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Scientific Knowledge in Bacon Philosophy: Insights from Dialectical Materialism

Quynh Thi Nguyen

Lecturer, M.A. in Philosophy, Faculty of Fundamental Sciences, Van Lang University, Ho Chi Minh City, Vietnam, https://orsid.org/0009-0000-5056-3096

***Corresponding author**: *quynh.nt@vlu.edu.vn.*

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Abstract: Francis Bacon occupies a central position in the history of the philosophy of science, representing a pivotal shift from medieval to early modern scientific thought. Therefore, in the contemporary context, understanding Bacon's philosophy is crucial for appreciating the foundations of modern science and its ongoing evolution. The purpose of the article is to examine the enduring relevance of Francis Bacon's philosophy of science, particularly in the context of his emphasis on empirical methodology, experimentation, and the socio-cultural dimensions of scientific knowledge. By analyzing Bacon's contributions, the study aims to elucidate his methodological innovations and their implications for contemporary scientific practice and theory. The work uses thematic and comparative analysis to determine the role of F. Bacon's philosophy in the analysis of the concept of knowledge.The research highlights Bacon's seminal contributions to the philosophy of science, emphasizing his advocacy for empirical methodology, systematic experimentation, and the socio-cultural context of scientific inquiry. By critiquing the methodological limitations of scholastic philosophy and advocating for a methodological overhaul grounded in experience and observation, Bacon laid the groundwork for

modern experimental science. In the conclusion, his integration of dialectical materialism and interdisciplinary perspectives underscores the significance of collective scientific endeavor and the foundational role of natural history in establishing the ontological basis of scientific knowledge. By elucidating Bacon's vision for a science that serves the general welfare of society, the study underscores the continued importance of his insights for addressing contemporary challenges and advancing scientific knowledge for the betterment of humanity.

Keywords: Baconian philosophy, inductive reasoning, knowledge acquisition, progress of science, critical analysis.

Introduction

In the history of human thought, Francis Bacon (1561–1626) is a leading philosopher who has made a significant mark on the path of formation and development of the philosophy of science. Bacon's views on scientific knowledge were presented in his *Novum Organum* "New Method" in 1620 (Donaldson, 2016). This work focuses on the main problems of scientific theory in the philosophy aspect. The "New Method" is considered a historical milestone of cultural transition between medieval thinking and early modern methodological thinking towards the advancement of human thought and that thinking must serve the general welfare of society. Through the work "New Method," Francis Bacon expressed his ambition to improve, innovate and "restore the sciences," direct sciences to practical problems, especially in experimental sciences. The work "*Novum Organum*" marks a critique of Aristotle's philosophy and attacks the medieval way of thinking that has proved outdated in response to the new demands of social reality (Cassan, 2021). The name of the work is reminiscent of Aristotle's Organon, as the name suggests; it is also the successor, critique and further development of the ideas of this predecessor philosopher. In a broader sense, with the "New Method," Bacon is also considered the pioneer of the Enlightenment movement, which flourished in Western Europe later, whose primary purpose was to fight against the remnants of "Night in The Middle Ages", relying on reason (scientific thinking) to guide people towards social progress and development.

It can be affirmed that the philosophical system of Bacon is the philosophy of science. The philosophy of science recognizes science as a socio-cultural phenomenon constituting one of the essences of social existence and human existence, so it needs to clarify the nature, purpose and historical development path (obstacles, ontological foundations, epistemology and methodology of science). This content of the term "philosophy of science" is clearly shown through the philosophical thought of science by Francis Bacon presented in his work "New Method."

The more advanced the age of science and technology, the more necessary science philosophy is than in any previous period of history (Do, 2006, p. 60). High-tech science itself is a new type of creative science, with a breakneck pace of innovation and change; it requires philosophy to have a timely summary and orientation for that change. Because, in the modern or post-modern period, science and technology are an extension of human power. It significantly influences society's movement, development, and existence. Thus, the philosophy of science remains one of the most widely studied and concerning issues in the new century (Do, 2006, pp. 61-63). From this perspective, the Baconian philosophical thought on the science in general and scientific cognitive views, in particular, hold an essential position in the history of the birth and development of the philosophy of science. Therefore, it is thought that returning to Bacon's legacy of philosophical reasoning about scientific knowledge has essential and urgent theoretical and practical significance because it allows clarifying the nature and purpose of science, and removes obstacles on the path of science's development, thereby contributing

to “turning science into a direct productive force”, affirming the position and role of science and technology as a decisive factor for the development of society (Rózsa, 2019). *The purpose of this study* is to characterize the phenomenon of scientific knowledge in Bacon's philosophy through the prism of dialectical materialism. Hence, the study seeks to explore the epistemological foundations of scientific knowledge within the framework of Bacon's philosophy and dialectical materialism. This involves examining questions related to the nature of knowledge, the criteria for truth, and the relationship between theory and observation.

Literature Review

Modern works contributed to the understanding of the philosophical, historical, and theological dimensions of science and its relationship to education, normative systems, and religious beliefs. They offer valuable insights into the complex interplay between science, society, and culture, advancing the understanding of the nature and practice of science in contemporary contexts. Fuller (2023) explored the relationship between science, education, and normative systems. Fuller (2023) examined the influence of Francis Bacon's ideas on modern science and education, contrasting them with Max Weber's views. His work provides a critical analysis of the role of science in contemporary society, highlighting the importance of understanding the historical and philosophical foundations of scientific practice. Anstey (2014) researched the philosophy of experiment in early modern England. Anstey (2014) focused on the contributions of Francis Bacon, Robert Boyle, and Robert Hooke to the development of experimental philosophy, highlighting their methodological innovations and their impact on scientific practice. Hunter (2021) evaluated the relationship between theology and science in the thought of Ian Barbour. He provides a Thomistic perspective on Barbour’s views, offering a critical assessment of his interpretation of the Catholic doctrine of creation. Hamafaraj (2022) examined the relationship between scientific knowledge and religion. Hamafaraj (2022) argued that scientific knowledge both builds upon and is indebted to religious traditions, highlighting the interconnectedness of science and religion in shaping human understanding of the world.

