THE PHILOSOPHY AND SCIENCE OF ROGER BACON

STUDIES IN HONOUR OF JEREMIAH HACKETT

Edited by
Nicola Polloni and Yael Kedar

The Philosophy and Science of Roger Bacon

The Philosophy and Science of Roger Bacon offers new insights and research perspectives on one of the most intriguing characters of the Middle Ages, Roger Bacon. At the intersections between science and philosophy, the volume analyses central aspects of Bacon's reflections on how nature and society can be perfected. The volume dives into the intertwining of Bacon's philosophical stances on nature, substantial change, and hylomorphism with his scientific discussion of music, alchemy, and medicine. *The Philosophy and Science of Roger Bacon* also investigates Bacon's projects of education reform and his epistemological and theological ground maintaining that humans and God are bound by wisdom, and therefore science. Finally, the volume examines how Bacon's doctrines are related to a wider historical context, particularly in consideration of Peter John Olivi, John Pecham, Peter of Ireland, and Robert Grosseteste. *The Philosophy and Science of Roger Bacon* is a crucial tool for scholars and students working in the history of philosophy and science and also for a broader audience interested in Roger Bacon and his long-lasting contribution to the history of ideas.

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The Philosophy and Science of Roger Bacon

Studies in Honour of Jeremiah Hackett

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Introduction

Nicola Polloni and Yael Kedar

This volume collects thirteen scholarly contributions on the life, thought, and context of one of the most fascinating characters of medieval culture, Roger Bacon. The volume is also meant to celebrate one of the most influential interpreters of Bacon's thought, Professor Jeremiah Hackett, who has recently retired and whose many contributions have shaped the scholarly consideration of Roger Bacon profoundly and substantively.

At least since John Dee's rediscovery of Bacon's works and, for different reasons, Robert Greene's *Friar Bacon and Friar Bungay*, the name of Roger Bacon is bound to the "Romantic" character of a peculiar scientist interested in the secrets of nature and living in a time of darkness. When the common perception is contrasted with the historical data, this fictional image fades away. The Middle Ages, and especially the thirteenth century, were not a time of darkness. The renewal of science and philosophy started in the twelfth century and flourished during Bacon's time with the discovery of new sciences, new theories, and new interests. In this context, however, it is surely true that Bacon's activity was characterised by some peculiar traits that nourished much of the early-modern narrative about him. He harshly criticised the world he was living in and, particularly, the academic system and the two mendicant orders, Dominicans and Franciscans. He publicly and repeatedly supported the study and practice of sciences like alchemy and astrology and became a central advocate of the use of mathematics and experimental science for the mastery of nature. He was the proponent of a profound reshaping of Latin culture through a reform of the education system, the details of which he submitted to the Pope.

As we look at Bacon's philosophical and scientific production in general, it seems that, as a scholar, he aimed to carry out three main roles: the philosopher, the scientist, and the theological-political agent of renewal. The first years of his career were devoted to commenting on Aristotle's newly translated natural and metaphysical works in Paris. In those works, Roger Bacon, the philosopher, shows much of his refined philosophical training, and many of his later stances are already attested, although often *in nuce*. Only a few years later, Roger Bacon, the agent of renewal, would harshly criticise both method and approach that he himself had followed in Paris in the 1240s. According to him, Scholasticism should be reformed by means of a return *ad fontes*, to the sources, and wisdom

should be investigated with new methods. He considered the study of foreign languages necessary in order to properly understand both philosophy and theology. Moreover, Christian knowledge was meant to accept and use a wide set of scientific disciplines in order to defeat the Antichrist and the perversion it was instilling into Christendom. Roger Bacon, the scientist, indulged consistently in the study of the sciences, starting with mathematics and optics – which he thought could be applied to the study of nature as such – and ending with transformative sciences like alchemy and the *scientia experimentalis*.

The tensions among these three roles played by Bacon are superseded by a more systematic reading of Bacon's works and a problematisation of his biography. Much of Bacon's scientific thought is grounded in his metaphysics, and both science and philosophy are primary subjects of his plans to reform Latin knowledge. The philosopher, scientist, and agent of renewal carry out different functions within Bacon's complex and ingenious thought. This occurred in an intertwining of personal reflections on theoretical problems and public stances aimed at different recipients – the Pope, the Order, Bacon's colleagues. The complexity of Bacon's historical character is therefore mirrored by the diversity of his philosophical and scientific thought.

Roger Bacon was born in England, in either 1214 or 1220. He was probably matriculated first at Oxford. Assuming that he was born in 1220, he should have become Master of Arts around 1240. He first taught at Oxford for a few years, thereby deepening his knowledge of Aristotle and the commentators and perhaps gaining some reputation. He went to Paris in the early 1240s – it may have been the case that he was invited there when the faculty of arts needed a teacher who knew Aristotle's works. In Paris, Bacon heard William of Auvergne and John of Garland. He may have become acquainted there with Albert the Great and perhaps was Robert Kilwardby's student or colleague. His Paris lectures covered Aristotle's *Metaphysics*, *Physics*, *De sensu et sensato*, probably *De generatione et corruptione*, *De animalibus*, and *De anima*, and perhaps also *De caelo et mundo*, *De causis* and the pseudo-Aristotelian *De plantis*. It appears that Bacon was one of the early lecturers, perhaps indeed a pioneer, on Aristotle's *libri naturales* in Paris.

