History, Philosophy and Theory of the Life Sciences

Peter Distelzweig
Benjamin Goldberg
Evan R. Ragland *Editors*

Early Modern Medicine and Natural Philosophy

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Chapter 1
Introduction

Benjamin Goldberg, Evan R. Ragland, and Peter Distelzweig

> *There is no more fruitful occupation than to try to know oneself. And the benefit that one expects from this knowledge does not just extend to morals, as many may initially suppose, but also to medicine in particular. – René Descartes, Description of the Human Body.*
>
> (Descartes 1998, 170)

Many, perhaps even most, members of the early Royal Society of London were physicians (though not all of these were *practicing* physicians).[1] The Society could never have prospered without the support of wealthy physicians, the rolls of the organization were filled with doctors and surgeons, and medical and biological observations and analyses crowd the pages of its journal. Indeed, some members of the College of Physicians complained about the Royal Society's forays into medicine. Any simple skimming of the *Philosophical Transactions* will immediately reveal a network of men (and they were only men) persistently occupied with medical and biological problems—hardly an issue was printed without mention of various medicinal cures, surgical or medical procedures, or observations of strange and mysterious animals or plants. To take one small example, in the very first issue of the *Transactions* there is a brief article entitled, "An Account of a very odd Monstrous calf" (*Philosophical Transactions* 1665, 10), which describes a calf with various deformities, including having no joints and a triple ('Cerebus-like') tongue.

[1] Cook 1990.

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Observations like this one—and much more detailed empirical and theoretical analyses—can be found throughout the early issues of the *Transactions*, and they were of vital importance to those working on various outstanding problems, in this case the problems of animal generation and of the origin of monstrosity. This news item was communicated by none other than the Honorable Robert Boyle, whose interests go well beyond the physical and chemical sciences for which we usually remember him.

This observation illustrates the core concern of this volume: to bring to the fore the medical context of natural philosophy—not only in England in the second half of the seventeenth century, but throughout Europe in the early modern period. While the papers in this volume range in approach and topic, they share a core background assumption, namely, that medicine and natural philosophy shaped and drove each other on multiple levels. This mutual influence took many forms and acted at numerous interfaces, including the institutional and (inter)personal. Of course, the universities constitute one major institutional interface, but others existed and developed in the period—as exemplified by the constitution and preoccupations of the early Royal Society. The mutual influence was driven both by overlapping traditions of learning and by a common imperative to understand, restore, and maintain human well-being. This influence ranged over shared theoretical concerns (for example, the nature of matter, the faculties of the soul, and the classification and operations of plants and minerals) as well as methodological debates on the appropriate way to gain, certify, and communicated knowledge of natural things. As Harold Cook has emphasized, medicine was often called 'physick,' and this term signals that the medical context was an important site where early moderns negotiated an understanding of *physis* (nature).[2] Medicine in the early modern period encompassed a much wider sphere of ideas and activities then it does today, and the relationship between natural philosophy and medicine was complex and substantial.

Attending to and articulating this relationship invites the reexamination of canonical actors of the Scientific Revolution, from Harvey, Boyle, and Locke to Descartes and Leibniz. But it also reveals connections with a wide variety of less canonical but historically important natural philosophers and physicians, such as Hieronymus Fabricius ab Aquapendente, Daniel Sennert, Pierre Gassendi, Louis de la Forge, and Petrus Severinus—all of whom shall be discussed in this volume. Our goal here is to expand the scope of who counts as a philosopher or physician important enough to study, as well as our conception of what debates and issues are important for a deeper understanding of early modern thought. We want to recapture something of the heterogeneity and interpenetration of early modern philosophy, medicine, and science—a complexity that can be obscured by our own disciplinary boundaries (e.g. between history of medicine and history of philosophy). A great deal of work needs to be done in unpacking the concepts and terminology of early modern actors in such a way as to ensure that our conceptual schemata do not distort them. This need is seen clearly in terms such as 'experiment' and 'mechanism,' and the medical perspective we aim to explore is central for their clarification and

[2] Cook 1990.

contextualization. In the early modern period, experiments on living things were widespread and complex, and likely influenced linguistic tactics in other disciplines—yet these developments have not been studied in comprehensive detail. The term 'mechanism,' meanwhile, was often contrasted with the spontaneous, responsive phenomena of life. Even for those wishing to extend mechanistic explanations into the living world, older accounts of what properly characterized living things—the presence and activity of a soul or the operation of faculties—remained a contrast class for their own replacement programs and vocabularies.

We hope to emphasize in this volume the myriad ways in which the intellectual training and disciplinary structure of medicine were congenial to the development of early modern science. For instance, medicine included both *theoria* and *practica*—training in medicine was based around both deep study of philosophical and medical texts (especially Galen and Aristotle) and practical anatomical and therapeutic experience and instruction which aimed at curing human bodies.[3] Medicine also surveyed a wide scope of divisions, often five in number.[4] The 1620 textbook *Institutiones* of the Aristotelian chymist Daniel Sennert of Wittenberg can give us one snapshot of the scope of medicine from near the middle of the chronology surveyed in this volume. First, he attenuates the distinction between *theoria* and *practica* by asserting that medicine is a unitary art, with even *theoria* aimed at the common end of health. This is consonant with his studied rejection of medicine as proper *scientia*, since the physician *qua* physician does not reach to first principles.[5] Of course, Sennert and other physicians were also philosophers, and used their findings from chymistry, anatomy, and natural history to build and critique philosophical claims.[6] Sennert, following Alexandrian tradition, then divides medicine into *physiology*, which treats the constitution, actions, and uses of the parts; *pathology*, which deals with the nature, differentia, and causes of diseases and symptoms; *semiotics*, which handles the signs by which the hidden causes of disease can be known; *hygiene*, which teaches rules for conserving health and, as much as possible, forewarns of disease; and *therapeutics*, which shows how the physician can restore lost health and eliminate diseases, their causes, and symptoms.[7] That Sennert was a committed and careful Aristotelian who combined humoral theory with sophisticated experiments pointing to ensouled chymical corpuscles illustrates the dynamism and diversity of the period.