Minazzi (2022) investigated the intersection of epistemology and the history of science, focusing on how historical perspectives on scientific knowledge shape the understanding of epistemic issues. Priest (2020) argued that philosophy is inherently historical, and understanding the history of philosophy is crucial for understanding contemporary philosophical issues. He provided a nuanced analysis of the nature of philosophy and its historical development, challenging traditional views on the relationship between philosophy and its history. These works contributed to understanding of the philosophy of science, epistemology, and the history of philosophy.

The role of F. Bacon in philosophy is shown in other papers. Jalobeanu (2019) explored how the experimental philosopher can benefit from a theoretically informed history of philosophy. This work is part of the broader context of early modern philosophy, emphasizing experimentation, speculation, and religion. Jalobeanu (2021) wrote about Bacon’s Novum Organum and offers insights into reading this seminal work. This piece contributes to epistemology and the philosophy of science, shedding light on Bacon’s approach to metaphysics and methodological considerations. Jalobeanu’s (2023) further expanded on Bacon’s ideas. This work likely examines Bacon's thoughts on measurement and its role in scientific inquiry, providing a nuanced understanding of Bacon's contributions to the development of scientific methodology. Overall, Jalobeanu’s papers provided valuable insights into Francis Bacon’s philosophy, offering a rich understanding of Bacon’s views on various philosophical and methodological issues. Her works contributed to the ongoing scholarly discourse on early modern philosophy and Bacon’s legacy in the history of ideas.

Sawchuk (2020) proposed a dialectical materialist methodology for understanding work, learning, and political economic consciousness. He advocated for a "mind-in-activity" approach that emphasizes the dynamic interplay between mind, activity, and material conditions in shaping individuals' understanding of the world. Skordoulis (2022) provided an overview of dialectical materialism as a philosophical framework. He explored the historical development of dialectical materialism, its key concepts, and its application to educational theory and practice, offering a comprehensive resource for scholars interested in Marxist perspectives on education. Psaros (2022) critically reflected on the intersection of learning, digital technologies, and sociomaterial approaches from the perspective of materialist dialectics. The author examined how digital technologies shape learning environments and practices, highlighting the importance of considering the material conditions of learning in the digital age. Together, these works contribute to the scholarly discourse on dialectical materialism and its application to various fields, including education, psychology, and political economy. They offer valuable insights into the complex interplay between mind, material conditions, and social structures, advancing the understanding of dialectical materialism as a critical theoretical framework.

Research Methodology

General Background

Bacon's science in the context of the need to criticize the old and unfashionable way of thinking, hindering the development of science and building new cognitive perspectives, paving the way for scientific development. Therefore, the research aims to elucidate the relationship between scientific knowledge as conceptualized in Baconian philosophy and insights derived from dialectical materialism.

Selection of Scientific Literature

For this article, the inclusion criteria for scientific literature were defined as follows:

1. Scientometric Databases.

The search for relevant sources was conducted using databases such as Google Scholar, Ebsco, IndexCopernicus, Scopus, Web of Science (WoS) and Taylor and Francis. These databases offer comprehensive coverage of scholarly literature across various disciplines, ensuring a diverse range of sources for analysis.

The search strategy involved the use of keywords related to the research topic, including "Baconian philosophy", "dialectical materialism", "knowledge", "empirical method", and related terms. This ensured the retrieval of articles specifically addressing the intersection of Bacon's philosophy with dialectical materialism. The search was limited to literature published within the last two decades to ensure relevance and timeliness of the sources. The date range spanned from 2003 to the current year, allowing for the inclusion of recent scholarly contributions while still encompassing a sufficient breadth of literature. However, the work uses several works of later years - authors who made a fundamental contribution to the study of the figure of Bacon.

Data Analysis

Data analysis involved a systematic approach to synthesizing and interpreting the findings from the selected scientific literature. The following methods were employed thematic analysis, comparative analysis and critical evaluation.

The selected articles were subjected to thematic analysis to identify recurring themes, concepts, and arguments related to the research topic. This involved categorizing and organizing the literature based on key ideas such as Bacon's empirical methodology, dialectical materialist perspectives on science, and intersections between the two frameworks. A comparative analysis was conducted to explore similarities, differences, and points of convergence between Bacon's philosophy and dialectical materialism in their treatment of scientific knowledge. This involved examining how each framework conceptualizes the nature of reality, the role of observation and experimentation, and the social context of scientific inquiry. The literature was critically evaluated to assess the strengths, weaknesses, and implications of integrating Baconian philosophy with dialectical materialism for understanding of scientific knowledge. This involved questioning assumptions, identifying contradictions, and considering alternative interpretations presented in the literature.

Overall, the data analysis process aimed to provide a comprehensive and nuanced understanding of the relationship between Baconian philosophy and dialectical materialism in shaping scientific knowledge, drawing insights from a diverse range of scholarly sources.

Research Results

The need for a new method of scientific perception

Bacon points out the outdated ways to affirm the need for a new scientific cognitive method (Peltonen, 2007). He said that the methodological backwardness of scholastic philosophy was especially evident when bourgeois production and technical invention flourished. Scholastic philosophy cannot become a vehicle for scientific discoveries and new technological inventions; it cannot explain the process of scientific discovery but stops at relying on a genius hunch, the scientist's intuition (Pérez-Ramos, 1988; Pérez-Ramos, 2023). Theoretical methods lead to a subjectivity that, when applied, no one can explain precisely how he came to his point of view. From there are innumerable hypothetical systems. According to Bacon, these theories are no longer relevant to new scientific tasks because their concepts are wrongly separated from things. There is a need for a correct method of conceptualization. Methods oriented toward analyzing existing ideas cannot correct the fundamental mistakes when forming abstract concepts. Attempts on this path only increase errors. Emphasizing the need for a suitable method, Bacon repeated that whoever follows the right path will reach the goal of those who follow the wrong path; the faster they go, the sooner they make mistakes.

For Bacon, by discovering the laws of nature, natural science needs to become a powerful tool for technical innovations that lead to real human power. It is required to transform all existing sciences that are not currently intended to be reformed. In order to turn science into the art of exploration, it is required to equip it with appropriate methods. The need to develop new methods stems from the fact that, although people possess innate cognitive abilities, they cannot achieve any results due to the lack of necessary means. This world-building and its structure is a maze to the human reason observing it. This reason always encounters countless tangled paths that cannot find a way out in that maze by themselves. Neither experience nor reason has great power by themselves.