Around 1247, and almost certainly by 1248, Bacon returned to Oxford and visited Lincoln. In 1251 he was back in Paris, but then gave up his membership in the arts faculty at Paris and returned to Oxford. There, he met with Adam Marsh and Thomas of Wales, and heard Richard Rufus of Cornwall lecture on the *Sentences*. The move to Oxford marked a turning point in Bacon's interests, broadening his outlook in the direction of Robert Grosseteste's philosophy and the contents of various Arabic sources and Alhazen in particular.

After returning to England, Bacon joined the Franciscans around 1257. Within the Order, Bacon had identified himself with the radical elements, including Joachim of Fiore and the "spirituals," who were accused of provoking a schism within the Order. In those first years as a Franciscan, Bacon was working on the Correction of the Biblical Text with William of Mara and others in the Franciscan Studium in Paris (until 1263). He also wrote the *De mirabilis potestate*

artis et naturae and the *De computo naturali*. This was the period of his most intense occupation with optics, and in the late 1250s or the early 1260s, he wrote the *De multiplicatione specierum* and the *De speculis comburentibus*. In the early 1260's, he received a first Mandate (*mandatum*) from Cardinal Guy de Foulques to write a work in philosophy. And by 1262 he had produced the first draft of his *Perspectiva*.

Bacon presumably had sent out requests for external sponsors, asking permission to return to Oxford. One of the people he contacted was the cardinal-bishop of St. Sabina, Guy de Foulques, who responded by asking Bacon to send him his writings. Guy de Foulques was elected Pope in February 1265. In response to de Foulques's request, Bacon wrote three crucial works: *Opus maius*, *Opus minus*, and *Opus tertium*. These comprised, in fact, a plan to thoroughly reorganise Christian education. The *Opus maius*, along with the *De multiplicatione specierum*, was sent to the Pope in late 1267 or early 1268, followed by the *Opus minus* and possibly by some works on astrology and alchemy, perhaps even the *De speculum comburentibus*. However, the Pope died in November 1268, which resulted in a failure of Bacon's attempt at renovating the Latin course of studies. About 1268, Bacon wrote his *Communia naturalium* and *Communia mathematica*, mature expressions of many of his theories. These works are followed by a period in which Bacon was mostly interested in languages with the preparation of his Greek and Hebrew grammars. The polemical *Compendium studii philosophiae* belongs to the same period since Bacon probably wrote it around 1271–72.

A chronicle from about 1370 states that the teaching of Bacon was condemned, that his works were banned, and that he was imprisoned. Nothing else is known about this event whose factuality has been questioned. The last evidence of Bacon's life is that in 1292 he wrote the *Compendium studii theologiae*, which he left unfinished. This work expands on many of the themes and ideas that had intrigued Bacon since his *De signis*. It is reasonable to assume that Roger Bacon died in 1292 or soon thereafter.

Roger Bacon's philosophical activity starts with an intertwining of tradition and renovation. Working in Paris during the 1240s, he commented on many of Aristotle's natural and metaphysical works. His task corresponded to the early philosophical emancipation from the ban on the reading of Aristotle's *libri naturales* promulgated in 1209–10 and confirmed in 1215. Only a few years before Bacon's set of questions, the earliest commentaries on Aristotle's *Physics* were written by Richard Rufus and Robert Grosseteste, two scholars whose positions and biographies would mark Bacon's activity in different and sometimes divergent ways.

Looking back at Bacon's Parisian activity as a commentator, we can consider him among the initiators of a method that would become one of the shared stylistic and methodological characteristics of Scholasticism. However, upon a closer look, this statement becomes more nuanced, as often happens with Bacon's life. While it is true that Bacon was among the first Latin philosophers to systematically comment on Aristotle's natural and metaphysical works, it is also true that he would dissociate himself from the Scholastic method and the Parisian academic

system only a few years later and with much criticism. This fact makes it rather difficult for historians to properly conceive the subtle theoretical correlations, marked by continuities and ruptures, between the *first* Bacon (the Aristotelian commentator) and the *second* Bacon (the opponent of Scholasticism).

