

Cambridge University Press
978-1-108-74521-5 — The Concept of Motion in Ancient Greek Thought: Foundations in Logic,
Method, and Mathematics
Barbara M. Sattler
Frontmatter
[More Information](#)

THE CONCEPT OF MOTION IN ANCIENT GREEK THOUGHT

This book examines the birth of the scientific understanding of motion. It investigates which logical tools and methodological principles had to be in place to give a consistent account of motion, and which mathematical notions were introduced to gain control over conceptual problems of motion. It shows how the idea of motion raised two fundamental problems in the fifth and fourth century BCE: bringing together Being and non-Being, and bringing together time and space. The first problem leads to the exclusion of motion from the realm of rational investigation in Parmenides, the second to Zeno's paradoxes of motion. Methodological and logical developments reacting to these puzzles are shown to be present implicitly in the atomists, and explicitly in Plato, who also employs mathematical structures to make motion intelligible. With Aristotle we finally see the first outline of the fundamental framework with which we conceptualise motion today.

BARBARA M. SATTLER has taught at the University of St Andrews and is now Professor for Ancient and Medieval Philosophy at the Ruhr-Universität Bochum. She works mainly on metaphysics and natural philosophy in the ancient Greek world, with a particular focus on the Presocratics, Plato, and Aristotle.

Cambridge University Press
978-1-108-74521-5 — The Concept of Motion in Ancient Greek Thought: Foundations in Logic,
Method, and Mathematics
Barbara M. Sattler
Frontmatter
[More Information](#)

THE CONCEPT OF MOTION
IN ANCIENT GREEK
THOUGHT

Foundations in Logic, Method, and Mathematics

BARBARA M. SATTLER



CAMBRIDGE
UNIVERSITY PRESS

Cambridge University Press
978-1-108-74521-5 — The Concept of Motion in Ancient Greek Thought: Foundations in Logic,
Method, and Mathematics
Barbara M. Sattler
Frontmatter
[More Information](#)

CAMBRIDGE
UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom
One Liberty Plaza, 20th Floor, New York, NY 10006, USA
477 Williamstown Road, Port Melbourne, VIC 3207, Australia
314-321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi - 110025, India
103 Penang Road, #05-06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning and research at the highest international levels of excellence.

www.cambridge.org
Information on this title: www.cambridge.org/9781108745215
DOI: 10.1017/9781108775199

© Cambridge University Press 2020

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 2020
First paperback edition 2021

A catalogue record for this publication is available from the British Library

Library of Congress Cataloging in Publication data

Names: Sattler, Barbara M., 1974– author.

Title: The concept of motion in ancient Greek thought : foundations in logic, method, and mathematics / Barbara Sattler, University of St Andrews, Scotland.

Description: Cambridge, United Kingdom ; New York, NY, USA : Cambridge University Press, 2020. | Includes bibliographical references and index.

Identifiers: LCCN 2020009167 | ISBN 9781108477901 (hardback) | ISBN 9781108775199 (ebook)

Subjects: LCSH: Motion. | Philosophy, Ancient.

Classification: LCC B187.M6 S28 2020 | DDC 116–dc23

LC record available at <https://lccn.loc.gov/2020009167>

ISBN 978-1-108-47790-1 Hardback

ISBN 978-1-108-74521-5 Paperback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party internet websites referred to in this publication, and does not guarantee that any content on such websites is, or will remain, accurate or appropriate.

CONTENTS

<i>Acknowledgements</i>	<i>page ix</i>
Introduction	1
Overview of the Project	1
Methodology, Treatment of Sources, and Relationships of Thinkers Investigated	5
Overview of the Chapters	11
1 Conceptual Foundations	17
1.1 The Concepts of <i>Kinêsis</i> , <i>Physis</i> , and Natural Philosophy	17
1.1.1 The Concept of Motion (<i>Kinêsis</i>)	17
1.1.2 The Ancient Greek Conceptions of <i>Physis</i> and Natural Philosophy	27
1.1.3 The Concept of Being	30
1.2 Criteria of Inquiry	31
1.2.1 The Principle of Non-Contradiction	32
1.2.2 The Principle of Excluded Middle	37
1.2.3 The Principle of Sufficient Reason	39
1.2.4 Rational Admissibility	46
1.2.5 Saving the Phenomena	49
1.3 The Role of Logic	53
1.3.1 Operators and Operands	55
1.3.2 Negation and Identity as Operators	57
1.4 The Role of Mathematics: The Connection between Mathematics and Natural Philosophy	67
1.4.1 The Use of Mathematics for Science in General	67
1.4.2 How to Do Things with Numbers: Measurement and Countability	73
2 Parmenides' Account of the Object of Philosophy	80
2.1 Introduction	80
2.2 Parmenides' Criteria for Philosophy and His Logical Apparatus	83
2.2.1 Criteria for Philosophy	83
2.2.2 Logical Operators	92
2.3 Parmenides' Logical Apparatus as Intimately Tied to His Ontology	103
2.4 Problems for the Very Possibility of Natural Philosophy	111

