Descartes *Agonistes*:

Physico-mathematics, Method and Mechanism 1618-33

John A. Schuster

Overview of the Argument

In this book I reconstruct key aspects of the early career of Descartes from 1618 to 1633; that is, up through the point of his composing his first system of natural philosophy, *Le Monde* in 1629-33. I focus upon the overlapping and intertwined development of Descartes' projects in physico-mathematics, analytical mathematics, universal method, and finally systematic corpuscular-mechanical natural philosophy. My concern is not simply with the conceptual and technical aspects of these projects; but, with Descartes' agendas within them and his construction and presentation of his intellectual identity in relation to them. Hence, my subject matter is selective and ultimately limited in relation to the potential field of concerns in which intellectual historians and historians of science and philosophy might place Descartes, even the young Descartes. Nevertheless, as I explain, my focus on technical projects, agendas and identity well fits the scope and aim of scientific or intellectual biography.

On my analysis Descartes' technical projects, agendas and senses of identity all shift over time, entangle and display great successes and deep failures. This motivates my choice of title, 'Descartes *Agonistes*': In all three dimensions—projects, agendas and identity concerns—the young Descartes struggles and contends, with himself and with real or virtual peers and competitors between 1618 and 1633, as he morphs from a mathematically competent, Jesuit trained graduate in neo-Scholastic Aristotelianism to aspiring prophet of a firmly systematised corpuscular-mechanism, passing through stages of being a committed *physico-mathematicus*, advocate of a putative "universal mathematics", and projector of a grand methodological dream.

I argue that Descartes' evolving program in physico-mathematics was the central, but not exclusive element in this complicated story, and thereby indicate how the more usual tales of Descartes' development can and must be retold around this axis. Unlike my previous work, the present book establishes that early on Descartes was very far from being interested in constructing a systematic natural philosophy, and that his commitment to corpuscular mechanism, though real, was more peripheral than central to the evolving tangle of his projects and concerns. Indeed, it was only through the maturation of his physico-mathematics, and the simultaneous collapse of alternative grand projects in method and universal mathematics, that he saw his way, finally, to becoming a systematic philosopher of nature, offering a corpuscular-mechanical system with, as he saw it, unusually strong grounding in physico-mathematical achievements and practices.

Analytical Table of Contents:

[Dot points denote chapter section headings. Clauses following dot point headings and separated by semi-colons indicate sub-sections, where applicable.]

Chapter 1 Introduction: Problems of Descartes and the Scientific Revolution

•Descartes and the Historians of Science •Key Pitfalls Facing Descartes' Biographers: The Problem of Method; The Problem of Natural Philosophy as a Dynamic Field of Discourse; The Problem of Scientific Biography and Historiography of Science •Overview of Argument

Chapter 2 Conceptual and Historiographical Foundations: Natural Philosophy, Mixed Mathematics, Physico-mathematics

•Jesuit neo-Scholasticism for the *noblesse de la robe* •In Search of Proper Categories and Angle of Attack •Constructing the Category of Natural Philosophy •Some Heuristic Help—Modelling Modern Sciences as Unique, Agonal Traditions in Process •Constructing the Category of Natural Philosophy—Dynamics and Rules of Contestation: Articulation on Subordinate Disciplines; Find or Steal Discoveries, Novelties or Facts; Bend or Brake Aristotle's Rules about Mathematics and Natural Philosophy—The Gambit of Physico-Mathematics; "Hot Spots" of Articulation Contest, Notably Realist Copernicanism; Modelling System Construction and Contestation—The Core, Vertical and Horizontal Dimensions of a Natural Philosophical System; The Mechanics of Responding to 'Outside' Challenges •The Special Status of the Problem of Method •Phases and Stages in the 'Scientific Revolution' •Looking Forward: What Kind of Natural Philosopher/Physico-Mathematician was René Descartes?