Roger Bacon's criticism of the Scholastic method is only one aspect of his wider project aimed at reforming substantively the entire edifice of Latin knowledge. His proposal is presented and discussed mainly on the three *Opera* (the *Opus maius*, *Opus minus*, and *Opus tertium*), yet its foundation is older and its pillars far wider. Bacon was perceiving a time of profound moral and epistemic bleakness which may oddly resonate with the narrative of the philosophical and scientific splendour of the thirteenth century. Hundreds of new texts had been recently translated from Greek and Arabic, allowing a new approach to sciences (some of which were newly established, like alchemy) and a new method in philosophy. While most of his contemporaries were enjoying this renewed availability of sources and thriving in the speculative context that these sources had created, Bacon fully perceived the consequentiality of that moment. His was not a reaction against the newly available texts. To the contrary, Bacon craved the "knowledge of the Ancients" that had been dispersed throughout the Mediterranean Basin and beyond. However, what concerned Bacon as regards these translations was what we may call the "naive approach" that he perceived so many of his colleagues were pursuing while reading them. In Bacon's view, they were treating the translations as if they were original texts, without considering the many errors, approximations, and misunderstandings that the translators incorporated in the translated text, incidentally yet culpably. The outcome of such epistemic naivety was a proliferation of errors in science, philosophy, administrative law, and, above all, theology.

Knowledge and wisdom must be seized wherever they come from and in the most efficacious way. In order to do so, Bacon insisted that Latin scholars had to learn languages, engaging with them directly and proficiently. Only through the knowledge of the languages in which the ancient texts were written is it possible to understand truly and profoundly the wisdom they hold. However, the study of languages is not enough in itself to ground Latin knowledge on safe and fertile soil. With a Joachimite spirit, Bacon felt the temporal closeness of the coming of the Antichrist. In Bacon's view, his proximity had already started to instil corruption into Christendom. The signs of his coming were evident to Bacon when looking at the moral and epistemic errors that characterised many of the activities of the Orders and the clergy, the dishonesty and turmoil of the political system, and the bleak consequences that all that has for the people. As a man of wisdom, Bacon thought that the key to saving Christendom from the upcoming calamity was wisdom itself. The way by which knowledge is taught and wisdom sought had to be restructured. Moral philosophy must be posited as the highest discipline since its pursuing corresponds to the realisation of what humans were meant to be. The consequences of the primal Fall of the human being must be amended, both spiritually and physically. Theological, ethical, and philosophical wisdom would take care of the former, but science would have to resolve the corporeal condemnation due to the latter.

A new approach to science is the most prominent feature in Bacon's system of knowledge. If Christendom is to defeat the army of the Antichrist, and if human beings are to win their moral struggle and overcome their physical enslavement originated by the first Sin, this can only be achieved, in Bacon's view, by the study of the sciences. Only the sciences can provide humans with the wondrous instruments required for both tasks, like optical devices to be used in war and the elixir to restore human health and longevity. But the sciences can only do so once their study is placed within the wider edifice of wisdom, which is both grounded on and crowned by what we might daringly call a theology of human liberation.

The first step of this process aimed at attaining wisdom consists of the study of languages. Bacon's interest in the study of language was broad and included philology, semantics, semiotics, and the study of ancient languages. He developed a theory of definition, imposition, and classification of signs; worked on a theory of connotation and analogy; provided an analysis of ambiguity and equivocation; and wrote books on Hebrew and Greek grammar.

Bacon's theory of signs underscored the context in which a sign is situated and the crucial role of the *impositor* in constituting the semiotic relations. He held that the context is determined not by concepts, but by the free will and the intentions of the *impositor*. An interpreter, however, is also required since without him, a sign remains a sign in name only. In the traditional semiotic triangle inherited from Plato and Aristotle, the relation of signs to things is mediated by a concept and is hence indirect. Bacon had the sign refer directly to the object, be it mental or extra-mental. This contradicted the widespread medieval conviction that the thing signified holds ontological priority over the relationship of a sign to the perceiver. Accordingly, he argued that words refer first and foremost to a present object. Cases in which the reference is to past or future, non-existent, or universal objects are in fact made by a second imposition, which creates equivocation: namely, the extension of univocal terms by means of analogy or metaphor.

Bacon's classification of signs was strikingly original, reshaping materials taken from Aristotle and Augustine. One class includes natural signs, representing their referents by concomitance, inference, and consequence; by likeness; or in the manner of cause and effect. The other class comprises signs given by a soul, which could be given either by employing one's free will or naturally, by way of an instinct. Words belong, according to Bacon, to the second category of signs given by a soul. Words differ from natural signs in that no essential linkage exists between them and their referents; they differ from signs given by a soul naturally, in that they arise from cognitive and rational processes involving knowledge, reflection, deliberation, and choice.

Notwithstanding his important contribution to the study of language and semiotics, Roger Bacon's name is primarily bound to the study of natural sciences. The theoretical framework in which these manifold sciences were situated is that of natural philosophy. Indeed, Bacon's constant appeal to the sciences required him to develop a comprehensive edifice of natural philosophy by which those sciences could be theoretically justified. As a consequence, some of the most

remarkable pages of Bacon's production proceed from sections or works – like the *Communia naturalium* – devoted to natural philosophy. There, both Bacon, the scientist, and Bacon, the philosopher, had to work together in order to produce a consistent and reliable description of nature. And it is exactly for this reason that Bacon's philosophy of nature bridges two worlds, two disciplinary realms – that of natural sciences and that of metaphysics – of which only the former plays an explicit, public role in Bacon's idealistic approach to knowledge. After the Parisian years dedicated to commenting on Aristotle, Bacon did not dedicate even a single work to metaphysics properly considered. Such textual absence, nevertheless, does not imply that Bacon had no interests in metaphysics or that he did not have anything to say about this discipline. To the contrary, much of Bacon's natural philosophy is grounded on his revision of Aristotelian ontology. This revision, in turn, is based on a series of original claims that, from Bacon's extreme realism to his hylomorphism and theory of matter, show abundantly that Bacon never abandoned metaphysics, even when publicly advertising other disciplines as more useful, accurate, and relevant. The scientist needed the philosopher, and the agent of renewal needed to reshape both disciplines in order to renovate knowledge as such.

