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The Origins of the Idea of Scientific Progress

Bernard de Fontenelle and His Contemporaries

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Daniel Špelda
Department of Philosophy
Masaryk University
Brno, Czech Republic

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About the Author

Daniel Špelda works as a professor at the Department of Philosophy in the Faculty of Arts at Masaryk University in Brno (Czech Republic). In his research, he has concentrated on the philosophical problems, concepts, and categories that played a role in the development of early modern science, including curiosity, teleology, progress. In recent years, he has addressed the question of how the early modern natural philosophers understood the history of their field and their position in the course of cultural history.

Chapter 1
The Concept of Progress

Contents

Abstract The concept of progress is often applied by philosophers and historians in confusing ways; the concept deserves clarification. First, it would be appropriate to make distinctions between the general progress of mankind, different kinds of progress in various fields of human activity (art, law, and philosophy), and the idea of scientific progress. There is a great deal of consensus in existing research that the idea of scientific progress became the model for all kinds of progress at the beginning of the Enlightenment. What is lacking, however, is a convincing answer to the question of where the idea of scientific progress came from. In this chapter, three previous interpretations of the origin of the idea of (scientific) progress are rejected: that the idea was the result of the advancement of knowledge; that the idea was the result of the secularization of eschatology; and that the idea existed in classical antiquity and was only revived in early modern times. This chapter also outlines the methodological tenets of the book. From the methodological point of view, the presented research is situated in the vicinity of Lorraine Daston's historical epistemology and subscribes to Hans Blumenberg's philosophical analyses of early modern science and philosophy. The main thesis of the book claims that the idea of scientific progress represented a methodological response to the contingency of nature. When nature was conceived as an inactive set of corpuscles that is completely indifferent to the human desire for knowledge and human cognitive capacities, it became clear that knowledge of nature must adopt a temporal regime. The bearer of this temporal regime was an institution.

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1.1 The Absence of the Idea of Scientific Progress

The traditional historiography of early modern science focused on the great figures of the so-called Scientific Revolution. Recent research has begun to explore new topics much more intensively. Historians have been examining important categories of early modern science, such as probability, fact, explanation, method, hypothesis, experiment, or observation. At the same time, methodological tenets from science studies have been transferred to the study of the history of science, and historians have carefully examined the sites of the production of scientific knowledge, its material side, the visual culture, the colonial aspects of science, the relationship of research to the state and the commercial world, the globalization of science, the *personae* of scientific research and their historically fluid identities.[1] All of these investigations have contributed greatly to transforming and deepening our understanding of early modern science, particularly in comparison to how it was interpreted by historians working between approximately 1920 and 1970.

The idea of scientific progress does not appear at all in recent scholarship on early modern science and philosophy. It does not occur in the third volume of *The Cambridge History of Science*, nor can it be found in *The Cambridge History of Seventeenth-Century Philosophy, A Companion to Early Modern Philosophy*, nor *The Cambridge History of Philosophy of the Scientific Revolution.*[2] No entry on progress appears even in the most recent and most detailed work on early modern thought, the *Encyclopedia of Early Modern Philosophy and the Sciences*.[3] All of these works mentioned traditional themes related to early modern science such as the mathematization of nature, experimental methods, and empiricism, but the belief in future advances in natural philosophy has disappeared from historical works on early modern natural philosophy, even though it was expressed repeatedly by the natural philosophers of the period.

Some historians may assume that the idea of scientific progress is self-evident and natural, posing neither historical nor explanatory problems. Others may believe that the category of scientific progress is too closely associated with the triumphalist history of science that contemporary historians wish to avoid.[4] Still other historians may have been influenced by the massive criticism that the idea of progress suffered

[1] See e.g. Daston and Park 2006; Van Damme 2015.

[2] See Garber and Michael 1998; Daston and Park 2006; Nadler 2008; Miller and Jalobeanu 2022.

[3] Wolfe and T. and Dana Jalobeanu. 2020.

[4] See e.g. index in Applebaum 2000, where 'progress' refers to the positivist historiography of science.

in continental philosophy during the second half of the twentieth century. This criticism seems to have loaded the very notion of progress with such negative connotations that it is not considered worthy as a subject of serious historical inquiry.