Francis Bacon considers the theory of method the main task for the great instauration of the sciences and the most important of all existing problems. He believes that it is necessary to create new methods and use them for building and developing science (Bacon, 2016). Natural science has only recently been established, but "there is something insane and self-contradictory in supposing that things that have never yet been done can be done except by means never tried." (Bacon, 2003, p. 34) Thus, Bacon was the first to declare that the mission of advanced philosophy was to develop new methods. He

further explains that if it is possible to get everything with money, then it is possible to build all other sciences by this science, that is, by new methods. If one particular discovery is to be appreciated, it is necessary to appreciate the enablement and discover others (Rees, 2000). If the method implies the possibility of all other discoveries, then, in turn, If these discoveries led to the domination of nature, the formulation of methods would be the most helpful product of the time.

Discussing the relationship between new scientific methods and new technical means, Bacon argued that bare hands and free reason would not have great power. The work is done by the tools and aids needed by reason no less than manual labor. Just as the tools of the limbs provide natural movement, the tools of the mind give direction to reason and protect it. The results will be insignificant if people perform mechanical works with bare hands, without the help of tools. Likewise, science cannot hope to achieve any significant achievements without the aid of the proper method. Bacon pointed out that, in all the vital work performed by human hands without tools and machines, the power of separate people cannot be fully utilized. He implied that the efficiency of bourgeois production was greatly enhanced through cooperation and division of labor in the workshop. He assumes a similar thing will happen in science; the new scientific method needs to be adapted to the cooperation and division of labor in scientific activity. At the same time, the speculative method is directed only at using one's reason and teaching how to act crazy according to a specific rule. Suppose the quality of a product in manual production depends entirely on the craftsman's skill. In that case, the process of scientific discovery in new forms of scientific development should not depend solely on talent.

Bacon believes that scientific development occurs only with capitalist production; therefore, the need for a new method is inevitable. He comprehensively studies the rigorous and in-depth method of natural perception so that human reason does not act arbitrarily from the beginning in any way. Confronting his method with abstract speculations, Bacon asserts,

> "*Our path of scientific discovery has shown that it leaves little to talent's depth and vigor, but seems to scratch with them. Just as the fortitude, dexterity, and experience of the hands are essential to drawing a perfect line or circle, if only the hands are used, they will be of little or no importance if a ruler is used and compass; the situation is the same with our method*" (Do, 2006, p. 25).

Bacon's significant contribution is that he understands the need for the collective assistance of leading scientists. He foresaw the role of the scientific community, and no scientific work could be accomplished outside the scientific institution (Zinner, 2008). It is clear that Bacon asserts that the rigor of the scientific method is primarily associated with the scientist's need for creative intuition to submit to the nature of things.

Ontological basis of scientific knowledge

The ontological basis of scientific knowledge is the factors that ensure the existence of science. This factor determines the worldview (materialist or idealist) position of the philosopher in the origin and science content question. In advance, it can be said that Bacon's conception of the ontological basis of scientific knowledge is his most important contribution, making him one of the arguers, laying the foundation for modern science. His materialist philosophical approach to the ontological basis of science has allowed science to focus on reality, and through which the knowledge brought by science is vital for human beings to conquer nature (Hylton, 2010).

Bacon believes that science should be based on experience, but due to the infinite diversity of experience, it is impossible to grasp it without an appropriate method. Only induction can generalize experience and discover the laws of nature, but induction itself cannot provide data for perception. Natural history needs to do this work—those who consciously perceive the real-world need to find all

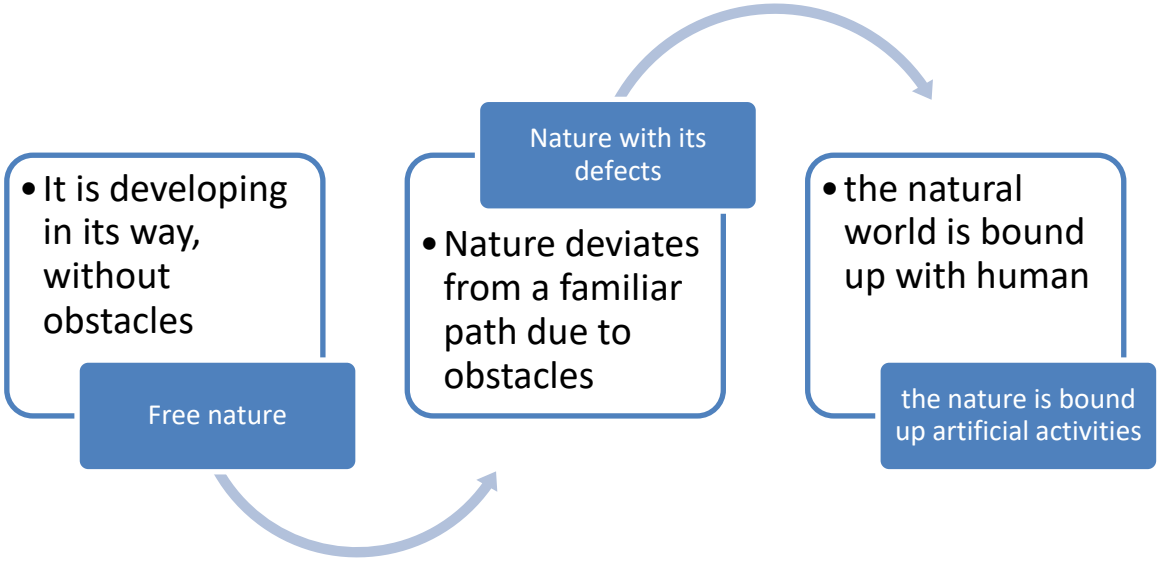
things themselves. Even with gathering all the powers of all minds, no single wisdom can be sufficient to replace the accumulation of data about the world. The claim to the construction of natural history was connected with his direct interest in the planned accumulation of social experience and its insight into the basis of experimental science. He considered natural history an essential part of the significant restoration of science. The attitude to experience shows the opposition of the new empirical science to the old speculative philosophy. If speculative philosophy is based on experience, it is merely incidental experience. Therefore, it is entirely reasonable that Bacon asserts that "it is necessary to find the beginning of the restoration of science in natural history" (Bacon, 2003, p. 8). Furthermore, he made specific claims about natural history as follows (Grant, 1994).