A key part of Bacon's program of reforming the curriculum in the universities was a new method of inquiry. He was convinced that pure syllogistic reasoning was not enough to gain certitude; hence he endorsed an active experience in the world by a method he titled *scientia experimentalis*. Bacon's experimental science was a call to recognise experience as a criterion of truth. It consisted of an appeal to observations, a demand to relate abstract theories to reality, and the use of instruments. Bacon listed three tasks for experimental science: to investigate the conclusions of the speculative sciences, to construct new instruments and technologies, and to supply prognostications and predictions. He did not elaborate, however, on the method of this science, which was more a critique of pure syllogistic reasoning than a well-defined method. Yet, he had much to say on its marvellous expected results. This last feature, which was loud and imaginative, has won Bacon much of his reputation. Bacon envisioned the construction of wonderful instruments and machines, new medical cures, alchemical discoveries, and military technologies.

One of Bacon's most persistent convictions was that knowledge is not gained solely for its own sake but is to be applied and directed to the promotion of human condition. He therefore portrayed an image of science that linked the progress of knowledge with operational, quasi-technical procedures. In this new ideal, which hailed the usefulness of knowledge, the practical sciences received precedence. Four practical sciences had the utmost importance in this regard: namely, optics, astrology, alchemy, and medicine. Practical alchemy can prolong human life by creating an "equal body," in which a perfect balance among the elements is established. *Perspectiva* and astrology would assist by constructing optical instruments which gather the celestial rays of beneficent stars and project them, thus rendering the elements in a body proportional. Such a body would be resistant to all decay and would confer its incorruptibility to both medications and other bodies, including the human body.

The core of Bacon's philosophy of nature was his theory of the multiplication of species, which is a theory of causation, meticulously described in *De multiplicatione specierum*. A species is a force or power defined as the "first effect" of an agent and issued by every "active nature." It resembles its agent in nature and operation and is brought forth out of the active potentiality of the matter of the recipient. Through species, the agent affects its recipients by rendering them similar to itself in some respect. Matter strives to receive the species and participates in their production since it has an inherent tendency to seek its perfection by receiving new forms. Bacon conceived the multiplication of species as a universal mechanism, active in physical, perceptual, and even spiritual processes. He defined the action of species in the bodily domain as "natural": that is, as spontaneous, occurring according to regular processes. The diversity of effects made by species is due to the diversity among the recipients, each according to its specific nature and ability.

The most accessible example of the multiplication of species in a medium are light rays issued by a source. Just like light rays, species proceed radially in straight lines, a procession which can be described geometrically. Hence, Bacon's profound interest in optics. His most notable scientific achievement was the initiation of the tradition of *perspectiva* in the Latin world, drawing on Greek, Latinate, and Islamicate sources, and especially Alhazen. He successfully communicated the geometrical principles of reflection in mirrors; the precept of equality of the angles in incidence and reflection; and the rules governing the location, size, and direction of images in different kinds of mirrors. Bacon established the principles of refraction at interfaces of various media, handed over a minute treatment of the phenomenon of pinhole images, and calculated the value of 42 degrees for the maximum elevation of the rainbow.

Bacon's system of knowledge is grounded in the recognition that mathematics plays a fundamental role among the sciences and that it holds the key to the understanding of nature; it hence had a prominent role in his program of reform. He provided reasons to reduce logic to mathematics, advocated the use of mathematics in physical explanations, and recognised its ability to provide certainty, especially when combined with experimental science. In his science of *perspectiva*, Bacon applied geometrical analysis to optical phenomena, such as the rainbow, images in mirrors, and the apparent dislocation of the stars. His theory of the multiplication of species was established on a geometrical analysis of the radiation of species. He advocated the use of mathematics in religious rites as in chronology, music, symbolism, calendar reform, geographical knowledge, and astrology.

Bacon's interest in mathematics relates to his acknowledgment of the possibility of providing accurate predictions for the processes of nature. He held that the multiplication of species conforms to a set of "laws of nature" (or laws of material forms). Such laws include the laws of reflection and of refraction, the two laws of the perpendicular, the law of uniform action, and the law of inverse proportion between force and distance. He prescribed laws that apply in domains other than species and adduced the law of universal nature, which governs the balance among the elements and ensures both continuity and progression of the natural world.

