

# **Boston Studies in the Philosophy and History of Science**

Volume 316

## **Editors**

Alisa Bokulich, Boston University

Robert S. Cohen, Boston University

Jürgen Renn, Max Planck Institute for the History of Science

Kostas Gavroglu, University of Athens

## **Managing Editor**

Lindy Divarci, Max Planck Institute for the History of Science

## **Editorial Board**

Theodore Arabatzis, University of Athens

Heather E. Douglas, University of Waterloo

Jean Gayon, Université Paris 1

Thomas F. Glick, Boston University

Hubert Goenner, University of Goettingen

John Heilbron, University of California, Berkeley

Diana Kormos-Buchwald, California Institute of Technology

Christoph Lehner, Max Planck Institute for the History of Science

Peter Mclaughlin, Universität Heidelberg

Agustí Nieto-Galan, Universitat Autònoma de Barcelona

Nuccio Ordine, Università della Calabria

Ana Simões, Universidade de Lisboa

John J. Stachel, Boston University

Sylvan S. Schweber, Harvard University

Baichun Zhang, Chinese Academy of Science

More information about this series at <http://www.springer.com/series/5710>

Joyce van Leeuwen

# The Aristotelian *Mechanics*

Text and Diagrams

 Springer

Joyce van Leeuwen  
Max Planck Institute  
for the History of Science  
Berlin, Germany

Dissertation zur Erlangung des Doktorgrades an der Philosophischen Fakultät I der Humboldt-Universität zu Berlin. Tag der mündlichen Prüfung: 9. Juli 2012.

ISSN 0068-0346                      ISSN 2214-7942 (electronic)  
Boston Studies in the Philosophy and History of Science  
ISBN 978-3-319-25923-9              ISBN 978-3-319-25925-3 (eBook)  
DOI 10.1007/978-3-319-25925-3

Library of Congress Control Number: 2015958726

Springer Cham Heidelberg New York Dordrecht London  
© Springer International Publishing Switzerland 2016

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made.

Printed on acid-free paper

Springer International Publishing AG Switzerland is part of Springer Science+Business Media  
([www.springer.com](http://www.springer.com))

# Acknowledgments

This book is a revised version of my dissertation, which was accepted at the Humboldt-Universität zu Berlin in 2012. It was written in the Excellence Cluster Topoi in Berlin to which I am grateful for research support between the years 2009 and 2011. First and foremost, I would like to thank my advisers, Jonathan Beere, Reviel Netz, and Henry Mendell, for their continued encouragement and help at various stages of my project. I was particularly fortunate to have the opportunity to spend a semester at Stanford University to work with Reviel Netz, to whom I am grateful for much illuminating conversation. It should also be evident from this book how much his own work on diagrammatic reasoning in Greek mathematics has influenced me. I acknowledge the Dean of the Faculty of Philosophy I at the Humboldt-Universität zu Berlin, Michael Seadle.

For granting a Mellon Postdoctoral Fellowship in 2012–2013, I am grateful to the Department of History and Philosophy of Science at the University of Pittsburgh. I benefited from Jim Lennox’s vast knowledge of Aristotle, for which I am especially thankful. I am grateful to Department 1 of the Max Planck Institute for the History of Science in Berlin for its generous support in 2013–2015. I owe a great debt to Jürgen Renn and Matteo Valleriani for their faith in this project and for expanding my horizon beyond the ancient world. I greatly benefited from the Department’s research on long-term developments of mechanical knowledge and, especially, the relationships between practical and theoretical knowledge. I thank Peter McLaughlin for many discussions concerning Aristotelian mechanics.

Earlier versions of parts of chapters have appeared in other publications. I thank Cambridge University Press for permission to reproduce my paper “The Text of the Aristotelian *Mechanics*,” published in *Classical Quarterly* 63.1 (2013), which is included in an extended version in Chap. 3. I also thank Brill for permission to reuse material from “Thinking and Learning from Diagrams in the Aristotelian *Mechanics*,” published in *Nuncius* 29 (2014), which appears as parts of Chaps. 5 and 6. These chapters were improved by the valuable comments of Markus Asper, Marko Malink, Jacob Rosen, Ken Saito, and the anonymous readers of *CQ* and *Nuncius*.