Chapter 3 Recalled to Study: Descartes *Physico-Mathematicus*

 Introduction •Beeckman—Mentor and Colleague Physicoin Mathematics and Natural Philosophy • Exemplary Physico–Mathematics: The Hydrostatics Manuscript of 1619 •What's the Agenda? Descartes' Radical Form of Physico-Mathematics • The Physico-Mathematics of Natural Fall: The Study of Fall as (Abortive) Physico-Mathematics; Beeckman's Problem and His Version of Descartes' Solution; Descartes' Solution-Triumphs and Pitfalls of a Physico-Mathematics of Fall; How and Why Descartes Hit a Pitfall; The Physico-Mathematics of Fall Stalls-Too Many Laws, Too Many Causes, No Measurements • A Physico-Mathematical Foray into Optics, 1620 • Conclusions: Options, Pitfalls and Trajectories

Chapter 4 Descartes Opticien: The Optical Triumph of the 1620s

•Genealogical Detective Work: Hints, Clues and the Problematic Text of the Dioptrique •Cartesian Dynamics in Le Monde •Making Sense of the Proofs of the Laws of Reflection and Refraction in the Dioptrique •Descartes' Dynamical Premises: Demonstrative Efficacy and Empirical Weakness •Descartes' Route to the Law of Refraction 1619-27 •The Dynamical Premises for the Deduction of the Sine Law of Refraction: their Pre-History and History 1618-29 • The Mechanical Theory of Light 1620-1628: Expository Strategy and Working Distinctions; Reprise—The Optical Fragment of 1620; Light as Instantaneously Transmitted Impulse 1626-28; The Balance Beam Model of 1628 •Full Circle-Cartesian Dynamics, Optics & the Tennis Ball Model 1628-33: The Exemplar for Descartes' Laws of Dynamics in his Physico-Mathematical Optics; In a Spin Over Tennis Balls and Boules of Second Element-Cartesian Dynamics, Optics and the Problem of Colour •Grist for the Method Mill: Method and Optics in Rule 8 of the Regulae • Conclusion-Looking Forward

Chapter 5 Analytical Mathematics, Universal Mathematics and Method: Descartes' Identity and Agenda Entering the 1620s

•Introduction: The Struggle over Mathematics, Universal Mathematics and Method •The Universal Mathematics of 1619: Rule 4 of the *Regulae* •Reading Rule 4: Method and Universal Mathematics •Straining at the Classical Bit: Descartes' Early Work in Analytical Mathematics •Genesis and Dating of Universal Mathematics •The Core of Descartes' Method Discourse in the Early *Regulae* •The Making of Cartesian Method-Talk in the Winter of 1619-20 •Conclusion: Descartes' Unfolding Agendas and Identities 1618-20.

Chapter 6 Method and the Problem of the Historical Descartes

•The Way Forward: Between Naïve Belief and Pure Debunking •The Cult of Method in Descartes Studies •Descartes' Method as Mythic Speech: Where 'Myth' is not a Colloquial Term of Abuse •The Failure of Adequate Redescription: An Example of Descartes Attempting to 'Methodologise' a Field of Inquiry •The Structural Levels and Underlying Metaphors in Descartes' (or Anybody's) Method Discourse •The First Two Structural 'Effects': 'Adequate Redescription' and 'Application' •The Third and Fourth 'Effects': The 'Unity' and 'Progress' of a Method Discourse •The Rhetorical Functions of Cartesian (and Other) Method Discourses •Rethinking Method and the Career of Descartes: The Original Inscription of Descartes' Method—Bricolage, Self-Deception and Self-Definition; The Failure of the Regulae, The Birth of the System and the Problem of the Cynical Discourse de la méthode

Chapter 7 Universal Mathematics Interruptus: The Program of the later Regulae and its Collapse 1626-28

•Introduction: Toward the Renewed Project of Mathesis Universalis in the later Regulae •Rule 8, The Emergence of the Project of the Later Regulae •Rule 12–From 'Most Splendid Example' to the Articulation of the Machinery of Universal Mathematics •Rules 14 to 18: The Machinery of Universal Mathematics •The Structure of Universal Mathematics in the Later Rules and its Legitimatory Functions •The Instability of the Later Regulae and the Beginnings of the Origins of Cartesianism •Conclusion—The Project of the Later Regulae and the Inflection of Descartes' Agenda and Identity Toward Systematic Natural Philosophy and Metaphysical Grounding

Chapter 8 Reinventing the Agenda and Identity: Descartes, Physico-mathematical Philosopher of Nature 1629–33