It would be very difficult to overestimate the importance that Jeremiah Hackett has had – and still has – for the study of Roger Bacon's thought. On the one hand, limiting the relevance of his contributions to the scholarly discussion would be a mistake, since Hackett has also managed to rediscover and present Bacon to a wider, non-specialised audience. On the other hand, the reader can assess directly Hackett's manifold, impressive contributions to scholarship by looking at the list of his publications at the end of this introduction.

At the very beginning of his career, however, Jeremiah Hackett's encounter with medieval philosophy was marked by interests other than Bacon. It is likely that when Hackett began his training in Medieval Studies and Philosophy at the University College Dublin in 1973, he would not have even considered working on Roger Bacon. Hackett's research was then focused on German Mysticism, directed in his explorations by F. X. Martin OSA and Michael Richter. In Dublin, Hackett had the invaluable occasion to be trained by eminent characters of the scholarly debate, like John J. O'Meara, Ludwig Bieler, John Chisholm and Michael Bertram Crowe. His wide interests and studies led him to discuss a thesis on mysticism in Jordan of Quedlinburg and Meister Eckhart, through which he completed his M.Phil. programme.

Driven by his interest in medieval mysticism, Hackett moved to Toronto, where he was affiliated with the Center for Medieval Studies and the Pontifical Institute of Mediaeval Studies since late 1975. In that splendid philosophical milieu, however, Hackett received a plurality of new intellectual stimuli that drastically expanded his research interests. As he would later recall, his reading of Étienne Gilson's *The Unity of Philosophical Experience*, as an undergraduate in Dublin, had instilled in him a new approach to the history of philosophy. Hackett benefitted from the scholarly community in Toronto during those gilded years, with scholars of the calibre of Joseph Owens, Armand Maurer, Edward Synan, Edouard Jeauneau, Jed Z. Buchwald, Betsey Price, Jocelyn Hillgarth, and James A. Weisheipl. The Toronto community influenced Hackett's method and interests profoundly. During those years, Hackett also worked as a teaching assistant in the Department of Philosophy of St. Michael College, in the Religious Studies Department of the University of Toronto, and later in the new and very successful program in Celtic Studies headed by Anne Dooley. Since 1980, Hackett was also teaching at the Notre Dame College of Ohio, which was then a women's college directed by the Sisters of Notre Dame de Namours. Hackett would often recall those years and the vibrant cultural and social life of Cleveland, Ohio.

Having contemplated working on Eriugena, leaving (momentarily) aside his research on mysticism, Hackett finally decided to write his Ph.D. dissertation on Roger Bacon's *Scientia experimentalis*, supervised by Weisheipl. A former Junior Fellow of Massey College (1978–80), Hackett defended his PhD dissertation there in March of 1983. Following his PhD defence, Hackett started to establish a series of promising collaborations. He consulted with Richard Lemay at the City University of New York on the importance of pseudo-Ptolemy's *Centiloquium*. In 1984, he participated in the NEH summer Seminar on Law and Virtue in Jewish, Islamic and Christian Traditions at Yeshiva University directed by

Professor Arthur Hyman. There, he was introduced to Paul Oscar Kristeller, who later granted him a very long (and "memorable," as Hackett recalls) interview that motivated Hackett to proceed with his academic career. As Hackett pointed out recently, Kristeller's "encouragement would remain fundamental" for years to come.

Later in 1984, Hackett was hired by the University of South Carolina. Since then, he has shaped the minds and careers of innumerable USC students, to whom he taught an impressive number of courses – from introductions to philosophy, logic, and ethics, to medieval and Renaissance philosophy, and phenomenology. In his seminars, Hackett demonstrated the relevance of medieval philosophy for modern philosophy, relating it to the works of René Descartes, Charles S. Pierce, and Martin Heidegger. In 1994–95, Hackett was involved in setting up the new PhD Program in Philosophy at the University of South Carolina. In 1996 he became the second Graduate Director of the program. Prior to this time, he had directed many MA students in the study of the history of philosophy and science. Among the doctoral students that Hackett supervised, we shall recall John Catalano, Cynthia B. Bryson, David Przekupowski, and Caleb Colley. While dozens more were the MA students that he led through their study of the history of philosophy and science.

Indeed, Hackett's teaching and supervision reflects his wide interests in medieval philosophy and beyond. In this regard, a central role is played by the study of Roger Bacon, of course. But Hackett also dived into the reflections of Eckhart and German Mysticism, Renaissance philosophy (especially Ficino and Pomponazzi), early modern philosophy, and phenomenology (in particular, Husserl, Heidegger, and Merleau-Ponty). This intertwining of interests corresponds to the development of a unique and brilliant philosophical mind that has touched both the intellects and hearts of many colleagues and students worldwide. Hackett did so through the great number of studies he published. Of those, let us recall the two monumental contributions to the study of Roger Bacon's thought. On the one hand, the volume *Roger Bacon and the Sciences: Commemorative Essays* that Hackett edited in 1997 for Brill has been and still is the main reference for the study of Bacon's reflections. On the other, the special issue of *Vivarium*, "Roger Bacon and Aristotelianism," edited by Hackett again in 1997, presented the philosophical value of Bacon's thought to the wider community of scholars, resulting in a "rediscovery" of Bacon's philosophy. These two ground-breaking works are preceded and followed by an impressive number of further contributions on Bacon, Eckhart, Aquinas, Grosseteste, and many more characters of the history of philosophy.