First, Only apparent data should be included in natural history, and nothing glamor should be included to cause surprise. Bacon was interested in disproving common, valid and documented fabrications throughout the centuries since they were all mere myths. Considering the needs of the experimental natural sciences, he stressed the need for the accurate processing of large amounts of data. For him, nothing has been ordered, checked, calculated, weighed, or measured so far in natural history. He did not forget to reflect in order to correct the error that lurks in natural history due to false experience so that he could "reject and eliminate erroneous experience based on discovered causes." (Do, 2006, p. 33) Afterward, the rigorously enforced experience requirement became the principle of all experimental natural science.

Second, Natural history must be directed towards the experience that characterizes all phenomena comprehensively, not one-sidedly. This is against the speculative method based on random experience. According to Bacon, nothing stands in the way of philosophy like the fact that people are not interested in them and do not seek their causes. It is impossible to judge beautiful things and create new things without discovering the cause of ordinary things. There is nothing that does not deserve scientific attention. Everything is subject to the laws of nature so that each thing can illuminate the perception of those laws. Thus, even the most ordinary things must be recognized as the most precious and most beautiful things in natural history. Natural history is not offended by that, for "whatever is worthy of being is worthy also of knowledge, which is the image of being." (Bacon, 2003, p. 92) In natural history, Bacon proposes to consider some important aspects (See Figure 1).

Figure 1.

Key components of natural history by Bacon



Source: Author's development

Bacon proposes to separate the basic properties of things. The natural history of these properties is critical, for they allow the discovery of the nature of things. He exhibits an analytic tendency in scientific research, which is his methodological limitation. However, he also emphasized studying nature's miracles (exceptions). Bacon rightly predicted that studying "pathology" in different fields could become a very effective means of scientific knowledge. He calls this distinct natural history. Another task of this natural history is to debunk fabricated data, imaginary miracles, etc.

The authors of the article believe that the most important part of natural history is the history of mechanics, and the experience includes the accumulated production experience in history. Bacon offers a practical and close to a scientific explanation of experience considering the actual production. He intends to overcome the intuition in experiential interpretation to counter the speculative and subjective, although he cannot yet understand reality as the activity of improving social relations. His approach, however, contained the seeds of a materialist conception of reality (Rusu, 2021). Francis Bacon conceives experience as intuition and description of things and as man's transformation of them. According to him, natural history should capture free and artificial nature data. He valued man's most fabulous creations and showed a connection between technical experience and the method of generative history. It is easy to understand that "mechanical history" and the method of generative history refer to the same thing: the appearance of things. Therefore, Bacon is particularly interested in considering all practical activities. Although there are certain limitations in completing natural history, it is necessary to evaluate Bacon's contributions in this field objectively; especially in the methodological matter of the natural sciences. He brilliantly captured the fundamental turning point in the development of science.

The nature of scientific knowledge

Standing on a materialist stance, Bacon said that the universe has no other cause than itself; the cause of any phenomenon and anything can only be another phenomenon or thing. He, therefore, disapproves of those who seek the common cause without trying to realize the cause of the lower and dependent things. To denote the cause, Bacon uses the term "form" derived from Plato and Aristotle. For him, the basis is the interpretation of form as the cause expressed through the laws of nature. Thanks to this concept, Bacon clearly defines the nature of scientific perception. Besides, Bacon also uses other synonyms when asserting that form and law are the same (Skordoulis, 2022). Bacon said that the nature

of things is the source for their manifestations, so nature is the cause of phenomena. Things often change due to their diverse manifestations, so nature is the law of change and phenomena. Hence nature, cause and law are just different aspects of the same inner content of things. His approach to metaphysics differs from scholastic philosophy. For Bacon, metaphysics is not a doctrine of supernature but an essential part of the doctrine of the natural world. He affirmed that metaphysics is one of the parts of natural philosophy, which is different from the "first philosophy" - the doctrine of the foundations of existence, which includes the general principles of all sciences.

In addition, there is no room for self-interest in studying the laws of nature. Metaphysics studies only the practical purposes and then interprets practical results based on perceived objective necessity. As for the perception of forms, he distinguishes metaphysics from physics on a general level: physics studies the material and permanent, while metaphysics mainly deals with the abstract and immutable. Physics considers nature "in the state of dispersion, that is, all things are varied. In essence, physics and metaphysics study the same number of things and their properties. According to Bacon, the form should be universal. Physical causes are not formal. The separation of metaphysics into a specialized field of the natural sciences has highlighted the role of analysis in contemporary science. From here is the orientation to perceive the laws and common causes through the path of analysis, going from the particular to the general. It reflects the ripe need for the natural sciences to move from general abstractions to the study of parts. It is a progressive trend; Bacon considers metaphysics not yet fully developed. However, it must necessarily be part of the science of the natural world. In addition, Bacon believes that finding the simple in the complex as a starting point in explaining the complex and the preliminary division into simple parts is a requirement for the rigor of the scientific method. This requirement has been accepted by philosophy and modern science; it is not separate from the analytical trend. By adhering to it, near-modern natural science has achieved remarkable achievements. However, it also contains the germ of reductionism - reducing the whole complex to the simple, ignoring the peculiarities of the complex (the whole), and combining the parts into a whole (Nguyen, 2022). Bacon's stance includes both the germ of reductionism and the possibility of overcoming it because he introduced the element of relativity and the concept of simplicity. Questioning analysis in new terms, he developed the tradition of ancient atomism. He asserted, "it is better to dissect nature than to abstract; as the school of Democritus did, which penetrated more deeply into nature than the others." (Bacon, 2003, p. 45) Bacon suggests paying particular attention to data that outlines the composition of parts of the universe and analyzing its parts. Analysis plays a crucial role in Bacon's methodology, reflecting the historical need for a transition to the study of parts, without which it is impossible to study the whole. The fact that Bacon put the analysis problem first stems from the need to make the materialistic worldview formed by ancient thinkers a solid basis for practical knowledge (Nguyen, 2022). The study of parts and details of the natural world took significantly slower than the formulation of general principles about the worldview .