•The Problem of Descartes' Career 'Inflection Point' and How to Approach It •Fundamental Intellectual Agendas and Projects, 1629-33: The Emergence of Cartesian Metaphysical Dualism; Some Voluntarist Theology and its Strategic Uses; Plenist or Holistic Realism •Events and Interactions Partially Shaping the Motives for and Content of *Le Monde*: Abandonment of the later *Regulae* the Most Important 'Event' of all; The Chandoux Episode and Relations with Cardinal Bérulle; Challenge of Renewed Interaction with Beeckman; The Galileo Affair and its Perceived Meanings •The Chronology of *Le Monde* •An Exercise in Counter-Factual History—If the *Regulae* had not Failed... •Aspiration, Identity and Strategy at the Birth of *Le Monde*: Between Natural History and *A Priori* 'Science'

Chapter 9 Reading Le Monde as Pedagogy and Fable

•Introduction •The Ground Plan of *Le Monde* •The Common Sense of Corpuscular-Mechanism *pour les honnêtes hommes*, The Opening Chapters of *Le Monde* •Why the Fable of the Mechanistic World? •Working Out the Fable: Chapters 6 to 8 of *Le Monde*: Cosmogony, Matter-Extension and the Introduction of Motion and its Laws; The Laws of Nature; Vortex Formation, Stability Principle and Re-Introduction of the Elements

Chapter 10 Waterworld: Descartes' Vortical Celestial Mechanics and Cosmological Optics—A Gambit in the Natural Philosophical Contest

•Introduction: Uncommon Vortices •Descartes' Vortical Celestial Mechanics in *Le Monde*: Charitable Hermeneutics–Principles and Aims; Size and Speed Distributions of Vortex Corpuscles and the Role of Central Stars; Locking and Extruding–Unpacking the Technical Core of the Vortex Celestial Mechanics; Genealogical and Systematic Dimensions of the Vortex Celestial Mechanics •Beeckman's Cosmic Balancing Acts–The Last Genealogical Step to the Vortex Mechanics •Descartes' Celestial Vortex

Mechanics as a 'Science of Equilibrium' •Applying the Vortex Mechanics to Local Fall, the Moon and the Tides–An Exercise in Charitable Interpretation •Some Intricacies of the Theories of Local Fall and the Moon, Bearing the Imprint of the Genealogy of Physico-Mathematics •Cosmological Theory of Light in Relation to Celestial Mechanics and the Style of Cartesian Physico-Mathematics in Corpuscular-Mechanical Model •Matching of Evidence: The Appearance of Comets in Relation to the Celestial Mechanics, the Cosmological Optics and the Style of Cartesian Physico-Mathematics in Corpuscular-Mechanical Mode •Conclusion: *Le Monde* as Competitive Gambit in the Natural Philosophical Field

Chapter 11 Le Monde as a System of Natural Philosophy

•Le Monde as a System: Core, Horizontal and Vertical Dimensions and System-Binding Moves •Remediating Problems and Taking the Best Steps Forward in the *Principia* •A Triumph of System-Binding—Cosmography, Copernicanism and the Structure and Formation of Planets in the *Principia* •Conclusion

Chapter 12 Conclusion: The Young and the Mature Descartes *Agonistes*

• *Coda*: Descartes' 'Youthful Struggles Reconsidered • *Epilogue*: The Mature, Public and Published Descartes *Agonistes*

Appendix 1 Descartes, Mydorge and Beeckman: The Evolution of Cartesian Lens Theory 1627-1637

•Introduction •Mydorge's Refractive Instrument–Cosecants, not Sines •Mydorge's Synthetic Propositions 3 and 4 on Anaclastic Surfaces—An 'Antique' Version of the Sine Law •Relating Mydorge's Propositions 3 and 4 to Descartes' Analogues in the *Dioptrique*: From 'Antique' to 'Natural' Representation of the Sines, Thanks to Isaac Beeckman in October 1628 • Decoding Mydorge's Proposition 5: The Cosecant Form Leads to the 'Discovery' of the 'Antique' Sine Form Then Used Synthetically in Propositions 3 and 4 •Reconstruction of Descartes' and Mydorge's First Analysis of the Anaclastic Problem, with Cosecant Law of Refraction to Hand •The Kramer-Milhaud Thesis: Discovering the Law of Refraction by Analysis of the Anaclastic Problem •Conclusions

Appendix 2 Decoding Descartes' Vortex Celestial Mechanics in the Text of Le Monde