[3] The relative status of medical *theoria* and *practica* courses changed over time. Taddeo Alderotti in the thirteenth century sought to elevate the status of medicine by associating its *theoria* with contemplative natural philosophy. Yet many physicians across the sixteenth century concentrated on the importance of medical *practica*, even to limiting *theoria* to mere introductory instruction. Siraisi 2001, 215; Maclean 2002, 68–9.

[4] Though there was no strict orthodox division. Maclean 2002, 69.

[5] Here he follows the strong subalternation of medicine to natural philosophy proposed by Avicenna, *Canon* 1.1.1.2. Siraisi 2001, 86.

[6] Newman 2006; French 1994; Findlen 1994.

[7] Sennert 1620, 3–7.

The fact that physicians were trained to bring their manipulations of the natural world into connection with a body of learned theory is a promising starting point for understanding how scientific experimentation and theorizing developed and changed over the early modern period.[8] In this regard, tantalizing leads remain to be explored and rendered with more exact content and more satisfying context. The works of Roger French and Robert Frank, for example, have stressed the importance of Harvey's approach to the circulation and the ensuing controversies and research traditions to the emergence of experimental practices and experimental philosophy.[9]

Recent scholarship has opened up new views of the multivalent nature of early modern medicine. We know much more about the widespread sharing of concepts and practices in natural history, medical case histories, and humanist erudition.[10] We have a much better sense of the permeability, overlaps, and dynamism of the communities of physicians and their places in early modern learned culture. Nonetheless, we still lack a complete picture of the relations between philosophy and medicine in the early modern period. This lacuna is problematic for reasons important both to historical actors and historians themselves; given that so many early moderns justified their systems on the basis of their ability to lead to medical knowledge, the lack of sophisticated and detailed historiography on the importance of medicine in early modern science and philosophy likely reflects more the biases and interests of modern historians than the people and events under discussion. Descartes' intense and prolonged interest in medicine and the significance of medical thought for his general philosophy is now coming into focus.[11] Other figures, from Locke to Leibniz, have also begun to be reevaluated from this biological and medical perspective.[12] This volume aims to benefit from and continue this effort. In addition, it seeks to place recent historiographical breakthroughs in richer and broader contexts of early modern philosophy and medicine. The renaissance of the study of the history of alchemy or 'chymistry' of the past two decades[13] should be brought into a mutually enlightening conversation with the history of medicine. Chymical endeavors from pharmaceutical remedies to the search for universal solvents and the elixir developed within medical traditions and vied for patients in the medical marketplace. The recent proliferation of studies concerning non-traditional actors and objects in this period—notably, *medical* actors and objects—demonstrates that there is still much to understand.

This volume attends to these historiographical concerns especially, but not exclusively, by providing detailed studies of key figures, keeping the intellectual content and context of their work in focus. While interest in the history of medicine from historians of philosophy may be increasing, leading historians of science have

[8] See Wolfe and Gal 2010.

[9] French 1994; Frank 1980.

[10] See, for instance, Ogilvie 2006; Pomata and Siraisi 2005.

[11] See, for instance, Aucante 2006; Manning 2008. For earlier treatments see Lindeboom 1979; Bitbol-Hespériès 1990.

[12] For example, in Anstey 2011 and Smith 2011.

[13] As represented in, e.g., Newman and Principe 2002.

begun to downplay the role of philosophy in early modernity. There has been a distinct move away from discussion of the content of philosophical and scientific theories as explanatory of—and in some cases, even *important to the understanding of*—scientific change. In its place, there is an increasing tendency towards explanations involving only economic and social factors. For instance, the prominent historian of science and medicine Harold Cook has recently been quite explicit about looking *away* from early modern philosophy for the motivating values and even basic ideas of the Scientific Revolution, such as the concept of 'objectivity.'[14] The work presented in this volume keeps intellectual content and context at the center. This is not, in any way, to deny that social and economic factors are important facets of our understanding of the Scientific Revolution, but simply to point out that we have much still to learn about this period through careful attention to intellectual content and context. We hope that this volume can begin to demonstrate that philosophy and medicine were in deep *theoretical* and *methodological* dialogue, as well as establish the fundamental importance of this dialogue for understanding the history of early modern philosophy, medicine, and science.

Chronological and thematic considerations have shaped the organization of this volume into four parts. The three papers in Part I (*Philosophy, Medicine and Method in the Renaissance*) each address ways in which disciplinary boundaries between medicine and philosophy were negotiated and renegotiated, and how such negotiations affected the goals, methods, sources, resources, and of course, the content, of the resulting work. Taken together, these chapters suggest that we must pay close attention to this process of negotiation between philosopher and physician in order to understand the changing methodological, epistemological, and social statuses of both philosophers and physicians.