Yet, beside his publications, Hackett's sharp mind and uncommon kindness touched many of us who had the chance to know him in person. That has never been quite complicated. Hackett's *peregrinatio academica* led him to many international academic institutions either as fellow or as invitee, from Binghamton University to London, Frankfurt, Paris, and Florence (SISMEL). For the past 15 years, Hackett participated in the regular Conferences on Medieval Philosophy in Hannover, held at the Leibniz House and organised by Professor Günther

Mensching. On all these occasions, Jeremiah Hackett has managed to give to those who listened to his talks and spoke with him the sense of being engaged in a developing philosophical investigation. This is one of Hackett's most peculiar traits: even if you have no specific interest in the topic of his discussion, when the talk is over, you will be intrigued by the questions and points that he raises through his encompassing knowledge of medieval thought. These points always transcend the limits of a single talk or subject to embrace the totality of the history of philosophy and philosophy itself. The editors of this volume know this kind of feeling very well. One of them, Nicola Polloni, will always bear in his mind the splendid week he spent together with Jeremiah Hackett and his wife, Lilla, in Columbia, South Carolina, for a conference on philosophical transfers of knowledge with Katja Vehlow and Caleb Colley organised by Hackett. The week ended with attendance at a Bob Dylan concert. We had an experience of art, science, music, and philosophy that was delightfully unique. The other, Yael Kedar, will never forget the fascinating conversations she had with Hackett, in diverse locations such as Lincoln, Boston, Georgetown, and Utrecht. She especially recalls Hackett's excitement, at a lunch in Paris, over the deleted pages of a manuscript and the single instance which he found of Bacon admitting to a mistake. On all those occasions, she was inspired by Hackett's unending curiosity, the breadth of his interests and knowledge, and the sharpness of his humour.

In 2020, the newly established Roger Bacon Research Society elected Jeremiah Hackett as its first president. That was only part of the scholarly acknowledgment of his important role in promoting the study of Roger Bacon within medieval philosophy and science. Another, again partial, acknowledgment of Hackett's contribution consists of this volume. With it, many of Hackett's colleagues and students want to offer a tribute to his inspiring and inquisitive curiosity. In accordance with Hackett's concern with different topics in Bacon's works, the volume offers a selection of new approaches, questions, and issues.

The chapters in this volume address several key points of Bacon's thought, of which the most notable are his metaphysics, his epistemology, and his program of reform. Specifically, the studies focus on Bacon's theory of multiplication of species, his struggle with the problem of the knowability of material singulars, his quest to prolong the human lifespan, the status he assigned to alchemy, his position regarding the problems of hylomorphism and physical alteration, the place he assigned to theology, and his relations with his contemporaries. Considered together, the chapters collected in this volume provide a vivid picture of Bacon's philosophical, scientific, and political originality, firmly placed within a historical context.

The first part of the volume is dedicated to Roger Bacon's examination of nature as a philosophical and scientific subject. Michela Pereira's chapter, "Roger Bacon on Nature," observes that "nature" in Bacon is linked from the outset with the notion of power, the most typical feature of which on both the metaphysical and physical levels is its creative impulse. Accordingly, Bacon defines nature as *virtus*, a force that operates as a non-voluntary principle of generation, transformation, and movement, in both the bodily world as a whole and its individuals. In

this context, the term *nature* describes both the essence of a thing and its activity. This conception of nature allows the definition of artificial human productions as natural and hence a part of nature. Nature and intellect, Pereira points out, are efficient causes, differing in the source of action and in their uniformity. As a consequence, art need not limit itself to the imitation of nature but can also lead it to its perfection.

Authored by Cecilia Panti, the next chapter addresses Bacon's interpretation of how nature and chance are intertwined. In her "Roger Bacon on Chance in Natural Generation in the *Questiones supra octo libros Physicorum Aristotelis*," Panti examines Bacon's notion of the "active potentiality" of natural matter. Differently from prime matter, natural matter has some causative power, which is directed by the external celestial virtues and enables the processes of natural change. The notion of active potentiality, however, entails some problematic outcomes when chance is considered. On the one hand, celestial virtues are intentional and cannot cause accidents. On the other hand, the active potentiality of natural matter cannot cause accidents either, because of its natural status. Bacon's solution follows Avicenna's distinction between the first and second intentions of universal nature. While the first intention is to imitate the first mover, the second intention is directed to natural matter and the generation of natural things. It is this second intention of the universal nature that causes incidental events, providing forms in cases of an overabundance of matter as to guarantee the best possible outcome.

