MECHANISMS IN SCIENCE

In recent years what has come to be called the 'New Mechanism' has emerged as a framework for thinking about the philosophical assumptions underlying many areas of science, especially in sciences such as biology, neuroscience, and psychology. This book offers a fresh look at the role of mechanisms, by situating novel analyses of central philosophical issues related to mechanisms within a rich historical perspective of the concept of mechanism as well as detailed case studies of biological mechanisms (such as apoptosis). It develops a new position, Methodological Mechanism, according to which mechanisms are to be viewed as causal pathways that are theoretically described and are underpinned by networks of difference-making relations. In contrast to metaphysically inflated accounts, this study characterises mechanism as a concept-in-use in science that is deflationary and metaphysically neutral, but still methodologically useful and central to scientific practice.

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Method or Metaphysics?

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To my parents, Panagiota and Giorgos, with gratitude. —S.I.
To the memory of those two who made this exciting journey possible for me, my father Dimitris (1927–2001) and my mother Maria (1934–2019). —S.P.

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Preface

This book is the product of genuinely collaborative work (the names appear in alphabetical order). We have known each other for almost two decades now. We met for the first time when S.I., still at high school, walked into S.P.'s office to ask advice concerning degrees in philosophy. S.I. became an undergraduate student in S.P.'s dept; then he did graduate studies in the philosophy of biology in the University of Bristol and joined the History and Philosophy of Science Department of the University of Athens as a postdoc in 2012.

Over the years, we have developed a philosophical partnership that extends from issues in the history of philosophy (mostly during the seventeenth century) to issues in contemporary metaphysics of science. Key to this partnership is mutual respect and tolerance as well as a common philosophical outlook. Both of us agree that good philosophy should be conceptually clear and historically sensitive. In fact, it seems that each and every philosophical problem is better illuminated if it is subjected to rigorous conceptual dissection; yet when the various parts are synthesised again, treating them in their historical concreteness enhances our understanding of their trajectory in time and space.

The project that led to this book started, like all of our joint ventures, with discussions over coffee on an early Saturday morning in a café in the centre of Athens. At the beginning of 2015, one of us (S.P.) received a kind invitation from Phyllis Illari and Stuart Glennan to contribute a piece on mechanisms and counterfactuals to the *Routledge Handbook of Mechanisms*. S.P. invited S.I. to work with him on this project. We started as we always did, by drafting the table of contents and dividing up the writing. Dozens of meetings and some heated discussions later, we submitted the piece in August 2016.

At the time of the mechanism project, we were both involved in a long and thorough study of the relations between metaphysics and physics in the seventeenth century. We started with Descartes and moved on to

Newton and Leibniz, with seminars, reading groups and workshops. We focused in particular on the transition from an Aristotelian power-based ontology to the modern law-based account of the world in terms of matter in motion. These endeavours brought with them the question of the relation between the Old Mechanism of the seventeenth century and the New Mechanism of the twenty-first. In October 2016 S.P. presented this historical narrative at the annual conference of L'academie Internationale de Philosphie des Sciences in Dortmund. The conference was on mechanisms and was organised by Brigitte Falkenburg and Gregor Schiemann.

The New Mechanism started to become the focal point of our research. Searching for a mechanism to study in detail, we came across the case of apoptosis, a.k.a. programmed cell death. We soon realised that that is a very rich case of a mechanism and it became the subject of our study. The more we thought about apoptosis, the more it became a showcase of our own approach to mechanism. This approach, which we called Methodological Mechanism, was aired first at conferences, most notably at the conference on Mechanisms in Medicine at the University of Kent at Canterbury in July 2017, organised by the gurus of mechanisms in the United Kingdom (the members of the 'Evaluating Evidence in Medicine' project (https://blogs.kent.ac.uk/jonw/projects/evaluating-evidence-in-medicine/).

The reception was mixed. John Worrall, our good friend, had to leave right after S.P. delivered the paper and on his way out he whispered in S.P.'s ear, 'You are back on the straight and narrow; you've become a logical positivist.' The hosts (Jon Williamson and Phyllis Illari) were more critical, arguing that the position is too thin, while María Jiménez Buedo (a young talented philosopher from Madrid) was enthusiastic. The result was a kind invitation from her to UNED in Madrid in May 2018, and a couple of talks in her research group (together with Jesús Zamora, Mauricio Suarez and David Teira) on the notion of mechanism in biology and the social sciences. In the meantime, our paper on apoptosis and Methodological Mechanism had appeared in print in the journal *Axiomathes*. Our main thesis, that the concept of mechanism in use in the sciences is mainly or exclusively methodological and not metaphysical, started to acquire some traction.