I believe that the idea of scientific progress is a legitimate subject of historical inquiry. The philosophical literature of the seventeenth century contains many references to 'the advancement', *les progrès*, or *progressus* of natural philosophy. The idea of progress is thus an actor's category, and it is neither necessary nor appropriate to burden it with the connotations it has obtained in contemporary philosophy, science, humanities, and developmental studies.

I want to approach the examination of the origins of the notion of scientific progress from a historical perspective without taking into account later debates about its legitimacy in twentieth-century philosophy. My work, however, does not fall within the history of ideas or intellectual history. My aim is not to pinpoint the originators of the idea if any. Nor do I wish to describe the spread of the idea in the intellectual context of the seventeenth century. Above all, I want to show that the idea of scientific progress was not self-evident in the context of European thought and that it emerged in natural philosophy as a consequence of the changes in ontology, anthropology, and epistemology.

As the concept of progress is burdened with many debates, connotations, and misunderstandings that emerged especially during the twentieth century, I want to present my understanding of the concept in this introductory chapter. In the following sections, I specify the concept of scientific progress itself; present the current state of the research; explain my approach; and describe the aims of this book.

1.2 The Idea of the General Progress of Humankind

The idea of progress was a major theme of continental philosophy in the second half of the twentieth century. Philosophers questioned the meaning, existence, benefits, and justification of progress. French and German philosophers in particular, from the Frankfurt School to the postmodernists, attacked the modernist belief in progress from various points of view. They considered it an ideological product of the Enlightenment's drive to improve the world without regard for the will of its inhabitants. Philosophers such as Karl Löwith and Theodor W. Adorno identified the belief in progress as one of the main culprits in the disasters that befell modern European culture.[5]

Regardless of this critical assessment of the idea of progress, many historians and philosophers of the twentieth century were aware that the idea of progress represented one of the most important categories of modernity. From the beginning of the twentieth century, historians therefore attempted to explain the history and origins of the idea of progress. However, philosophical and historical works often

[5] See Löwith 1963; Adorno 1964; cf. also Loewenstein 2009.

used the concept of progress in a vague way, ignoring the historically shifting semantics of the concept. In my opinion, historical research thus failed to provide a sufficiently convincing explanation of its origins.

A major problem of research to date has been the lack of distinction between concepts such as the progress of humanity, the progress of knowledge, the progress of society, and the progress of history itself. As Reinhart Koselleck and Jochen Schlobach demonstrated, there was no general idea of human progress before the end of the eighteenth century. At that time, progress was spoken of in the plural followed by a genitive (e.g. *les progrés de l'astronomie*).[6] The Enlightenment philosophers distinguished several separate kinds of progress and applied each to different areas of human activity. There was the progress of science, the progress of technology, the progress of morality, the progress of civilization, the progress of society, the progress of economics, the progress of literature, the progress of art, etc. These kinds of progress were often understood to have a tempo of their own, distinct from advances in other areas of culture. Koselleck convincingly explained that a synthesis of all these kinds of progress took place at the height of the Enlightenment. The individual kinds of progress became the universal progress of history. The term 'progress' became grammatically a collective singular expression that tied numerous experiences together into a single word. According to Koselleck, this process occurred in three steps[7]:

> First of all, the subject of progress was universalized. It no longer referred to a delimitable sphere, such as science, technology, art, etc., any of which were formerly the concrete substratum of particular progressions. Instead, the subject of progress was expanded to become an agent of the highest generality, or one with a forced claim to generality: it was a question of the progress of humanity. At first, 'humanity' was not meant as the acting but rather the referential subject, for instance in the sense of those 'hypothetical people' to which Condorcet subordinates all individual instances of progress as an intellectually constructed subject. The chosen people of the Judeo-Christian heritage become the hypostasis of progress. Soon one can also speak of the 'progress of time' and much later, of 'the progress of history'. Thus, out of the histories of individual cases of progress comes the progress of history. This is the second phase. For in the course of the universalization of our concept, subject and object switch their roles. The subjective genitive turns into the objective genitive: In the expression 'the progress of time' or 'the progress of history', progress assumes the leading role. Finally, in a third phase, this expression came to stand alone: progress became 'progress purely and simply,' a subject of itself.