In his contribution, Craig Martin argues that Renaissance physicians, marked by humanist attitudes and approaches to knowledge and the recovery, evaluation, and assimilation of ancient texts, attempted to assimilate Hippocratic and Galenic works with the Aristotelian *Problemata*. He attends especially to the ways Lodovico Settala, among others, attempted to integrate the Aristotelian *Problemata* and the Hippocratic *Airs, Water, Places*. This story vividly illustrates interaction between natural philosophy and medicine arising out of the negotiation of overlapping traditions of learning. Thus philosophers could draw on Hippocrates for understanding the soul, especially in response to Galen's apparent agnosticism about its immortality; physicians, changing their scholarly hats, could find in Aristotle more resources for discussing the nature of the heart, plagues, semen, and bodily spirits.

Cynthia Klestinec considers a rather different kind of dynamic at work among medical practitioners, concentrating on changing attitudes to the relationship between anatomy and surgery among learned surgeons in Renaissance Italy. Focusing on the works of Giovanni Andrea della Croce and Leonardo Fioravanti, Klestinec suggests that debates between learned surgeons and empirics problematized

[14] See Cook 2007, which won the Pfizer Award from the History of Science Society in 2009. Cook does discuss philosophy and philosophers, but his focus is clearly on other aspects of early modernity.

"the authority of anatomy and the legitimacy it offered to learned surgery." She illustrates how, by the second half of the sixteenth century, anatomy, which in learned settings was connected closely to natural philosophy, had become a conflicted resource in the medical marketplace. There, anatomical expertise was in danger of being connected not to the reduction of clinical errors, but to a practitioner's violent approach to the living body of the patient. Klestinec shows how, in this context, Croce is concerned to distinguish learned surgery from anatomy and to assimilate the practice of the learned surgeon to the visual arts.

In the final chapter of this section, Tawrin Baker shifts our focus from anatomy and surgery to anatomy and natural philosophy. He provides a detailed, careful account of their close interaction in the works on vision of logician and natural philosopher Jacopo Zabarella and physician and anatomist Hieronymus Fabricius ab Aquapendente. Both thinkers integrate philosophical accounts of light, color, and vision with anatomical accounts of the structure, action, and usefulness of the parts of the eye. Baker's meticulous study of their works demonstrates important interaction between the two thinkers, between broadly medical and natural philosophical approaches, and between anatomical and experimental research and ancient authority. Finally, Baker emphasizes the influence of these efforts at integrating anatomical and philosophical accounts of vision on Kepler's work. Baker's study nicely captures mutual influence between late Renaissance medicine and natural philosophy at personal, theoretical and methodological levels.

The papers in Part II (*Life and Mechanism*) focus firmly on the seventeenth century and on the place of mechanism in that period's investigation of living things. These chapters explore a range of conceptual, explanatory, and methodological issues surrounding the application of mechanical or mechanistic perspectives to understand the complex causal and ontological systems of living things. Here the interaction between anatomy (particularly post-Harveian anatomy) and Cartesian philosophy looms large.[15] However, as these chapters make clear, seventeenth-century mechanism was a multifaceted phenomenon and cannot be identified with the Cartesian program.

This important point is reflected in the first chapter of the section. Domenico Bertoloni Meli provides a wide-ranging and stimulating exploration of mechanistic anatomy broadly conceived—of efforts to provide machine-like explanations of bodily operations. Bertoloni Meli begins the important process of *asking questions* about the interaction between mechanisms and mechanical constructions and the study of life in early modernity, ultimately forcing us to think about what the mechanization of living bodies really meant. What did 'mechanical' mean, and when? The relevant conceptual and manual resources for thinking and working with bodies changed. There were many new machines in the seventeenth century, and new uses of machine-behavior and analogies to understanding living structures and actions. Thus Robert Hooke used a new microscope to observe drop-like structures hanging under the wings of some insects. He conjectured they might be used in these minia-

[15] Matter theory and mechanism, while making a supporting appearance in these chapters, takes a more central role in Part IV of the volume.

ture flying entities to regulate flying motions, just as pendulums act in human-made machinery. Bertoloni Meli here explores these complex processes and ends by investigating the role of dead bodies and body parts as tools of investigation and experimentation, a sort of boundary object between the world of living organism and that of artificial machines. Thus anatomists could work on the blood and vessels of the body—compared to sluice gates, mills, and pumps from Harvey to arch-mechanists—as on other objects of study. Johannes Walaeus produced support for Harvey's circulation by pressing blood from an artery into an emptied vein that ought to have been continuous with the artery by the invisible connecting vessels. Like pendulums and sluice gates, dead bodies have no life in them. Yet their structures are much the same as living bodies.

Peter Distelzweig picks up on the role of machine analogies in William Harvey, in particular, and places them within a broader analysis of the nature and role of mechanism and mechanics in Harvey's thought. He distinguishes six meanings of 'mechanical' relevant to understanding Harvey's work and argues that Harvey has a consistent, stable understanding of the place of mechanism within his broadly Galeno-Aristotelian anatomical project—a project much influenced by the works of Hieronymus Fabricius ab Aquapendente. To this end, Distelzweig examines Harvey's published work, as well as methodological and programmatic remarks found in his lecture notes and his unpublished working notes on the organs of local motion.

