathematical explanation, he means only that scientific justifications are based on the same kind of reasoning as mathematics.

[2] For example, Schuster refers to Gabbey's work (see Schuster 2013a, p. 597). Nevertheless, the content of Gabbey's work called into question Schuster's entire interpretation of Descartes' natural philosophy. Schuster maintains that the mathematical aspect of Descartes' work remained hidden from his contemporaries and later scholars. That this is not is the case is clear from Newton's *Principia*, which was written, at least partially, in response to the contradictions contained in Descartes' system (cf. Janiak 2015, Chap. 4, *Newton's struggle with Descartes*). The mathematical aspect of Descartes' work could hardly have remained hidden from Newton when he had explicitly responded to it. Similarly, Gabbey is mentioned in (Schuster 2013b, p. 86), but again without any willingness on Schuster's part to clarify the technical content of Gabbey's work.

ideal starting point. It is meticulously articulated and its theses are thoroughly argued and supported by textual evidence from Descartes' published works, manuscripts, and correspondence. However, above all, Schuster subjects Descartes's views to a precise historical and philosophical reconstruction, so that the development of Descartes's views is presented by Schuster like a chess game, where each move is the result of the situation introduced by the previous moves. Schuster's book is an ideal foil for the presentation of the alternative interpretation: it allows us to pinpoint exactly where and why my understanding of Descartes diverges from the mainstream interpretation. The interpretation of Descartes' physics in (Kvasz 2012) was merely an alternative, set alongside the views of authors such as Garber, Gaukroger, and Shea. Schuster's book makes it possible to explain the reasons for the departure from the mainstream view, to substantiate these reasons with detailed arguments, and thus to put the alternative interpretation of Descartes' physics into the context of the mainstream view. I shall explain why the mainstream view, despite the consensus of leading historians of philosophy and historians of science, is mistaken in interpreting Descartes' physics as a natural philosophy.

In my view, the main source of this mistake is vagueness of the concept of mathematization. Historians read the works of the main *historical figures*, such as Galileo and Newton, and analyze the role mathematics plays in them. This is how, for example, Alexandre Koyré arrived at his famous thesis that the geometrization of the cosmos was a key moment in the scientific revolution. The background to the present work is a very different approach to the understanding of the notion of mathematization. I have looked at *contemporary mathematical physics* and have sought to understand how contemporary physics mathematizes nature. From this perspective, the mathematization of dynamical process by means of differential equations appears to be a key move. Whether it is electrodynamics, thermodynamics, hydrodynamics, or quantum mechanics, physicists are still doing the same thing: they use differential equations to describe the *temporal evolution of the state* of a physical system. Thus, it seems that mathematization was not simply a transition from the cosmos to an infinite universe. Therefore, in order to understand the origins of mathematical physics, it is not helpful to analyze the geometrization of space. We have to focus on the *mathematization of the concept of state* and the emergence of a *mathematical description of its temporal evolution.*

This monograph is thus not historical but epistemological. In my view, there are sufficient excellent historical reconstructions of Descartes' scientific work. We can take, for example, the aforementioned works by Shea, Gaukroger, Garber, and Clark: they are written with the highest degree of historical erudition and insight. When I claim that they misinterpret the overall nature of Cartesian physics (denying it the status of mathematical physics and thus excluding it from the development leading from Galileo to Newton), this is not due to some overlooked manuscript or piece of correspondence. The problem is more epistemological than historical. In my view, the causes of this misinterpretation of the overall character of Cartesian physics are twofold. One cause lies in a failure to clearly grasp what mathematization in the seventeenth century was actually about—namely that it was a *mathematization of motion.* The second cause lies in the lack of clarity about what a mathematization