Parts of my work were presented in seminars at the Humboldt-Universität zu Berlin, Lund University, Stanford University, Ludwig-Maximilians-Universität München, University of Pittsburgh, and the Max Planck Institute for the History of Science in Berlin. I am grateful for various comments and encouragements offered by all these audiences. The collation of the manuscripts of the *Mechanics* was conducted at the Aristoteles-Archiv of the Freie Universität Berlin. I benefited from its extensive microfilm collection as well as paleographical and codicological materials. I thank Dieter Harlfinger for instruction on the Aristotelian manuscript tradition. I wish to thank Urte Brauckmann for helping to obtain digital reproductions of the images and the related permissions. I am indebted to Lindy Divarci and Lucy Fleet for assisting me in the publishing process. Joshua Crone and Simon Mills proofread the manuscript for me and saved me from many mistakes.

Berlin  
May 2015

Joyce van Leeuwen

# Contents

<b>1</b>	<b>Introduction</b> .....	1
1.1	Collections of <i>Problēmata</i> .....	4
1.2	Authenticity .....	7
1.3	History of the Text in Antiquity .....	18
	Bibliography .....	23
<b>2</b>	<b>General Characteristics of the Transmission</b> .....	25
2.1	On the Method .....	25
2.2	List of Manuscripts .....	27
	Bibliography .....	33
<b>3</b>	<b>The Textual Transmission</b> .....	37
3.1	Manuscript Families .....	39
3.1.1	Family <i>a</i> .....	39
3.1.2	Family <i>b</i> .....	43
3.1.3	<i>O</i> <sup>a</sup> and Its Descendants .....	48
3.1.4	Family <i>c</i> .....	50
3.1.5	Contaminated and Incomplete Manuscripts .....	54
3.2	The Paraphrase by Pachymeres .....	57
3.3	The Latin Tradition .....	61
3.4	The Arabic Tradition.....	62
3.5	Critical Editions .....	64
3.5.1	The <i>Editio Princeps</i> .....	64
3.5.2	Later Editions.....	65
3.6	Results.....	67
3.6.1	<i>Stemma Codicum</i> .....	67
3.6.2	On a New Text .....	68
	Bibliography .....	70

<b>4</b>	<b>Editing Diagrams</b> .....	73
4.1	Transmission of Diagrams .....	75
4.1.1	Manuscript Families .....	75
4.1.2	Correspondence of Diagrams .....	79
4.2	Practices of Diagrams .....	89
4.2.1	Terminology .....	89
4.2.2	The Lettered Diagram .....	91
4.2.3	Characteristics of Diagrams .....	96
4.2.4	Byzantine Origins .....	97
4.3	Critical Edition .....	101
4.3.1	Introductory Remarks .....	101
4.3.2	Case Study: Problems 3 and 23 .....	102
4.3.3	Critical Edition .....	114
4.4	Notes on the Critical Edition .....	119
4.5	Independent Diagrams .....	134
	Bibliography .....	136
<b>5</b>	<b>Diagrammatic Reasoning</b> .....	139
5.1	Diagrams in Modern Critical Editions .....	140
5.2	Validating the <i>Stemma Codicum</i> .....	144
5.3	Cognition of Diagrams .....	148
5.3.1	Rectilinear Motion .....	148
5.3.2	Circular Motion .....	151
5.3.3	Circular Motion Continued .....	154
	Bibliography .....	157
<b>6</b>	<b>Early Modern Transformations of Mechanics</b> .....	159
6.1	The Mechanical Discipline .....	160
6.2	Latin Translations and Their Sources .....	164
6.3	Niccolò Leonico Tomeo's <i>Mechanical Questions</i> .....	166
6.4	Practical Knowledge .....	170
6.5	Selected Problems .....	178
6.5.1	Problem 20 .....	178
6.5.2	Problem 25 .....	182
	Bibliography .....	187
<b>7</b>	<b>Conclusion</b> .....	189
	Bibliography .....	191
	<b>Appendix: Reproductions and Reconstructions of the Diagrams</b> .....	193
	Introduction .....	193
	Problem 1.1 .....	199
	Problem 1.2 .....	201
	Problem 1.3 .....	204
	Problem 1.4 .....	206



Problem 2 .....	210
Problem 3 .....	215
Problem 5 .....	219
Problem 17 .....	221
Problem 21 .....	224
Problem 22 .....	228
Problem 23 .....	230
Problem 24.1 .....	235
Problem 24.2 .....	240
Problem 25 .....	243
Problems 26–27 .....	248
Problem 30 .....	251