Bacon has highlighted several achievements to defend the emerging empirical natural science. For him, the analysis of the natural world means perceiving forms and direct and actual division of things utilizing labor and means for discovering indirectly observed structures of objects, their "masking scheme". Nevertheless, he believes that all of that is only the beginning of perception. It is concerned with the subtle differences between the tiny parts and their invisible movement but substantial effects. They have not been studied, so they somehow need to be captured by experience. Bacon set out to analyze the task of not dividing things but penetrating experimentally into concealed structures and invisible processes, primarily through rational research methods. He affirmed that separating and dividing the natural world is necessary, not by fire, but by reason, which seems to be divine fire (Nguyen, 2010, p.113). The division of things will be more efficient through inference and induction, "with auxiliary experiments; and by comparison with other bodies, and the reduction to simple natures and

their forms." (Bacon, 2003, p. 108) Karl Marx gives a very in-depth assessment of Bacon's research method: Science is an empirical science and manifests itself in applying a rational method to sensory data. Induction, analysis, comparison, observation, and experiment are the essential conditions of the rational method (Nguyen, 2022).

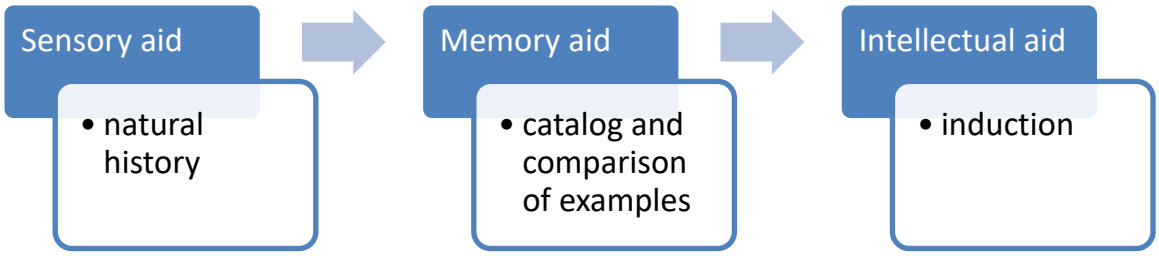
The rational analysis begins with facts and goes to "general forms" through "private forms," i.e., the most abstract concepts and properties. Unlike the abstract concepts of speculative philosophy, these are based on the specific study of things (Do, 2018). According to Bacon, it is possible for someone to feel forms are non-specific because they combine different things. However, the analysis also unites different things according to their common properties by dividing things into attributes and studying them one by one, seeking unity stemming from the general unification of the natural world (Le, 2020). Bacon asserts that one who understands the form of things grasps the unity of nature in other matters. Generalization means reducing the complex and diverse to the simple, unified, i.e., unifying or reducing the complexity. Thus, through analysis, perception clarifies that the relationship between things is made through their common properties and the laws that regulate them. This conception is the first step to a scientific understanding of the universal unity of the world. It needs to be awarded by the scientific method - the new induction.

The path of scientific knowledge

It can be said that Bacon's entire creative career was mainly devoted to showing the path of scientific perception and building a new method of scientific perception - induction. With this method, he first derives premises from empirical observation and then separates new experiences from the premises. He believes that his method "is not to draw results from results or experiments from experiments (as the empirics do), but (as true Interpreters of Nature) from both results and experiments to draw causes and axioms, and from causes and axioms in turn to draw new results and experiments." (Bacon, 2003, p. 90) Generalization of experience, going from it to the postulate, and presenting the laws of nature (i.e., induction in the narrow sense) is only one aspect of Bacon's method. Another aspect of it is the use of deduction to derive consequences from the premises of science to apply them to experience and practice. This first division is, in turn, further subdivided into sub-divisions – "sensory aid" (natural history), "memory aid" (catalog and comparison of examples) data capture so that reason can act upon them, "intellectual aid"(i.e., induction) (See Figure 2).

Figure 2

Bacon's idea of the role of deduction and induction in scientific knowledge



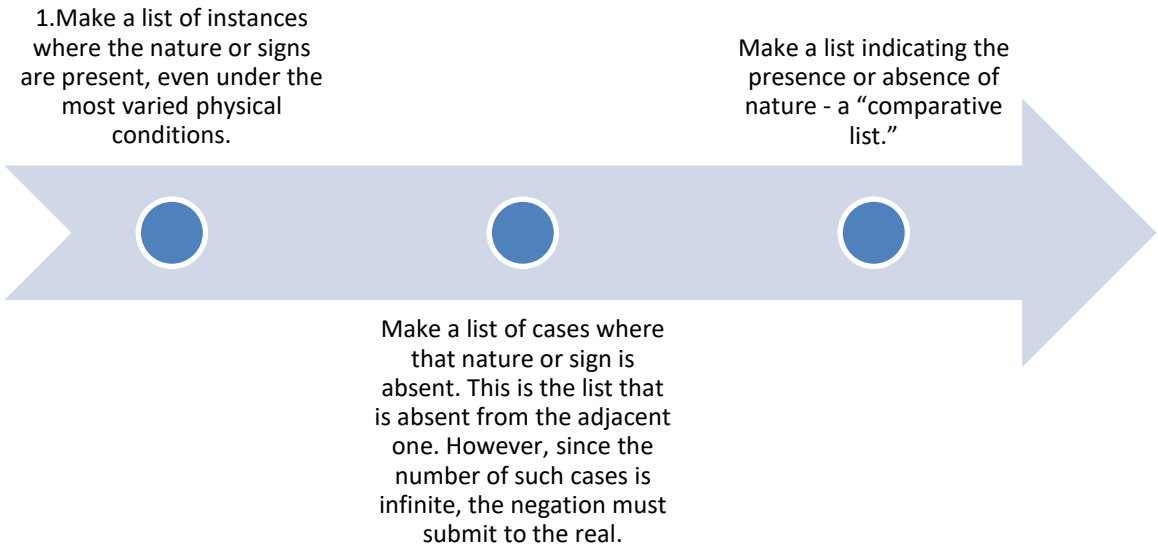
Source: Author's development

According to Bacon, induction only begins when there is enough factual data. This is the materialist stance as the basis for the scientific cognitive methodology. Thereby, induction has the task of

determining the cause of things or discovering another nature that can be transformed into this essence (Hubbell & Ryan, 2021).. The cause is what gives birth to another. From the materialist point of view, the main thing here is causality - the necessary relationship between cause and effect (Breda, 2024). Bacon gives specific steps on the path of scientific knowledge. Figure 3 shows this"presentation list".