2.4.1	The Absence of Adequate Basic Concepts for Natural Philosophy	111
2.4.2	No Distinction between Operators and Operands	114
2.4.3	The Indeterminacy of Background Concepts	116
2.4.4	Problems with Relations	117
2.5	Relation to the <i>Doxa</i> Part: The Role of Cosmology	119
3	Zeno's Paradoxes of Motion and Plurality	124
3.1	Introduction	124
3.2	The General Aim of Zeno's Paradoxes	128
3.3	Parmenidean Inheritance	130
3.3.1	Advancing Parmenides' Criteria	130
3.3.2	Deepening of the Challenge Parmenides Poses	134
3.4	The Fragments, Their Sources, and Their Connection	134
3.5	The Paradoxes of Plurality	136
3.6	The Paradoxes of Motion	143
3.6.1	The Dichotomy: Passing Infinitely Many Segments in a Finite Time	144
3.6.2	Achilles: A Variation of the Dichotomy Paradox	155
3.6.3	The Flying Arrow: Motion as a Sequence of Rests	156
3.6.4	The Moving Rows: Double the Time Is Half the Time	164
3.6.5	The Basic Problems of All Paradoxes of Motion	174
4	The Atomistic Foundation for an Account of Motion	176
4.1	Introduction	176
4.2	Eleatic Inheritance in the Atomists	178
4.2.1	Rational Admissibility	179
4.2.2	Consistency	182
4.2.3	The Principle of Sufficient Reason	183
4.3	Atomistic Changes	184
4.3.1	What Truly Is Must Explain the Phenomena	184
4.3.2	A Physical Theory	185
4.3.3	Change of Logical Operators	187
4.3.4	The Atomistic Account of What Is	190
4.3.5	New Physical Features and Their Functions	191
4.4	Consequences of the Atomistic Changes for Natural Philosophy	194
4.4.1	Reply to Eleatic Problems	194
4.4.2	Motion and Changes in the Atomistic Framework	198
4.4.3	Problems that Remain	200
5	The Possibility of Natural Philosophy According to Plato I: The Logical Basis	202
5.1	Introduction: The Investigation of the Natural World as an <i>Eikós Mythos</i>	202
5.2	The <i>Sophist</i>	210
5.2.1	The Reinterpretation of Negation and the Connection Operator	211

CONTENTS

vii

- 5.2.2 The Reinterpretation of the Criteria for Philosophy 1:
The Principle of Non-Contradiction and the Principle
of Excluded Middle 225
- 5.2.3 Widening the Conceptual Possibilities 230
- 5.2.4 Possible Answers to Parmenides' Problems 232
- 5.3 The *Timaeus*: Logical Advances 235
 - 5.3.1 The Reinterpretation of the Criteria for Philosophy 2:
The Principle of Sufficient Reason and Rational
Admissibility 236
 - 5.3.2 An *Eikōs Mythos* 240
- 6 The Possibility of Natural Philosophy According to Plato II:
Mathematical Advances and Ultimate Problems 245**
 - 6.1 Introduction 245
 - 6.2 Introducing Mathematical Structures 246
 - 6.3 Locomotion and Mathematical Structures 253
 - 6.3.1 Time and Eternity 253
 - 6.3.2 Time as the Measure of Motion 256
 - 6.3.3 Space as Excluded from the Measurement Process 266
 - 6.4 Problems with a Simple Measure 269
 - 6.4.1 Restricted Comparability 274
 - 6.4.2 Lacking Consistency: The Tortoise Wins the Race 274
- 7 Aristotle's Notion of Continuity: The Structure Underlying
Motion 277**
 - 7.1 Introduction 277
 - 7.2 Notions of Magnitude Influencing Aristotle's Concept
of a Continuum 284
 - 7.2.1 Parmenides' *Suneches* 285
 - 7.2.2 Atomistic Notions of Magnitude 289
 - 7.2.3 A Mathematical Notion of *Suneches* 291
 - 7.3 Aristotle's Two Accounts of the Continuum 295
 - 7.3.1 Things Whose Limits Touch and Are One 296
 - 7.3.2 Things Being Divisible without Limits 299
 - 7.4 Implications of Aristotle's Concept of a Continuum 303
 - 7.4.1 A New Understanding of the Part-Whole Relation 305
 - 7.4.2 A New Twofold Concept of a Limit 311
 - 7.4.3 A New Conception of Infinity 328
- 8 Time and Space: The Implicit Measure of Motion in Aristotle's
Physics 335**
 - 8.1 The General Concept of Measure in Aristotle's *Metaphysics* 337
 - 8.1.1 A Simple Measure: Being One-Dimensional and
of the Same Kind as What Is Measured 338
 - 8.1.2 Comparison with a Modern Conception and the Relation
between Counting and Measuring 344