At roughly the same time, S.P. had finished a book review of Glennan's *The New Mechanical Philosophy* for the *Australasian Journal of Philosophy*. This book came to us as manna from heaven. Stuart presented very eloquently and forcefully the view that we wanted to oppose – the metaphysics-first view, as it were – and made us think harder about how

best to defend our own practice-first approach. In the end, the review grew longer and longer and only a small part of it appeared in the *Australasian Journal of Philosophy*. The rest of it, focused as it was on activities qua a new ontic category, was destined to go into another paper, which was invited by the journal *Teorema*. In this paper we took on the concept of activity and developed our own difference-making account of the workings of a mechanism.

At the beginning of 2019, we received a kind email from our good friend Orly Shenker inviting us to a star-studded workshop in Jerusalem on the levels of reality, towards the end of May 2019. We took this opportunity to sharpen our thoughts on the issue of levels of mechanisms, and in particular on the relation of constitution that is supposed to hold between a mechanism and other mechanisms as its parts. That is an idea we reject in favour of causation. At the end of the day only S.I. managed to go as S.P.'s mother fell terminally ill and passed away a couple of weeks later.

The last station of this journey was in Geneva in September 2019, at the EPSA 19 Conference, where S.I. presented work concerning our main thesis, that mechanisms are causal pathways described in theoretical language. A few months later, just before the COVID-19 pandemic and the first lockdown, a good chunk of manuscript was submitted to Hilary Gaskin and Cambridge University Press. We should thank Hilary for her patience, care and support throughout the occasionally very demanding and tiring health-related issues that we both faced during the period of the completion of the manuscript. Two anonymous readers for Cambridge University Press made wonderfully detailed, critical but positive comments on the first draft. Without them the book would have been philosophically poorer.

Philosophy is essentially a communal enterprise. The book has benefitted a lot from a number of individuals who cared enough to make oral and written comments, ask questions and pose various challenges. The list of all those we would like to thank wholeheartedly is a lot bigger than the list of those mentioned by name. Hence our deepest thanks go to all those who asked questions and made comments, but whose names we don't know. But also to Konstantina Antiochou, Ken Binmore, Diderik Batens, Craig Callender, Nancy Cartwright, Paul Churchland, Peter Clark, Lindley Darden, Mauro Dorato, Jan Faye, Alexander Gebharter, Mania Georgatou, Michel Ghins, Donald Gillies, Olav Gjelsvik, Alan Hajek, Haris Hatziioannou, Chris Hitchcock, Carl Hoefer, Ilhan Inan, Gürol Irzik, Philip Kargopoulos, Patricia Kitcher, Buket Korkut, Daniel Kostić,

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Over the years, ideas that eventually formed parts of the book have been presented in seminars at the University of California San Diego, Caltech, American College of Thessaloniki, Bogazici University, University of Oslo, University of Ghent, UNED University in Madrid, Western University, Aristotle University of Thessaloniki and the University of Cyprus; also at the fourth Athens–Pittsburgh conference on Proof and Demonstration in Science and Philosophy, in Delphi (June 2003); at the workshop of the Metaphysics in Science Group in Athens (June 2003); at the Symposium on Mechanisms in the Sciences, APA Central Division, Chicago (April 2006); at the Conference on Causality in the Sciences, University of Kent (September 2008); at the Conference on Mechanisms and Causality in Science, University of Kent (September 2009); at the Workshop on the Metaphysics of Science, University of Warsaw (January 2010); at the Symposium on the Metaphysics of Science, College de France (May 2012); at ISHPSSB 2015 (Montreal, UQAM); at the AIPS Conference on Mechanistic Explanations, in Dortmund (October 2016); at the 'Mechanisms in Medicine' workshop, Centre of Reasoning, University of Kent (July 2017); at the Conference on the Multi-Level Structure of Reality (Israel Institute for Advanced Studies, Hebrew University of Jerusalem, and University of Haifa, May 2019); and at the EPSA19, Geneva (September 2019). S.P. would like to thank wholeheartedly the three women in his life, who help him get his bearings: Athena, Demetra and Artemis.

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