Figure 3

Model of specific steps on the path of scientific knowledge



Source: Author's development

Hence, these categories provide data to reason, then the induction itself begins to take place. The first step of reason gives the first definition of form – "harvesting the first fruit". The induction process is referred to as eliminating the absent essences in a given case. Elimination leaves a natural, stable, accurate, and utterly concrete form. This whole process is done by reason. According to Bacon, the most important thing here is the operation of elimination (negation). Just one case in the exclusion list is enough to disprove the form hypothesis. Therefore, the opposing argument has excellent power in constructing all true premises (Bevery, 2020). The arguments of Bacon stipulate the special significance of negative cases in induction - eliminating the nature or signs that have no relation to the form to be sought. Thus, Bacon tries to study form (the positive) through the negative. Although induction is not finished until a form is found, it is an exclusion that lays the groundwork for proper induction. It should not be rushed to establish a form based on only a tiny number of affirmative cases, thereby building false premises and concepts. Such is the induction of the scholastic philosophers because they do not know the method of elimination, so it leads only to an unwarranted premise. According to Bacon, if not influenced by false reasoning, relying on his innate strength, Human natural reason can perform induction more perfectly than scholastic philosophers. However, it is still not as effective as scientific induction. Bacon first presented how induction is systematic, and this is his significant scientific contribution. Bacon's most important innovation in induction is the elimination process.

The authors of the article believe that despite emphasizing the importance of new induction, Bacon still understands that objective truth can only be achieved on Sthe path of combining induction with deduction. He sought a means of overcoming the limitation of induction. The first step on this path

is the preferred case or decision experiment. They allow choice when reason fluctuates, choosing to assign the cause of the phenomenon under study to which of several natures.

The next step is to combine analysis with synthesis. Although Bacon lived in a period when natural science moved from abstract arguments about nature to the analysis of particular things, he did not wholly absolutize the analytical method. He did not acknowledge the absolute opposition between analysis and synthesis. In the perception of nature, analysis requires synthesis since it is conducted with the original assumption of the general unity of nature. According to Bacon, analysis allows us to achieve the most outstanding achievements in studying nature. Synthesis is useless, and even preliminary analysis is indispensable because the form of tangible things is very complex. However, analysis is not an end in itself for Bacon. Its task is to prepare conditions for synthesizing concrete things and recreating that thing in practice based on the perceived form. In turn, perceiving "abstract" (analytical) characteristics only ends in the perception of concrete (synthetic) things because Bacon argues that this perception prepares a rational (theoretical) synthesis and a practical synthesis between concrete things.

The authors of the article believe that according to Bacon, the cognitive process consists of two aspects. On the one hand, the perception comes from tangible things is made sense, then through analyzing them into abstract features and then perceiving the causes of those features. On the other hand, perception goes from abstract forms to their interpretation employing concrete things. In summary, Francis Bacon conceives that perception is a complex and contradictory process in which analysis and synthesis interact.

Discussion

Therefore, the results testify to the significance of Francis Bacon's contribution to the development of scientific method and epistemology. They confirm that Bacon did recognize the importance of scientific community collaboration and collective expertise in scientific research. They also confirm that Bacon emphasized the importance of empirical observation and systematicity in scientific research, but at the same time he also understood the limitations of the inductive method alone and sought ways to overcome it through deduction and solution experiments. The specified aspects are confirmed and studied in detail in other modern works, which highlight the theory of Bacon's philosophy (Miner, 2023; Kivotidis, 2024).

The results indicate that Bacon saw the importance of a combination of analysis and synthesis in the study of nature, which allows for a fuller and deeper understanding of the subjects of study. Thus, these results testify to the relevance and diversity of Francis Bacon's ideas in modern scientific discourse.

The study's emphasis on the collective assistance of leading scientists and the role of the scientific community aligns with the views of Zinner (2008), who emphasized the importance of collaborative scientific endeavors. Both this study and Zinner (2008) underscore the necessity of collaboration and institutional support for scientific progress.

Moreover, the author's mind about Bacon's advocacy for the importance of experience and induction in scientific inquiry is consistent with the broader empirical tradition in philosophy of science. Scholars like Grant (1994) have highlighted Bacon's recognition of the need for systematic observation and experimentation in the construction of natural history, which forms the basis of experimental science.

However, while Bacon emphasizes the significance of induction in generalizing experience and discovering the laws of nature, the authors of the article suggest that Bacon also recognized the

limitations of induction alone. They argue that Bacon sought to overcome these limitations by incorporating deduction and decision experiments into the scientific process. These aspects are also discussed and described in detail in modern scientific works (Gannon et al., 2022; Sharpe, 2019; Remmling & Remmling, 2022).This perspective adds nuance to Bacon's methodology, suggesting a more complex interplay between induction and deduction in the pursuit of objective truth.

Moreover, recent research has delved into Francis Bacon's utilization of Renaissance reading and writing practices as foundational elements in proposing a groundbreaking method for comprehending nature (Werlin, 2020). Despite his pioneering efforts, the research proved that Bacon remained cognizant of the inherent vulnerabilities within these techniques, which were susceptible to errors, miscommunications, and failures. This awareness is exemplified in his utopian narrative, "New Atlantis," where instances of misinterpretation surface, demonstrating Bacon's acknowledgment of the potential for misreading within his vision of a decipherable world (Werlin, 2020; Verburgt, 2021). This nuanced understanding suggests that Bacon's aspiration for a legible world also encompasses the acknowledgment of the possibility of misinterpretation, enriching perception of his philosophical framework and its complexities. Hence, the contemporary scientific literature extensively examines and elaborates on these aspects. Scholars delve into the intricacies of Francis Bacon's utilization of Renaissance reading and writing practices as foundational elements in his proposal for a new method of comprehending nature (Werlin, 2020; Brown, 2023). Moreover, recent research thoroughly explores Bacon's acute awareness of the inherent vulnerabilities within these techniques, which were susceptible to errors, miscommunications, and failures (Anderson, 2022). These discussions in modern scientific literature enrich the understanding of Bacon's philosophical framework by providing detailed insights into its complexities and nuances.