Karen Detlefsen's paper brings us to Descartes' mechanistic project. Detlefsen is concerned with understanding whether and how Descartes could articulate a coherent theoretical conception of living things to delineate them as an object of study, given his austere mechanistic ontology and rejection of final causal explanations in natural philosophy (because of our ignorance of God's ends). She develops an account of Descartes' theoretical conception of life, and, in doing so, demonstrates that Descartes does not eliminate the class of living bodies from his natural philosophy. He is a reductionist with respect to explanation but not an eliminativist with respect to life. However, Detlefsen argues further that the best theoretical account of living beings available on Cartesian terms needed to make reference to God's ends, and she explores the possibility that, while he in fact rejects such a move, there is room within Descartes' system for employing such teleological explanations as merely hypothetical.

Evan Ragland explores the ways in which philosophy, anatomy, and chymistry were inextricably bound together in lively, late seventeenth-century Dutch debates over the action of the heart. The chapter explores the shifting nature and use of mechanical explanation in the realm of living things in the wake of Harvey's anatomical demonstration of the circulation of the blood and Descartes' provocative but error-prone anatomical speculations. Ragland shows how Dutch physicians adopted varied positions on the sources and status of anatomical knowledge, focusing on Franciscus Sylvius' central place in this history. Sylvius and his colleagues were generally comfortable with mechanical explanations, which they had already met in Galen's depictions of the mechanical anatomy of Erasistratus, but only as far as they squared with sensory experience. Even prominent mechanistic anatomists such as

Sylvius' student Nicolaus Steno would accept ideals and methods of mechanistic explanation, while rejecting particular proposed mechanisms for their sensory and experimental inadequacy. Our own sense of early moderns' errors may be of little use to historical understanding, but tracing *their* perceptions of error, especially in the autoptic anatomical tradition, is essential.

The discussion of post-Cartesian, mechanistic philosophy and medicine continues in the chapter by Patricia Easton and Melissa Gholamnejad examining the work of the French physician Louis de la Forge. They trace how La Forge, in his *Remarks* in the French edition of Descartes physiological works, advanced Descartes' account of the generation and the working of the animal spirits in the human body-machine. They examine similar themes in La Forge's *Treatise on the Human Mind*, in which he explained the functions of the soul while defending dualism and the mechanism of the body machine. Their discussion of his reception, development and revision of Descartes's physiology shows that Descartes' mechanical model of the body provided La Forge a scientific framework for reasoning about and testing the operations of the body. It also corrects for a tendency in the history of philosophy to attend only to La Forge's work on causation.

The papers in Part III (*Matter and Life, Corpuscles and Chymistry*[16]) explore sixteenth- and seventeenth-century thinkers writing on these subjects. The authors here demonstrate how vital it is for our histories of matter theory, corpuscularianism, and philosophical medicine to include chymical traditions. The rise of corpuscular thinking, so characteristic of seventeenth-century natural philosophy, is inexplicable without looking to traditions and figures such as those analyzed here. These papers also enrich the discussion of mechanism begun in the previous section by approaching it from a different perspective—one centered on questions of matter theory and generation and developed in relation to traditions of learning distinct from the anatomical context discussed there. Once more our attention is turned to varied and changing definitions of 'mechanical'—from Severinus' *semina* generating material beings according to divine plans to Boyle's material explanations of generation with plastic powers—and to the relevance of the medical context for understanding these variations. All the authors point out the importance of early modern chymistry to the rise of new matter theories and key problems such as generation and fermentation.

One major source for corpuscular thinking appears in Jole Shackelford's discussion of Petrus Severinus' *semina*, semi-material locations for development with ineliminable vital properties of development. Shackelford's chapter provides a systematic treatment of Severinus' doctrine of transplantation. Liminal between material and immaterial entities, semina connect impressions or ideal influences and material generations. At a general level, they draw on Neoplatonic ideas of the generation of material being and Aristotelian natural teleology. Distinct from transmutation or transformation, transplantation depended on the transference of semi-material seeds from place to place. In contrast to the later mechanical philosophies, semina had intrinsically temporal properties. Transplantation explained timed

[16] On the use of the term 'chymistry,' see Newman and Principe 1998.

development, development informed by the original seeds but altered by external influences from stars and elements. Severinus' vital semina—always as nondimensional locations which then put on material bodies—provided a corpuscular alternative to Lucretian atomism.

Complementing Shackelford's discussion of Severinus' complex doctrines of semina and transplantation, Hiro Hirai's chapter analyzes the role of seeds or living corpuscles in the accounts of generation and animal life in the work of Daniel Sennert, Pierre Gassendi, and Athanasius Kircher. For the physician and philosopher Sennert, living beings reproduce through an internal principle hidden in matter, a "seminal principle" or "soul." The soul informs the body, vivifies the body, but can also exist in a third mode, that of a latent soul residing in a body as if in a container. Hirai identifies some of the seeds of Sennert's own views in a little-known treatise on spontaneous generation, written by the Paduan professor of philosophy Fortunio Liceti. Liceti provided Sennert with the ideas that a soul can reside in a single atom and that the souls of many atoms can gather together under a ruling form or soul. Many of Boyle's deep debts to Sennert are fairly well-known from William Newman's recent work,[17] but Hirai adds another dimension, connecting Liceti, Sennert, and Boyle's interest in seminal principles. Gassendi, too, argued for the propagation of souls, though animal souls for him were closer to those of Democritus. These corporeal "little flames" composed of tiny, mobile corpuscles were endowed by God with *scientia* to form regular structures and species. As Hirai shows, Gassendi borrowed much of this notion of working seeds from Severinus, but casts it into a more materialist, atomist model. Hirai turns finally to Athanasius Kircher, focusing on his account of semina in spontaneous generation. Loosely following Thomas Aquinas, Kircher held that the substantial forms of living beings were drawn from the potentiality of the matter. But, as Hirai nicely traces, Kircher develops a view of seminal corpuscles and material spirit to account for spontaneous generation that draws on a diverse range of corpuscularian and chymical resources. And here, too, the influence of Liceti's account of spontaneous generation can be seen.