Authored by Cecilia Trifogli, the next chapter is focused on another pillar of Bacon's natural philosophy: his theory of substantial change. In her "Roger Bacon on Substantial Change," Trifogli shows the originality of Bacon's doctrine of generation and corruption, which stands in contrast with the common medieval interpretation that substantial change is instantaneous. According to Bacon, substantial change happens in time and involves different degrees of completion. Trifogli stresses that Bacon's doctrine is grounded in the fundamental assumption that the graduality which is appreciated in accidental features must be admitted also in the case of substantial change. According to Bacon, the consecutive degrees of a substance undergoing change do not have corresponding substantial forms. The process can be explained by the intension and remission of accidents which provide the structural model for substantial degrees.

With Nicola Polloni's chapter, "Roger Bacon on the Conceivability of Matter," the focus shifts to the tension between natural philosophy and metaphysics. The chapter explores Bacon's solution to the problem of the conceivability of prime matter, which, by reason of its formlessness, was thought to escape the capacities of the human intellect. The originality of Bacon's ontology and his philosophical interests led him to consider "matter" primarily as secondary matter, the last step of a chain of hylomorphic composites rooted in the *genus generalissimum*. As a consequence of Bacon's peculiar hylomorphism, prime matter can be grasped by a combination of two strategies – analogy and abstraction. By his discussion of this curious outcome, Polloni examines Bacon's theory of matter from a wide point of view by which the dependence of Bacon's natural philosophy on metaphysics can be better appreciated.

Theo Kobusch's chapter, "*Ens rationis:* Über die vielfache Bedeutung des Gedankendingbegriffs," touches another aspect of Bacon's epistemology: namely, the concept of entity of thought. Kobusch observes that Bacon defines a thought-entity as that which is cognised in the form of propositions in the soul. A thought-entity could be either cognised sentences, numbers, relations, time, or universals. Universals include first intentions, which signify the universals existing within external entities, and second intentions: namely, the concepts of reflection and the objects of phantasy, like a golden mountain or a chimaera. In his later work, Bacon makes a distinction between subjective and objective intra-mental existence. In addition, Kobusch points out that in Bacon's theory of the rainbow, he elaborates a theory of a phenomenal being. This kind of being corresponds in the realm of the sensory to what is represented by the objective being in the realm of the intellective, and, as Kobusch underlines, its origins can be found in the Stoic doctrine of human consciousness.

Next, the volume shifts to examine Bacon's programme of reform aimed at reshaping Latin knowledge from its foundations – education, university, and research methods. Gunther Mensching's chapter, "Roger Bacons Idee der Einheit der Wissenschaft und des universalen Friedens," argues that one of the central goals of Bacon's reform was to promote world peace. Mensching observes that Bacon secularises the idea of *pax Christiana*, although reckoning that its achievement should pass through ecclesiastic power and the primacy of the Pope. According to Bacon, the unity of the church would ensure the unity of science, which is vital in his conception for a full realisation of science's potential. The unity of reason deprived war of any rational legitimation and calls for the unity of mankind. Mensching also stresses the pivotal role of alchemy and experimental science in Bacon's plan of reform. Both disciplines show that nature is not just a static structure for contemplation, but a substrate of actions made to promote human bliss and society's perfection. Accordingly, the theological goal of salvation can be attained only by a peaceful enhancement of the community of humans.

Nikolaus Egel's chapter, "Roger Bacon's New Founding of the Sciences in the Thirteenth Century," examines Bacon's programme of reform in terms of what Egel calls "scientific-historical creationism." Starting with a discussion of Bacon's criticism of the state of studies of his time and, in particular, the "seven sins" of theology, Egel points out Bacon's emphasis on the direct study of the Bible. This point is connected to the urgency felt by Bacon to institutionalise the study of languages for biblical exegesis and the use of sciences. According to Egel, the essence of Bacon's scientific-historical creationism is the retrieval of an all-encompassing knowledge that was revealed to the prophets of God at the beginning of the world and which is contained in the Scriptures. This "scientific messianism" was grounded on the acknowledgment that knowledge is meant to improve the human condition of both individuals and the Christian society.

The next two chapters of the volume examine the place and function of specific sciences within Bacon's project of reform. Yael Kedar's chapter, "Sound Is Not Made of Rays: Roger Bacon's Rejection of Heavenly Music," analyses Bacon's treatment of sound and music, focusing on three main themes: the definition of

sound, heavenly music, and the analogy between sound and light. She argues that Bacon had an original account of the ontological status of sound, differing from that of both the Pythagoreans and Aristotle. According to Bacon, sounds are non-enduring quantities. By this definition, he integrates both mathematical and physical aspects of sound. In light of this new consideration of sound, Bacon follows Aristotle in rejecting the theory of heavenly music, albeit for different reasons. It also leads Bacon to assume that the analogy between light and sound cannot be maintained and to argue that the dynamic of sound production and transmission cannot be explained by the mechanism of the multiplication of species.