Cambridge University Press
 978-1-108-74521-5 — The Concept of Motion in Ancient Greek Thought: Foundations in Logic,
 Method, and Mathematics
 Barbara M. Sattler
 Frontmatter
[More Information](#)

viii

CONTENTS

8.2	The Measure of Movement in Aristotle's <i>Physics</i>	350
8.2.1	Time as a One-Dimensional Measure and Number of Motion	351
8.2.2	The Search for a Measure of the Same Kind as Motion	356
8.2.3	The Relation of Time and Space	374
9	Time as the Simple Measure of Motion	385
9.1	Other Accounts of Speed	385
9.2	Reasons Why Aristotle did not Explicitly Use a Complex Measure	393
9.3	Constructive Developments: A Résumé	403
	<i>Bibliography</i>	404
	<i>Index Locorum</i>	423
	<i>General Index</i>	426

ACKNOWLEDGEMENTS

For a long time the fate of this book resembled that of Achilles' competition with the tortoise – while the point of accomplishment was clearly in sight, it seemed the finishing line would never be crossed. The length of the race is evident from the fact that some crucial ideas go back to my PhD thesis.¹ Some chapter sections overlap with articles I have published in the meantime, but these articles explore or develop individual points.² A full view of my subject can be found only here.

While the project seemed to move with the speed of a tortoise, I was lucky in receiving a wealth of support, for which I am immensely grateful. First and foremost, I want to thank those people who committed the time and effort to read the entire manuscript: Sarah Broadie, whose comments always pushed me to dig deeper into the philosophical problems; Ken Winkler, who is perhaps the most careful and subtle reader I have ever known; and Michael Della Rocca, the most generous monist around.

Furthermore, I want to thank Verity Harte, from whom I learned so much about framing, for reading chapters 2–4 and 7–9. Both Henry Mendell and Stephen Menn read several chapters and gave me valuable feedback, especially on ancient science and mathematics. Individual chapters or sections profited from comments from Andrew Gregory, Larry Horn, Arnaud Macé, Malcolm Schofield, Michalis Sialaros, Stewart Shapiro, Katja Vogt, and readers for the press.

I also want to thank Rona Johnston for helping me with my English in a way that always occasioned learning more about the English language in general, Cady Crowley for help with the index, and Hilary Gaskin for handling the manuscript for CUP so quickly, professionally, and flexibly.

¹ Material from chapters 7, 8, and 9, as well as the second half of Chapter 3, and the last part of Chapter 5. My doctoral thesis, titled “The Emergence of Motion”, can be read on microfiche at the library of the FU-Berlin and at a couple of other German libraries.

² Section 1.3.2.1.1 in Chapter 1 and parts of chapter 2 overlap with Sattler 2011; section 3.6.4 in Chapter 3 with Sattler 2015 and a subsection of 3.6.1 with Sattler 2019b; section 7.2.1 in Chapter 7 with Sattler 2019a; and sections 1.4.2 in Chapter 1 and 8.1 and 8.2.3 in Chapter 8 with Sattler 2017a.

Cambridge University Press
978-1-108-74521-5 — The Concept of Motion in Ancient Greek Thought: Foundations in Logic,
Method, and Mathematics
Barbara M. Sattler
Frontmatter
[More Information](#)

x

ACKNOWLEDGEMENTS

Finally, I want to thank my brother Wolfgang Sattler, my dear friends Michael Della Rocca and Justin Broackes, and my partner Marcus Lala for emotional support during what turned out to be, unrelated to my work, very difficult times.

Dem liebenden Andenken an Ulrich Bergmann gewidmet – ohne ihn wäre dieses Buch nie begonnen worden.