Following Koselleck, other historians were also convinced that at the end of the Enlightenment Age, partial kinds of progress were united in one immense historical current labelled as the progress of humankind (or "man").[8] In this book, I refer to this narrative of advancing humanity (or history itself) towards a better future as the general idea of progress. This idea constituted a key metanarrative of the modern interpretation of world history, which is why it was most often challenged by

[6] Schlobach 2001, 1100; Koselleck 2006, 81–85, 172–173; Rohbeck 2005.

[7] Koselleck 2002, 171–174. In this paper Koselleck summarized his earlier research, see especially Koselleck 1975.

[8] Wagner 2016, 23–25; see also Rohbeck 2008, 859–860; Blumenberg 1996a, 43; Zedelmaier 2003.

twentieth-century philosophical currents that were critical of modernity. This general idea of progress, its origins and history, is not the subject of this book.

The general idea of progress was created by universalizing partial kinds of progress. But where did the partial progress of individual cultural areas come from? Among historians, there is a fairly broad consensus that the progress of science was the paradigm for partial kinds of progress.[9] According to this interpretation, the idea of progress appeared first in the empirical investigation of nature (science) and was then conveyed to other cultural and social areas. The idea of scientific progress served as a formal model for conceptualizing change and improvement in other fields of human culture such as politics, arts, moral or economy because it offered an explanatory formula for the relationship between human actions and historical time that suited the interests and goals of the Enlightenment and modernity. The process of generalization and conveying the idea of scientific progress is also not the subject of this monograph. This book investigates a different question: If the general notion of progress and the partial kinds of progress originally arose from the idea of scientific progress, where did the idea of scientific progress come from?

1.3 Existing Approaches to the Origins of the Idea of Scientific Progress

The difficulty with finding the origin of the idea of (scientific) progress is that historians often do not know what they are looking for because they confuse the general notion of progress, partial kinds of progress, and scientific progress. In the search for the origins of the unspecified and very vague idea of progress (encompassing also scientific progress), three basic narratives have emerged. According to the first, the notion of progress arose as a natural consequence of progress itself. The second narrative explains the emergence of the idea of progress as the result of the secularization of eschatology. According to the third narrative, the idea of progress was already formulated in classical antiquity and its later occurrences were only diverse adoptions of the Greek notion. The interpretations of historians of science who were active in the second half of the twentieth century can be added to these three narratives as the fourth view. In order to better understand the main argument of the book, it is necessary to consider these four narratives in more detail.

The first major works on the history of the idea of progress were written in the early twentieth century by Jules Delvaille (1910) and John Bury (1920). In his book,

[9] In different variations, the idea was formulated by various historians: Bury 1920, 4, 111; Rohbeck 1987, 31, 126–132; Pomian 1988, 54; Rapp 1992, 124; Gembicki and Reichardt 1993, 131–132; Blumenberg 1996a, 38; Schlobach 2001, 1102; Taguieff 2002, 61; Rouvillois 2010, 15–17; cf. Israel 2004.

Delvaille collected progressivist-sounding quotations from the history of European philosophical literature. Bury followed Delvaille in some respects, but he rejected the presence of the idea of progress in classical antiquity and concentrated on the period from the Renaissance to the twentieth century. Both works were important because they provided readers with lists of texts and contexts in which formulations of what both historians regarded as the notion of progress appeared.

The problem with both books was the vagueness of the category of progress, which they more or less identified with overcoming the past and expecting future improvement. Both Delvaille and Bury conflated the progress of civilization, the progress of knowledge, the progress of humanity, or the progress of morality. In their internalist reading, the idea of scientific progress was just an exemplification of the abstract idea of progress. Bury and Delvaille ultimately reduced the idea of scientific progress to a resistance to the authority of the ancient authors and a vague belief in the further perfecting of knowledge. Therefore, according to both historians, the *querelle des anciens et des modernes* represented the original context in which the idea of the progress of knowledge was formulated (Bury 1920, 98–120; Delvaille 1910, 212–221).

Both Delvaille and Bury considered key texts for the genesis of the idea of progress to be Francis Bacon's *Novum Organum* (1620), the short fragment *Préface sur le Traité du vide* (1648) by Blaise Pascal, and Bernard de Fontenelle's essay *Digression sur les Anciens et les Modernes* (1688). According to both historians, these texts reassessed the relationship of philosophy to authority and emphasized the possibility of further advancing knowledge. However, this explanation of the origin of the idea of progress remained rather vague and reductive because the idea of progress brought more to the field than a simple rejection of authority and a belief in the open-ended nature of knowledge.