Furthermore, the authors of the article underscore Bacon's profound recognition of the inherent interdependence between analysis and synthesis in the study of nature. While Bacon acknowledges the pivotal role of analysis in deconstructing complex phenomena into manageable components, he equally emphasizes the indispensable need for synthesis in reconstructing concrete objects based on perceived forms (Páez Bonifaci, 2020). This holistic perspective challenges the conventional dichotomy between analysis and synthesis, advocating for a more integrated approach to scientific inquiry that encompasses both aspects seamlessly.

This nuanced understanding of Bacon's philosophy elucidates both areas of agreement and divergence with the views of other scholars. On one hand, Bacon's emphasis on collaboration, empirical observation, and systematic methodology resonates with broader trends in the philosophy of science, affirming the importance of collective endeavor and rigorous methodology in scientific inquiry (Çimen, 2019). However, Bacon's unique approach to induction, deduction, analysis, and synthesis adds depth to this understanding of scientific inquiry within the Baconian tradition, diverging from more rigidly defined methodologies proposed by other scholars.

In essence, the discussion unveils the complexity and richness of Bacon's philosophical framework, highlighting its compatibility with contemporary scientific thought while also showcasing its distinctive contributions to the philosophy of science. By reconciling seemingly disparate elements such as analysis and synthesis, Bacon offers a comprehensive approach to scientific inquiry that transcends traditional boundaries and invites scholars to explore new avenues of research and inquiry.

Conclusions and Implications

Hence, Francis Bacon's lasting legacy in the philosophy of science is a testament to his visionary approach to scientific research and methodology. The study demonstrated that through his seminal work Novum Organum, Bacon not only criticized prevailing Aristotelian and Scholastic methodologies,

but also laid the foundation for a new paradigm of scientific thought, emphasizing empirical evidence, inductive reasoning, and the utility of science for the development of society. His advocacy of a methodological revolution based on experience and experimentation paved the way for the modern scientific method, emphasizing the importance of systematic observation, analysis, and the collective efforts of the scientific community.

Bacon's philosophy of science, which focuses on the sociocultural aspects of scientific knowledge, the ontological basis of science, and the need for methodological revision, remains relevant in today's rapidly evolving scientific environment. His understanding of the nature of scientific knowledge, the role of natural history, and the importance of empirical data in establishing scientific laws greatly contributed to the development of experimental science and the broader Enlightenment movement. As the complexities of the 21st century are navigated, Bacon's call for science to serve the common good of society and his vision of a collaborative, methodologically sound scientific community resonate as never before. His contributions highlight the critical relationship between science, technology, and society, and remind us of the continuing need for philosophical reflection on the nature, purpose, and direction of scientific inquiry. In conclusion, Francis Bacon's work is a cornerstone in the philosophy of science, offering ideas and methodologies that continue to influence scientific thought and practice, affirming the role of science as a pivotal force in social development and human progress. Moving forward, it is imperative to heed Bacon's calls for methodological rigor, interdisciplinary collaboration, and the ethical use of scientific knowledge, ensuring that science continues to serve the betterment of humanity.

Suggestions for future research

From a philosophical standpoint, the implications of Francis Bacon's philosophy hold significant importance for society and are therefore relevant. Bacon's philosophy, characterized by its emphasis on empirical evidence, systematic observation, and the collective advancement of scientific knowledge, continues to inform contemporary discourse on the nature and purpose of science. In light of this, several avenues for future research emerge. For instance, future research could investigate how Bacon's philosophy can address pressing societal challenges in the 21st century, such as ethical considerations in scientific research or the ethical use of emerging technologies. By exploring the relevance of Bacon's ideas in modern contexts, researchers can contribute to the ongoing dialogue on science and society.

Another area of inquiry could involve examining how Bacon's philosophy is interpreted and applied in different cultural contexts around the world. By exploring cultural variations in understanding and practicing scientific knowledge, researchers can gain insights into the universal and culturally contingent aspects of Bacon's philosophy. Moreover, historical case studies could be conducted to examine the practical implications of Bacon's philosophy on scientific discoveries and movements throughout history. By analyzing historical examples, researchers can elucidate the influence of Bacon's ideas on the development of scientific thought and practice over time. Adopting interdisciplinary approaches, researchers could explore the intersections between Bacon's philosophy and other fields, such as sociology, anthropology, or psychology. By examining how Bacon's ideas intersect with and inform other disciplines, scholars can contribute to a more holistic understanding of scientific knowledge production.

Finally, comparative studies comparing Bacon's philosophy with other philosophical frameworks could provide insights into the unique insights and limitations of Bacon's approach. By comparing Bacon's philosophy with other frameworks, researchers can contribute to a deeper understanding of the diversity of philosophical perspectives on scientific knowledge. In conclusion, future research on Francis Bacon's philosophy of scientific knowledge holds the potential to deepen the understanding of the role of science in society and contribute to ongoing discussions on the nature and purpose of

scientific inquiry. By exploring these avenues of inquiry, scholars can build upon Bacon's legacy and continue to advance the understanding of the philosophical fou ndations of science.

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References

Anderson, W. (2022). History and philosophy of science takes form. *Studies in History and Philosophy of Science*, *93*, 175–182. https://doi.org/10.1016/j.shpsa.2022.04.001

Anstey, P. R. (2014). Philosophy of Experiment in Early Modern England: The Case of Bacon, Boyle and Hooke. *Early Science and Medicine*, *19*(2), 103–132. https://doi.org/10.1163/15733823-00192p01

Bacon, F. (2003). *Francis Bacon: the new Organon* (L. Jardine & M. Silverthorne, Eds.). Cambridge University Press.