Antonio Clericuzio's study of fermentation, especially the context and content of Robert Boyle's account of fermentation, draws on and develops a number of themes in Shackelford's and Hirai's chapters. Attending to Boyle's medical interests and focusing on fermentation, Clericuzio can trace in Boyle's explanation of vital phenomena the interplay between chymistry, corpuscularianism, and experiment. Just as yeast worked real changes in bread and beer, so active ferments wrought alchemical transmutation, according to influential writers from the Middle Ages on. Paracelsus, especially, embraced ferments as agents of change throughout the body and in metallic transmutation. His heirs, especially Van Helmont, elaborated and spread the notion of active, spiritual ferments. Like his colleagues Thomas Willis and Ralph Bathurst, Boyle initially (if cautiously) allowed for the action of ferments for causing changes in bodies. Later, following chymical experiments into the nature of fermentation and the blood, Boyle, Willis, and others dropped talk of ferments. For Willis, John Mayow's nitre theory was more attractive, though Boyle

[17] Newman 2006.

remained hesitant to commit himself to a new chymical doctrine. Throughout, though, Boyle and his colleagues remained committed to material explanations for fermentation and processes supposedly caused by ferments.

Few problems in the interrelation of philosophy and medicine were as vexing as generation.[18] The last chapter in this section, by Ashley Inglehart, analyzes the work on generation of Robert Boyle and its reception by Marcello Malpighi. Boyle's appeal to 'plastic powers' to organize the process of generation has smacked of the vestiges of Galenism or Aristotelian thinking to some scholars. However, Inglehart argues that, while he sometimes used similar terminology, Boyle never advocated the existence of something like Galenic faculties. Boyle's explanations of animal generation, in contrast to Harvey's search for the organizing activity of the soul, remained mechanical since he adhered to material explanations of *how* generation unfolded, rather than *why*. For Boyle and Malpighi, even granting the existence of directing souls, such souls would still be bound to work mechanically, by arranging matter in motion. This matter and its motions were the proper subject of inquiry, not the activity of the soul. Specifically, Boyle applied his researches into the mechanical explanation of the formation of stones and gems to the phenomena of animal generation. Malpighi closely followed Boyle's language and explanations and added experiments and mechanisms of his own. In the end, Boyle appropriated and re-shaped traditions of chymical investigation in terms of ensouled or *scientia-bearing* corpuscles to push material explanations as far as possible.

The final section of the volume (*Medicalizing Philosophy?*) takes a broader view on the relations between natural philosophy and medicine. This section contains two wide-ranging papers that explore different ways in which the interactions between medicine and philosophy affected the goals and larger social image of physician and philosopher. The first finds Justin E. H. Smith forcing us to rethink what being a philosopher in early modernity meant, arguing that we must take seriously the medical or therapeutic goal of philosophy. Smith explores how Gottfried Leibniz's medical, dietetical, and pharmacological concerns and endeavors were intimately linked with his philosophical ideas concerning the metaphysics of corporeal substance. Smith argues then that the proper maintenance of the human corporeal substance constitutes a sort of corporeal flip-side of morality and was thus a central concern to a philosopher. According to Smith, the primary concern of the physician, health, is also of deep metaphysical importance to the natural philosopher and, for Leibniz, could offer the possibility of harmonizing rationalism and empiricism.

The final chapter of the book has Charles T. Wolfe considering the social and epistemological implications of medicine and the resulting cultural conception of the physician in early modern Europe. Wolfe focuses on the image of the physician as an atheist and explores the origin of this image in a certain sort of medical philosophy. Wolfe calls this *radical medicine* – a medical precursor of the Radical Enlightenment, symbolized by the slogan, *tres medici, duo athei*: medicine as a basis for atheism. This theme runs through various medical and medico-theological

[18] Smith 2006. See also Roger 1963.

works, such as Thomas Browne's 1643 *De religio medici*, which begins with Browne regretting rumors of doctors being atheists as the "general scandal of my Profession." But these are examples of the *fear* of a radical medicine – a medicine that denies the existence of an immortal soul, or even defends materialism and atheism. Are there positive statements of this doctrine? Indeed, as Wolfe demonstrates, attacks on it were much more common than statements identifying with it.

The chapters in this volume examine figures from the sixteenth century to the mid-eighteenth, and across this breadth there are a number of trends and themes we want to emphasize. First, there is a strongly suggestive trend across the sixteenth and seventeenth centuries of greater interrelation of medical and philosophical concerns, perhaps even a cross-disciplinary unification of methods and modes of explanation. This may be part of the larger expansion and reorganization of natural philosophy across these centuries, as evidenced by classifications from the end of the seventeenth century that include medicine, natural history, mathematical disciplines, and mechanical arts in the category of 'natural philosophy.'[19]

We can observe illuminating moments in this gradual, though not universal, trend of integration. Our second chapter shows how learned physicians across the sixteenth century such as Girolamo Cardano understood the Hippocratic text *Airs, Waters, Places* to share topics and even methods with natural philosophy, especially in reasoning from effects to causes. The fourth chapter shows the philosopher Zabarella and the physician Fabricius experimenting around 1600—almost certainly, together—to understand the *usus* of the vitreous humor of the eye.