This is related to another problem with the books written by Delvaille and Bury. Neither historian dealt with the idea of the progress of scientific knowledge found in seventeenth-century scientific texts. Both focused on the texts that made programmatic statements about the relationship of early modern philosophy to the authority of ancient scholarship. The emphasis on capturing the historical self-positioning of early modern philosophy prevented either historian from grasping more precisely the functions that the concept of progress performed in scientific practices themselves and the motives that initiated its introduction. They understood the idea of scientific progress (or the idea of the progress of knowledge) primarily as a category explaining history of knowledge and therefore they interpreted its origins in the framework of the philosophy of history, and not in the context of scientific knowledge and epistemic practices typical of natural philosophy.

Later in the twentieth century, other historians also placed the roots of the idea of scientific progress in the early modern rejection of the authority of Greek philosophy and the *querelle des anciens et des modernes*. The three texts by Bacon, Pascal, and Fontenelle were often considered a new way of conceptualizing the history of knowledge and therefore also the roots of the idea of scientific progress. From this perspective, historians and philosophers such as Hans Robert Jauss, Hans Blumenberg, Reinhart Koselleck, Jochen Schlobach, Friedrich Rapp, and Frédéric

Rouvillois provided valuable interpretations of these texts and the philosophical context of the *querelle*.[10]

However, these historians and philosophers also understood the idea of scientific progress as a historical category that explained the course of the history of knowledge and defined the historical self-awareness of early modern natural philosophy. Unfortunately, they did not pay any attention to the role which historical time played in epistemic practices of natural philosophy and science. Thus, while there is much agreement that the development of scientific knowledge in the seventeenth century was the original source for the birth of the general idea of progress, philosophers and historians have not addressed how the category of progress was used by the seventeenth-century representatives of natural philosophy, such as Galileo Galilei, Pierre Gassendi, Jean-Dominique Cassini, Robert Boyle, Christiaan Huygens, and Isaac Newton. I argue that research conducted from the perspective of the philosophy of history will not help to apprehend the origins of the idea of scientific progress. Instead of inquiring into the period notion of history, it is necessary to study the temporal regime that emerged in epistemic practices of early modern natural philosophy.

The second big narrative about the genesis of the general notion of progress was based on the secularization hypothesis. In the 1950s and 1960s, an interpretation became widespread among philosophers, historians, and theologians that presented the origin of the (general) idea of progress as a consequence of the secularization of Christian eschatology. In his review from 1967, W. Warren Wagar mentioned five main representatives of the secularization hypothesis (in the English-language research): Karl Löwith, Reinhold Niebuhr, John Baillie, Eric Voegelin, and Emil Brunner (Wagar 1967). It would certainly be possible to name other scholars from the continental milieu, but perhaps the most famous statement of the secularization thesis in the field of the philosophy of history was a book by the German philosopher Karl Löwith, originally published in English as *Meaning in History* (Löwith 1949, cf. Barash 1998). Löwith's book dealt with the general idea of progress in the philosophy of history but did not mention scientific progress. Löwith only later applied the secularization model to scientific progress. In one of his articles, he noted that due to the success of scientific progress, the physicist had taken over the place of the theologian and planned progress had assumed the function of providence (Löwith 1963: 34).

The secularization hypothesis was assailed by the German philosopher Blumenberg in the first edition of his *Die Legitimität der Neuzeit* (1966). In the revised edition from the 1970s, Blumenberg widened and diversified his argument. The fundamental philosophical-theological dispute between Blumenberg and Löwith (and also Carl Schmitt in the field of political philosophy) has since become a standard part of the account of how the philosophy of history has been interpreted in the twentieth century. The Blumenberg-Löwith-Schmitt debate has been

[10] Jauss 1964; Blumenberg 1986, 173–208; Schlobach 1980, 226–302; Rapp 1992, 174–176; Blumenberg 1996a, 54–67, 530–543; Rouvillois 2010, 129–165.

summarized and commented on several times and has become a research topic in its own right, so I do not address it here.[11]

What is important for our topic is that Blumenberg formulated fundamental objections to the idea of secularization as an interpretive category. After Blumenberg, other historians and philosophers developed and sharpened his arguments or formulated their own reservations about the persuasiveness of the secularization hypothesis in interpreting the origins of the general idea of progress.[12] Despite this critical assessment, the idea of the secularization of Christian beliefs remains a popular interpretive paradigm for the history of certain categories of modern thought, including the idea of progress. Robert Nisbet, for example, in his widely read *History of the Idea of Progress* (1980), superficially conflated the Christian conception of history, especially Augustine's, with the modern idea of progress, without bothering to mention the serious arguments of Blumenberg and other scholars against the persuasiveness of this construction (Nisbet 1994, 75, 127).