Meagan S. Allen's chapter, "Roger Bacon's Medical Alchemy and the Multiplication of Species," addresses Bacon's ideas on alchemy in the service of medicine. Allen demonstrates how, through the mediation of alchemy, the doctrine of multiplication of species became central to Bacon's understanding of the power of medicine. His account of the multiplication of species enabled him to surmise that the elixir, once produced, would not be diminished. A central notion in Allen's paper is the *gloria inestimabilis*, a compound medicine which removes sin and strengthens the mind, rids the recipient of errors, and makes him better able to stick to the *regimine sanitatis*. It also strengthens the body and corrects its constitution to restore elemental balance. According to Bacon, the use of such remedies would allow the human body to become *almost* identical to the body of Adam before the Fall. Only after the resurrection, however, will a stable equality of elements be able to sustain in the human body, giving it eternal life. Until then life can be prolonged, but death is inevitable.

The last four chapters of this volume consider Bacon's relations with other scholars within the academic and religious setting of his time. Bacon's intense engagement with the prolongation of life is the main point of Michael Dunne's chapter, "From *longitudo vitae* to *prolungatio vitae*: Peter of Ireland and Roger Bacon on Life and Death." Dunne stresses the originality of Bacon's approach to the prospects of the prolongation of life. He contrasts Bacon's approach with Peter of Ireland's *determinatio magistralis*, which represents the Aristotelian tradition, according to which nature fixes a natural term to all life. Dunne conjectures that the theoretical approach characterising the Aristotelian commentaries was due to the disciplinary divide between philosophy, which considers the general reasons for a phenomenon, and medicine, which focuses on practical solutions in individual cases. Bacon's novelty is to employ the latest developments in astronomy, alchemy, and the experimental sciences to the goal of extending life.

Dominique Demange's chapter, "Bacon/Olivi: un état des lieux," maps the complex relations between Bacon and Peter John Olivi. Demange points out that, notwithstanding their shared criticism of the university system, Bacon's and Olivi's solutions were rather divergent. In Bacon's view, the main reason for the bleak state of university teaching was the neglect and ignorance of ancient wisdom, pagan and Christian alike. Olivi, in turn, saw the source of contemporary corruption in the fascination of many theologians with pagan teaching, including Aristotle. Accordingly, in Olivi's view, Bacon himself is a victim of such fascination. Demange identifies several points of contention between Bacon and Olivi,

among which is the cognitive process of perception. Olivi criticises Bacon's theory of vision, based on extramission, on both theological and scientific grounds. According to Olivi, the intromissive theory of vision fits much better with the Christian ethics of the will as an active force. Similarly, Olivi rejects the basics of Bacon's theory of species, even though he acknowledges the validity of Bacon's attempt to construct a unified theory of action.

In turn, Caleb Colley's chapter, "The Soul in Roger Bacon and John Pecham," is concerned with the influence exerted by Bacon over John Pecham's doctrine of the soul. According to Pecham, the soul is the fundamental force of the life of the organism, wherein the first act of life occurs as a striving toward the perfection or completion of the living thing. It is an emanative, immanent force, in its farthest-reaching emanation from God, which animates all living corporeal matter. Colley finds that Pecham adheres to Bacon's theory of multiplication of species for all sensory knowledge. Just like Bacon, Pecham is committed to corporeal species as a prerequisite for intellectual knowledge of anything corporeal. Unlike Bacon, however, Pecham's most important source was not Aristotle, but Augustine and Avicenna. Both Bacon and Pecham held to a hylomorphic conception of the soul based on Ibn Gabirol's *Fons vitae*.

In his chapter, "Plato's unholy Trinity: The life, death, and afterlife of the *anima mundi* in the Middle Ages," Jack Cunningham discusses some fundamental aspects of the history of the notion of the World Soul up to the twelfth century. Originated from Plato's *Timaeus*, this notion was used as an explanatory device to understand the modalities of how the world is ordered and governed. After having discussed some main points of how Proclus, Calcidius, and the Stoics engaged with Plato's *anima mundi*, Cunningham examines a set of twelfth-century authors who, like Peter Abelard, Thierry of Chartres, and William of Conches, struggle to understand how the World Soul can be related to the Christian Trinity. As Cunningham suggests, even though Bacon never refers to the World Soul in his works, he appears to have inherited from Adelard of Bath and Grosseteste a peculiar understanding of mathematics which can be related to the long history of discussion and criticism of the *anima mundi*.

It is our hope that the plurality of perspectives and interpretations collected in this volume will offer the reader a taste of the incredible richness of Roger Bacon's reflections and the relevance his thought has had for the history of medieval philosophy and science. Many of the studies presented here open new perspectives and lines of research about Bacon's contribution to that history. As the reader goes through the pages of this volume, she will probably realise how many of these studies are indebted to Jeremiah Hackett's tireless effort to fathom Roger Bacon's thought. It is with immense gratitude that we offer to him this volume, which is no more than a small sign of our greatest appreciation of his studies. This great thankfulness to Jeremiah Hackett is shared by all members of the Roger Bacon Research Society who were unable to directly contribute to this volume. Also, many other colleagues supported us in the preparation of this tribute to such a distinctive and unique scholar and, in particular, we are very grateful to Caleb Colley for his help and assistance.

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