In Harvey's work, and the ensuing controversy with Descartes over the action of the heart, we find anatomical observations and arguments used as key components in comprehensive philosophical systems and debates. For Descartes, accounting for living bodies was difficult, given his own austere ontology and his rejection of claims to knowing God's ends. Yet it also presented him with a problem he could have domesticated by accepting bodies as having simple natures with ends as a working hypothesis. La Forge, discussed in Chap. 9, following Descartes, attempted to extend and refine the application of Descartes's simple but comprehensive principles, keeping his accounts of animal spirits, the pineal gland, generation, and memory squarely within Cartesian philosophy. We should note counterexamples, though, and the chapters by Klestinec and Ragland remind us that the integration of medicine and natural philosophy was neither complete nor uncontested.

Second, as is well-known, mechanism in all its meanings engaged medical topics in productive and complicated ways.[20] Fully half of our chapters grapple with mechanism and living things. Taken together, they showcase some of the diversity of meanings embraced by the term 'mechanical.' They also outline some key

[19] Daston and Park 2006, 3. Gregor Reisch's important 1503 *Margarita philosophica*, in contrast, placed the operative part of medicine under the headings of practical and factive philosophy, and the *theoria* of medicine under divisions of theoretical, real, and physical or natural philosophy. Cf. Bylebyl 1990; Mikkeli 1999.

[20] For recent work, see Bertoloni Meli 2011; Smith 2006 and 2011; Wolfe and Gal 2010; Manning 2008; Cook 1990.

problems or areas of investigation. The chapters by Bertoloni Meli, Distelzweig, Shackelford, and Inglehart explicitly treat different meanings of the term 'mechanical.' Distelzweig and Bertoloni Meli, in particular, survey a range of meanings from the machine-like composition and interaction of parts to the rejection of souls and Galenic faculties as explanatory principles.

These chapters dealing with mechanical approaches to medical themes and phenomena largely agree with the view that 'the mechanical philosophy' dealt in restricted ontologies and means of explanation. But in most of the chapters, mechanical philosophers—perhaps even Descartes, as Detlefsen argues in Chap. 7—needed to adopt hypotheses that reached beyond utterly inert extended matter to account for the details of disease and generation, the seemingly obvious view that living bodies have natures, and the regularity of living forms and kinds. But if Boyle, Malpighi, and other illustrious proponents of 'the mechanical philosophy' adopted such tools as active chymical powers, it seems that much mechanical philosophizing in the seventeenth century slipped more neatly into the outlines of an eclectic materialism.

Third, in terms of chymistry and life, integration proceeded in at least two directions: philosophical explanations of living things informed chymical theory while chymical practice and ontology informed philosophical doctrines. Hirai's chapter shows Liceti's novel account of spontaneous generation bearing fruit in Sennert's chymistry of ensouled corpuscles. He also shows chymical theory and practice shaping metaphysical doctrines of souls. The Paracelsian Severinus, struck by the temporal emergence and development of diseases, plants, and animals, made chronological development according to divinely-implanted knowledge or *scientia* a central feature of his doctrine of *semina*. Drawing on Severinus and the philosopher Fortunio Liceti, Sennert, Gassendi, and Kircher combined observations of the organization of living entities and chymistry to frame new philosophical accounts of souls and matter. Phenomena of fermentation—from brewing to blood—became resources for the articulation of an array of chymical accounts of digestion, disease, and metallic transmutation. Some thinkers, such as Van Helmont, opposed materialist principles and cast ferments as spiritual agents shaping corporeal matter. Others, such as Boyle and colleagues, generally sketched material accounts of fermentation.

Inevitably, it seems, we return to mechanism. The chapters here should help to clarify our understanding of its meanings for the historical actors. Looking to philosophical categories, it seems that Boyle's nescience on the *nature* of the seminal principles or plastic powers should leave his ontology open to something like the souls in Sennert's chymical corpuscles. After all, Sennert's explanations of qualitative chymical change in terms of the association and dissociation of corpuscles deeply informed Boyle's chymical program, and Boyle's explanations of generation seem to reach for some sort of organizing principle. Yet, as Inglehart stresses, Boyle strove to shift the mode of explanation from one of understanding causes in terms of natures and ends to one of explaining natural events in terms of *how* material constituents interact. Whatever the organizing cause was, the materials of generating gemstones and chicks moved about in ways the mechanical philosopher could investigate. In this respect, Boyle appears closer to a methodological materialism

than Gassendi, who drew on Severinus's doctrine of *scientia*-bearing corpuscles to describe his own seminal *moleculae,* which acted according to God's plans to dispose the corpuscular elements and principles in the distinctive order and regular succession of living species. For Gassendi, the souls and semina of plants and animals remained corporeal, yet he explicitly adopted impressed divine *scientia* which exceeded the limits of strictly inert mechanism.