In this book, I do not intend to go into further discussion of secularization. I believe that secularizing interpretations of the idea of progress have been convincingly challenged and disproved. I also think that even without sophisticated philosophical, historical, and theological arguments, the secularization hypothesis should be refuted simply on the basis of a lack of convincing evidence. David Spadafora, for example, simply noted a lack of evidence for Ernest Tuveson's idea that science had secularized eschatology into the idea of progress (Spadafora 1990, 127). This is a very effective remark, because indeed it is hard to find traces of secularization in the texts of seventeenth-century natural philosophers. I also agree with Peter Harrison that secularization is an inappropriate category for capturing the hybrid relations between religion and natural knowledge in the seventeenth century because it is too crude and ideologically and historically loaded (Harrison 2019; cf. Groh 2010). I argue in this book that the idea of scientific progress had its origins in sources other than Christian eschatology, and it is therefore not subject to a secularization hypothesis.

The third major narrative about the history of the concept of progress claims that the concept originated in classical antiquity. Delvaille found the origins of progress in Lucretius (1910, 67–72). Bury rejected the presence of the idea of progress in classical antiquity (1920, 9–13). In 1967, classical scholar Ludwig Edelstein published *The Idea of Progress in Classical Antiquity*, in which he collected a large number of progressivist-sounding passages from ancient literature (Edelstein 1967, 144–154). In their reviews of Edelstein's book, both Albrecht Dihle and Eric R. Dodds argued that while many quotations in Greek literature resembled the

[11] See e.g. Wallace 1981; Schmidt-Biggemann 1987; Monod 2002, 230–279; Koselleck 2003, 185–195; Gordon 2019; Griffioen 2019.

[12] Dagen 1977, 21; Seifert 1982; Seifert 1986; Spadafora 1990, 104–132; Koselleck 2006, 165–166; Günther 1996, 157–158; Rohbeck 2005, 119; Taguieff 2002, 27–29; Rouvillois 2010, 51–57; Sommer 2014.

modern notion of progress, it was possible to find equally many quotations that denied the progress and proclaimed a decline or cycles of flourishing and decay. It is thus impossible to state unequivocally whether the idea of progress existed in classical antiquity.[13]

The debate about the existence of the idea of progress in classical antiquity continued in the years following the publication of Edelstein's book. The main problem, of course, has always been the vagueness of the category of progress and the willingness of some historians to infer an intellectual affinity from the verbal analogies between ancient and modern quotations. In the 2010 edition of the classic Pauly's *Encyclopaedia of the Ancient World* (2010), Wilfried Nippel indicated in the entry 'Progress' that Edelstein's attempt to document the presence of the modern idea of progress in classical antiquity had failed. In fact, in classical Greek and Roman literature, it is only possible to find equivalents of some aspects of the modern idea of progress, such as the improvement of political organization, the succession of stages of subsistence, or the outlines of future advances in natural philosophy and sciences. Referring to the works of Eric R. Dodds (1978) and Christian Meier,[14] Nippel concluded that despite the existence of partial equivalents, a unifying general theory of progress as we know it from the modern philosophy of history cannot be found in classical antiquity.[15]

The view that the Greeks and the Romans developed only partial equivalents of the modern idea of progress can be substantiated in several ways. For example, Koselleck noted that the Greek idea of progress was different from the modern one because it was concerned with the past but did not extend to the future (Koselleck 2002, 221–222):

> In those places where progress was registered in antiquity, it always concerned a look back, not an opening up of new horizons. [. . .] From both past history and the comparison with contemporaneously living barbarians, we thus find, formulated in modern terms, a relative model of progress that recognizes the uniqueness and singularity of the level of civilization reached by the Hellenes. But the path does not lead to the future.

This general remark may also apply to the area where we find the nearest equivalent to the modern idea of scientific progress, which is the field of technology and empirical science. In the Greek sources, the opinion of the superiority of contemporary knowledge and the belief in the gradual improvement of technology and scientific knowledge occurred. But even in these fields, the Greek notion of progress differed from the modern one.

The most important difference was that the Greek belief in the advancement of scientific and technical knowledge had teleological features. Leonid Zhmud noted that for the Greeks 'the notion of progress of *techne* in the past and its nearing perfection in the present come together.' Zhmud called this view teleological

[13] See Dihle 1969; Dodds 1968; cf. also Kehl and Marrou 1978, 749–751.

[14] Meier 1975; Meier 1978; cf. also Thraede 1962; Thraede 1972.

[15] Nippel 1998, cf. similarly Dihle 1988; Rapp 1992, 110–114; Burkert 1997; Neuser 2011; Ritter 2021.

progressivism: 'The more striking the progress that had already been made, the more natural it seemed to believe that the efforts of contemporaries, including their own, would soon reach a perfection not, or unlikely, to be surpassed in the future'.[16] According to Zhmud, furthermore, the idea of progress was limited by rather narrow bounds. Most authors of the Classical and Hellenistic periods who were interested in the historical transformations of knowledge 'regarded progress as either already accomplished or to be completed by the generation to come.'[17] The teleological concept of progress thus provided an optimistic vision of the perfection of knowledge in the present or immediate future. But as with the concept of general progress, the path did not lead to the future.

Another argument against the presence of the idea of general progress and scientific progress in classical antiquity concerns the nature of Greek philosophy. Greek philosophy (including natural philosophy) had in many ways different functions and goals than early modern philosophy. According to Pierre Hadot, Greek philosophy was above all a means of self-creation and self-cultivation. Philosophy was a way of living, not an accumulation of knowledge, nor a means of opening the way to the future. In Hadot's view, knowledge of the natural world was only part of the formation of the self and the path to happiness. Knowledge of nature was not an end in itself and had only a limited function in the larger project of individual perfection. The therapeutic function of philosophy thus excluded concern for the progress of knowledge and happiness of future generations.[18]

All three narratives presented the history of the concept of scientific progress as part of a larger story about the history of the general concept of progress. From this followed the problems that I summarize here in a few points. The notion of scientific progress was treated as just one exemplification of a general idea, as if there were a contextually indifferent, abstract, ahistorical idea of progress that was merely applied to different domains, such as science, technology, society, agriculture, or humanity. Existing research has also suffered from reducing the idea of scientific progress to a historical category that interprets the past or the future and thus belongs to the philosophy of history. This is also related to the fact that historians and philosophers, although they have written about scientific progress, have rarely worked with the texts of representatives of early modern natural philosophy or science. A final problem is that previous research relied on analogies rather than precise contextual analyses and conceptual distinctions. Historians took isolated progressivist-sounding quotations from various texts without more carefully examining whether these quotes expressed the same progressivist paradigm of knowledge.

The last narrative of the origins of the idea of scientific progress can be found in the historiography of science. Among historians of science, there is only one clearly defined approach. This approach originated in Marxism, and its most famous

[16] Zhmud 2006, 79, 114, 121, 210–213; Meier 1978, 291, 297; Burkert 1997, 33–34; Rapp 1992, 114.

[17] Zhmud 2006, 60; similarly Lloyd 1999, 330, note 147.

[18] Hadot 2002, 209–211, 220–231; Hadot 1995, 63–97, cf. Dodds 1978, 24; Rapp 1992, 104–106.

example was an article by the Marxist historian and sociologist Edgar Zilsel (1945). According to this interpretation, the idea of progress did not exist in classical antiquity and came to science from outside, especially from the field of artisanal labour during the rise of capitalism in the early seventeenth century.

Zilsel's sociologizing interpretation of the idea of progress was part of a more general conception that came to be called the Zilsel thesis. According to this thesis, modern science had its origins in early capitalism, the development of technologies, and the interaction of artisans with theorists (Krohn 1976).

In the 1960s and 1970s, with a greater or lesser degree of continuity with Zilsel, Blumenberg, Arthur C. Keller, and Paolo Rossi emphasized the importance of the development of technology for the constitution of the idea of scientific progress.[19] I believe that this type of research is built on outdated methodological foundations and purposely chose cases from the history of early modern science in which the connection between scientific theory and technical practice was evident. Early modern scientists, however, often expressed the notion of scientific progress without any connection to technology or to the practice of artisans. In the following chapters, I argue that epistemology, rather than technical improvement, was the dominant context for the emergence of the idea of scientific progress.