Most of the time, our chapters expand and refine our understanding of early modern accounts of the constitution, action, and ends of living bodies. In terms of Sennert's division of medicine into physiology, pathology, semiotics, hygiene, and therapeutics, we can note that physiology and philosophy receive the lion's share of our attention. However, hygiene and therapeutics are not absent. They make leading appearances in Smith's stimulating chapter. For Leibniz, in particular, learning *how* to care for and cure the body was not only the corporeal counterpart of ethics, but furnished notions of *appetitus* important for his later thought about perceptive monads. The question of *why* humans, uniquely among creatures, had to learn how to preserve and restore health was also a pressing philosophical problem, with consequences for notions of human-animal distinctions, ethics, and epistemology. Clericuzio's contribution points out that Boyle hoped to concoct beneficial foods and medicines through the study of ferments inside and outside the body. And mechanistic physicians could reap new rewards in pathology and therapeutics, as Bertoloni Meli points out. The influential seventeenth-century anatomist and physician Marcello Malpighi defended the medical utility of mechanical approaches to the body and health by citing the origins of gout in excess acidity. Mixing "mechanically" spirit of vitriol or another strong acid with other fluids produces similar effects *in vitro*.

Objects, especially new ones, were important things to think about and think with in early modern philosophy and medicine. More than others, Bertoloni Meli's chapter illuminates the productive interworking of new machines and experiments with philosophical questions about the soul and medical goals of healing. He stresses the swiftly-changing flow of resources investigators had on hand with which to think about and work with bodies. Microscopes, pendulum devices, and barometers were new to the seventeenth century, as were new ways of thinking about simple machines, such as Hooke's law of the spring. In Baker's chapter, philosophers and physicians think in strikingly similar ways about eyes, lenses, diagrams, and *camerae obscurae*. And Inglehart demonstrates similar mechanisms of ontology and explanation Boyle and Malpighi applied to gemstones and embryos.

Finally, in terms of institutions, we find the sort of variations in human interaction one might expect. Institutional or geographic proximity could foster productive collaboration, as Baker's study shows in the teamwork of Zabarella and Fabricius at Padua, and as we find in Ragland's examples of teaching experimentation at Leiden. But institutional sharing can also become crowded and even antagonistic. Thus Klestinec points to the association of natural philosophy and anatomy in the universities, an integration that contrasted sharply with learned surgeons' distancing of surgery from university anatomy. And in Leiden, Ragland argues, anatomist-physicians repeatedly objected to the perceived anatomical errors of Cartesian

philosophers by partitioning disciplinary identities and trumpeting their own reliance on their senses. Even in a period in which philosophers and physicians enlarged the borders of natural philosophy, different social groups could survey the intellectual and institutional landscape along different lines and stake claim to their own territories.

Our historiographic stances are most squarely historicist; each author aims primarily to articulate concepts and explicate texts with fidelity to the arguments and contexts of the historical actors. Thus Smith urges us to reconsider the aims of philosophers in terms of body-soul *eudaimonia* and Inglehart explains how seminal principles could remain properly mechanical. Sometimes, though, translation and understanding calls for present-day terms and speculations. For Shackelford, calling the divine *scientia* in Severinus' semina 'programming' helps us to understand the regulated, temporal developments so important to his thought. And Detlefsen offers scholars a novel suggestion not only for what Descartes *could* have argued in order to secure the seemingly robust natures of living bodies in health and disease, but also what he *should* have argued, given his resources and commitments. Attempting to think along with our subjects, we hope, can help us to craft historical interpretations of their texts and thought that they might have recognized and perhaps even found akin to their own.

This volume provides strong evidence of the indispensability of medical concerns and contexts to the history of early modern philosophy. It also provides ample evidence that philosophy was integral to early modern learned medicine.

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Part I
Philosophy, Medicine and Method in the Renaissance

Chapter 2
Lodovico Settala's Aristotelian *Problemata* Commentary and Late-Renaissance Hippocratic Medicine

Craig Martin

Abstract Renaissance physicians, influenced by humanism and spurred by their increased knowledge of Hippocratic and Galenic writings, attempted to assimilate these medical works with Aristotelian thought. The similarities between the Aristotelian *Problemata* and the Hippocratic *Airs, Waters, Places* allowed Girolamo Cardano and Lodovico Settala, among others, to blur the distinctions between natural philosophical and medical authorities. Philological and historical considerations of these texts as well as judgments about authenticity were colored by the belief that these works were useful for humoral physiology and offered insights into the unity of ancient and modern knowledge.

Keywords Aristotelian *Problemata* • Hippocratic *Airs, Waters, Places* • Renaissance humanism • Lodovico Settala • Girolamo Cardano

2.1 Introduction

Late-Renaissance Italian intellectual debate often involved attempts to change or defend the status of particular disciplines. The hierarchy of subjects was frequently a matter for dispute, and leading intellectual figures attempted to raise the status of their particular fields. Just as this was true for mixed mathematics, it was also true for medicine. A number of physicians attempted to promote the status of medicine by defining it as part of natural philosophy, even though some philosophers and humanists insisted that medicine was an art not a *scientia*.[1] To the contrary, well known professors of philosophy at Bologna and Padua, including Alessandro Achillini, Pietro Pomponazzi, Lodovico Boccadiferro, Giacomo Zabarella, and Cesare Cremonini, maintained that medicine was subaltern and thus inferior to

[1] For the view that medicine was an art see Averroes 1564, 4r; Achillini 1548, 148v; Salutati 1947, 2224; Mikkeli 1992.