For Zilsel, Keller, and Rossi, the aforementioned problems of three narratives also apply. These historians of science also chose progressivist-sounding quotations from Renaissance and early modern literature focusing on authors such as Loys Le Roy or Fontenelle. From these quotations, they then constructed the idea of scientific or technological progress without taking into account the intellectual context in which these quotations were formulated.

The ordering of progressivist-sounding quotations without considering their context appears in other articles on the history of the idea of scientific progress. For example, both Alistair C. Crombie (1975) and Plinio Prioreschi (2002) in their articles assumed a kind of timeless and abstract idea of progress that is in turn exemplified in history by different authors. I do not think that making lists of various statements that resemble a later idea of scientific progress is the right way to understand the origin of this idea. It must be understood as part of concrete epistemic practices.

1.4 The Idea of Scientific Progress as an Epistemic Category

The definition of scientific progress in the contemporary philosophy of science does not help our inquiry much. Definitions of scientific progress are analytical and already focus on the specific problems of scientific change in contemporary or recent science, which is different from early modern natural philosophy. Philosophers of

[19] Keller 1950; Keller 1972; Blumenberg 2013; Rossi 1996; Rossi 1970; Blumenberg 2009, 18–37.

science also follow agenda that differs from the theme of this book. They argue in favour of various models of scientific progress and examine whether progress is a normative or descriptive category, etc.[20] They also often seem to take the idea of scientific progress for granted without questioning its origins. The main problem, however, is that the contemporary philosophy of science presupposes the timeless existence of certain features of the idea of progress such as the temporal regime of acquiring knowledge and the collectivity of epistemic practices. These epistemic standpoints are neither natural nor obvious and have come to science and natural philosophy under certain circumstances, some of which I want to clarify in the following chapters.

I would characterize the idea of scientific progress quite generally as an idea that considers time a relevant epistemic factor in the knowledge of nature. This is not trivial, because until the end of the Renaissance the tradition of natural philosophy believed that knowledge of nature did not depend on time, or more precisely, time was not considered an important condition for producing knowledge of nature. Introducing time as a relevant epistemic factor meant a complex reconfiguration of ways of knowing nature that involved the emergence of new epistemic practices and the birth of new epistemic virtues that significantly transformed natural philosophy. Thus, I understand the idea of scientific progress, with all its connotations and implications, primarily as part of a new type of epistemology which included the following three features: the temporal regime of acquiring knowledge, the collectivization of research, and the necessity of progressive development in distinct phases.

In order to better understand this epistemological reconfiguration I propose distinguishing two slightly different ideas of scientific progress: descriptive and prescriptive.[21]

The descriptive idea of scientific progress arose from looking into the past and comparing it with the present. On the basis of this comparison, the concept conveys the superiority of existing knowledge over previous knowledge. Knowledge is always perfectible and has a cumulative nature. It improves and grows in proportion to the passage of time. Analogous to biological maturation processes, later knowledge is always more mature. Analogous to the mechanical processes of accumulation, later knowledge is always more extensive because the course of time provides more experience. Thus, descriptive progress is primarily an expression of the experience of accumulating knowledge.

The prescriptive idea of progress encompasses the descriptive notion, but it also includes something more: It is future-oriented and provides natural philosophy with an open-ended character. It is an epistemic category that contributes to the expansion of knowledge and prevents the closure of knowledge into a definitive system. The prescriptive idea of progress encompasses epistemic attitudes such as long-term data

[20] Losee 2004; Niiniluoto 2019.

[21] Both concepts are mentioned in the context of progress by A. C. Crombie, without explaining and elaborating on them; see Crombie 1997, 48.

gathering, constant perfecting of methods and instruments, collective collaboration, data sharing, postponing conclusions to the future, and rejecting preconceptions. It thus brings to natural philosophy a relativist belief that every moment in this development is only temporary because every piece of knowledge will be surpassed or even denied by unpredictable discoveries in future. Each historical form of natural philosophy corresponds to currently available data and the ability to cope with error and prejudice.

Based on comparison with the past, the descriptive idea of scientific progress of knowledge led to the conclusion that the current generation knew more than its predecessors because it had data over a longer period and did not have to start from scratch, i.e. it could build on the work of its predecessors. The prescriptive idea of progress moreover involved the notion that existing knowledge becomes a preparatory stage for the more perfect knowledge of future generations. Contemporary natural philosophers are the precursors of their successors.

The descriptive idea of progress essentially articulated the relation of present knowledge to the knowledge of the past emphasizing the superiority of present knowledge over that of predecessors. We can find the idea in classical antiquity in the form of teleological progressivism. This idea also appeared in all the historical forms of the quarrel between the Ancients and the Moderns. As August Buck, Hans Baron, and Charles Trinkaus[22] have shown, the idea that I labelled the descriptive idea of progress can be found without difficulty in Renaissance versions of the dispute between the Ancients and the Moderns, where it served as an argument against the slavish worship of classical antiquity.

In the early modern period, natural philosophy introduced the prescriptive idea of progress as its essential component. Thus, the progress of knowledge no longer meant a mere assertion of superiority over predecessors. It also assumed the necessity of further development, the open-ended character of knowledge, and the historical relativity of sciences.

It is the prescriptive idea of the progress of knowledge that I understand as the proper idea of scientific progress. My book focuses on the origin and legitimation of this idea.

I would like to finish this section with a minor terminological note. The term ‘scientific progress’ appears in the title of this book, and for the most part in its text. The term is an admitted anachronism. The contemporary history of science, in its recent methodological self-reflection, has shown how tricky it is to carry the modern concept of science and its derivatives into the past. The ancient, medieval, and early modern disciplines of *artes liberales* (*quadrivium*), *naturalis historia*, *philosophia naturalis*, and *scientiae mixtae* should not be unwisely, ahistorically, and simplistically confused with science and its connotations in the modern sense. Yet it seems practical to me to continue to use the term scientific progress. Replacing it with equivalents that would precisely fit the historical context would require complicated formulations that would greatly burden the reading of this book. Even though I retain

[22] Buck 1958; Baron 1959; Trinkaus 1987.

the traditional term scientific progress in my text, I try to avoid the term science (unless it is used as an actor's category) and use the term natural philosophy. For other branches of knowledge that did not fall under natural philosophy, I use their specific names, such as natural history, mixed sciences, astronomy, or optics.

1.5 Methodological Background

This book is a work in the history of natural philosophy and thus stands at the border between the history of philosophy and history of science. Historical research interpreting early modern natural philosophy has in recent years focused quite significantly on the non-epistemic context. The history of science has abandoned the internalist paradigm established by Herbert Butterfield and by Alexandre Koyré and has begun to describe the social and cultural aspects of the history of science by adopting inspirational moments from the sociology of science and science studies. This practical turn in the history of science has undoubtedly broadened the knowledge of the history of modern science and greatly enriched research with new topics and approaches.

In a recent article, however, Tamás Demeter noted that since the publication of the famous book *Leviathan and the Air-Pump* (1985) by Steven Shapin and Simon Schaffer, epistemological stances and debates have been attributed to clashes of political and theological ideologies. Demeter called for a change: 'with an awareness of (. . .) context, it is now worth turning back to questions of the epistemic content itself' (Tamás 2015, 2). I share this opinion. The current social history of science tends to neglect the intellectual context and epistemological nature of some of the problems of early modern science.

Dmitri Levitin has come out even more strongly against the social history of early modern science, writing that the obsession of social historians of science with controversy, politics, and power led to accounts that are often parochial, i.e., concentrating on British culture and society, but still formulating general conclusions. In contrast, Levitin justly noted two important things. First, early modern natural philosophers understood their theories primarily as philosophy, just as their Renaissance, Medieval, and Greek predecessors did. We should therefore also understand and interpret their work as philosophy. Second, the continental natural philosophers conducted natural philosophical research in a way similar to their British colleagues. The research at the Académie des sciences in Paris was much closer to the British experimental philosophy than present-day social historians assume.[23]

I agree with both of Levitin's points. The social history of science has convincingly shown that some epistemological problems had their origins and solutions in

[23] Levitin 2014. See also Levitin's book *Ancient Wisdom in the Age of the New Science: Histories of Philosophy in England*, c. 1640–1700 where he presents his continuity thesis (Levitin 2015).