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philosophy.[2] During the sixteenth century, philosophy and medicine became separated to a greater degree institutionally at Padua and Bologna, where professors in the faculty of arts and medicine were increasingly specialized in either philosophy or medicine.[3] This institutional division of philosophy and medicine likely engendered a competitive atmosphere in which professors sought to defend or raise the status of their fields.

The attempt to raise medicine's status is well known for the field of anatomy, where its practitioners, drawing from ancient sources, increasingly presented themselves as creating a proper philosophical *scientia*, not merely a craft, during the second half of the sixteenth century. For example, Andreas Vesalius advocated anatomy as natural philosophy, perhaps inspired by Galen's methodological treatise, *De anatomicis administrandis*, which staked a similar claim.[4] Later in the century, Girolamo Fabrici used public anatomies in Padua to investigate topics of natural philosophy.[5]

Links between medicine and natural philosophy extended beyond anatomy, as physicians and philosophers alike investigated dietetics and temperaments. Despite disparaging his physician predecessors, Pomponazzi examined in detail the subject of digestion in his commentary on *Meteorology* IV, blurring the lines between philosophical and medical knowledge.[6] Francisco Vallés wrote a comprehensive tome that aimed to reconcile disagreements between philosophers and physicians on numerous physiological topics in his *Controversiae medicarum et philosopharum*.[7] While Vallés's work undermined distinctions between medical and philosophical knowledge, Girolamo Cardano went so far as to claim that medical knowledge was more certain than natural philosophy, which he maintained derives causes from effects, while medicine often infers effects from causes.[8]

As medical treatises and philosophical treatises, such as Vallés's and Cardano's, made a greater attempt to improve natural philosophy through medical knowledge, Aristotle, still extremely dominant in natural philosophy, grew in importance for the field of medicine during the sixteenth century. A number of Aristotle's writings, such as his zoological works and *Meteorology* IV, were potentially relevant to medicine. The sixteenth century also witnessed the rise in the number and influence of commentaries on the Aristotelian *Problemata.* Interpretations of the *Problemata* became a touchstone for those who wanted to blur the boundaries between Aristotelian philosophy and erudite medicine. For example, Cardano argued that it was possible to use medical principles to investigate issues of natural philosophy

[2] Martin 2002, 10–14; Mikkeli 1992, 159–177; Schmitt 1985; Agrimi and Crisciani 1988, 21–47; Bylebyl 1990.

[3] Lines 2001; Bylebyl 1979, 338.

[4] Carlino 1999, 125–128.

[5] Klestinec 2007.

[6] Pomponazzi 1563, 27r-30r.

[7] Vallés 1591.

[8] Cardano 1663, 8:585. "Et ob hoc intelligimus, Medicinam esse certiorem naturali philosophia, cum naturalis philosophia semper procedat ab effectibus ad causas, Medicina vero persaepe a causis supra effectus."

that were not directed toward medical purposes, and cited the third book of the *Problemata* that concerns drunkenness as an example of such an investigation.[9] Gabriele Falloppio (1523–1562), a professor of surgery at Padua best known for his anatomical research and the eponymous tubes, integrated material about teeth from the *Problemata* in a commentary on the Galenic *De ossibus*.[10]

The emergence or reemergence of the *Problemata* as a source for medical and philosophical commentary in the late sixteenth century stemmed from the values of medical humanism that prized ancient sources and philological investigations. Learned physicians integrated their interest in the *Problemata* with reconsiderations of Hippocratic writings and a broader knowledge of the Galenic corpus. The best example of this integration is found in Lodovico Settala's 1200-page commentary on the *Problemata* that was printed in the first decades of the seventeenth century.[11] Philological and historical investigations form a significant part of Settala's considerations of the *Problemata*. They were part of his goal of applying Aristotle's writing to issues of medicine and philosophy, including importantly the relation between temperament and the human soul. Settala described his work as flowing "across the banks into the open field of philosophy and philology."[12]

Rising interest in the *Problemata* occurred simultaneously with the development of an Aristotelian medicine that was at times at odds with long-standing Galenic views that were often transmitted in Avicenna's *Canon*, still the most important book for university instruction of medicine.[13] The medical reading of Aristotle also coincided with the growth of Hippocratism and humanist medicine in general, which grew slowly from the new editions and translations first printed by the Aldine press in the 1520s.[14] Ancient sources grew in value, while medieval sources were discounted. The *Problemata* was particularly valuable because of its links to the Hippocratic text *Airs, Waters, Places* (*AWP*), a work that, despite being available in Latin from the fifth or sixth centuries, had no commentary tradition until the 1570s.[15] *AWP*, which examines the effects of climate and diet on temperament and health, became one of the more influential Hippocratic texts during the seventeenth century.[16] Correspondences between portions of the *Problemata* and *AWP* made the two texts useful for forging considerations of temperaments and the effects of climate on health into knowledge that could be seen as appropriately authoritative for both philosophy and medicine. Moreover, the correspondences between the texts suggested that the blurred boundaries between philosophy and medicine had its roots in the writings of the most ancient authoritative authors of those respective fields, Aristotle and Hippocrates.

[9] Siraisi 1997, 52–57.

[10] Falloppio 1570, 40v.

[11] Settala 1632.

[12] Settala 1632, 1:4r.

[13] Siraisi 1987.

[14] Nutton 1989.

[15] Kibre 1975, 123–126.

[16] Wear 2008.