Bacon, F. (2016). *New Atlantis and The Great Instauration* (J. Weinberger, Ed. 2nd ed.). Wiley-Blackwell. https://www.wiley.com/en-us/New+Atlantis+and+The+Great+Instauration%2C+2nd+Edition-p-9781119098010

Bevery, J. (2020). Moral Philosophy: A Contemporary Introduction. *Teaching Ethics*, *20*(1), 172–174. https://doi.org/10.5840/tej20202012

Breda, S. (2024). Materialism and dialectics. In *Marx: Key Concepts* (pp. 16–31). Edward Elgar Publishing. https://doi.org/10.4337/9781800880764.00007

Brown, S. (2023). Renaissance philosophy outside Italy. In *The Renaissance and 17th Century Rationalism* (pp. 70–103). Routledge. https://doi.org/10.4324/9781003419532-3

Cassan, E. (2021). "A New Logic": Bacon's Novum Organum. *Perspectives on Science*, *29*(3), 255-274. https://doi.org/10.1162/posc_a_00368

Çimen, Ü. (2019). Francis Bacon and the Relation between Theology and Natural Philosophy. *Synthesis philosophica*, *34*(1), 105–123. https://doi.org/10.21464/sp34108

Do Minh Hop. (2018). The problem of subjectivity in modern Western philosophy, *Journal of Philosophy*, (1), 29–33.

Donaldson, I. M. L. (2016). Francis Bacon's comments on the power of negative observations in his Novum Organum, first published in 1620. *Journal of the Royal Society of Medicine*, *109*(12), 459-460. https://doi.org/10.1177/0141076816675805

Fuller, S. (2023). Hearing the Call of Science: Back from Max Weber to Francis Bacon. In *Evaluating Education: Normative Systems and Institutional Practices* (pp. 67–91). Springer International Publishing. https://doi.org/10.1007/978-3-031-36327-6_4

Gannon, M. J., Taheri, B., & Azer, J. (2022). Contemporary Research Paradigms and Philosophies. In *Contemporary Research Methods in Hospitality and Tourism* (pp. 5–19). Emerald Publishing Limited. https://doi.org/10.1108/978-1-80117-546-320221002

Grant, E. (1994). *Planets, Stars, & Orbs. The Medieval Cosmos 1200–1687*. Cambridge University Press.

Hubbell, J. A., & Ryan, J. C. (2021). Environmental philosophy. In *Introduction to the Environmental Humanities* (pp. 109–128). Routledge. https://doi.org/10.4324/9781351200356-7

Hunter, F. J. (2021). Theology and Science in the Thought of Ian Barbour: A Thomistic Evaluation for the Catholic Doctrine of Creation. *The Lonergan Review*, *12*, 207–210. https://doi.org/10.5840/lonerganreview20211210

Hylton, P. (2010). Willard Van Orman Quine. Retrieved from: https://plato.stanford.edu/archives/fall2010/entries/quine/

Jalobeanu, D. (2019). Francis Bacon on Sophists, Poets and Other Forms of Self-Deceit (Or, What Can the Experimental Philosopher Learn from a Theoretically Informed History of Philosophy?). In *Experiment, Speculation and Religion in Early Modern Philosophy* (pp. 8–35). Routledge. https://doi.org/10.4324/9780429022463-2

Jalobeanu, D. (2021). On Metaphysics and Method, Or How to Read Francis Bacon's Novum organum. *Epistemology & Philosophy of Science*, *58*(3), 98–118. https://doi.org/10.5840/eps202158347

Jalobeanu, D. (2023). Francis Bacon and the practices of measurement. *Annals of Science*, 1–21. https://doi.org/10.1080/00033790.2023.2282772

Jamal Hamafaraj, N. (2022). The scientific knowledge is what it has and what it owes to religion. *Journal of Kurdistani for Strategic Studies*, (3). https://doi.org/10.54809/jkss.vi3.93

Kivotidis, D. (2024). A Dialectical Materialist Approach to Democracy. In *The Dialectics of Democracy* (pp. 35–77). Routledge. https://doi.org/10.4324/9781032710884-4

Le Thi Huyen. (2020). F. Bacon with the project of Great Scientific Restoration, *Journal of Philosophy*, (2), 15–18.

Minazzi, F. (2022). Epistemology and the History of Science: The Problem of Historical Epistemology in the Italian Debate of the 20th Century (With Some Unpublished Documents). In *Studies in Applied Philosophy, Epistemology and Rational Ethics* (pp. 243–284). Springer International Publishing. https://doi.org/10.1007/978-3-030-96332-3_13

Miner, R. (2023). Anti-System in the Philosophical Practice of Francis Bacon. *International Journal of Philosophical Studies*, 1–21. https://doi.org/10.1080/09672559.2023.2235370

Nguyen Huy Hoang. (2022). "The relationship between culture and social progress in F.Bacon's philosophy", *Journal of Philosophy*, (9), 18–22.

Páez Bonifaci, J. (2020). History as the Organon of Philosophy. *Idealistic Studies*, *50*(2), 185–209. https://doi.org/10.5840/idstudies2020914120

Pérez-Ramos, A. (1988). *Francis Bacon's Idea of Science and the Maker's Knowledge Tradition*. Clarendon Press.

Pérez-Ramos, A. (2023). Francis Bacon and man's two-faced kingdom. In *The Renaissance and 17th Century Rationalism* (pp. 140–166). Routledge. https://doi.org/10.4324/9781003419532-5

Priest, G. (2020). Philosophy and its History: An Essay in the Philosophy of Philosophy. *Analytic Philosophy*, *61*(4), 297–303. https://doi.org/10.1111/phib.12190

Psaros, H. (2022). Learning, digital technologies, and sociomaterial approaches: A critical reflection from the perspective of materialist dialectics. *Theory & Psychology*, 095935432211292. https://doi.org/10.1177/09593543221129235

Remmling, G. W., & Remmling, G. W. (2022). Francis Bacon and the French Enlightenment philosophers. In *Towards the Sociology of Knowledge* (pp. 47–59). Routledge. https://doi.org/10.4324/9781003074359-4

Rózsa, G. (2019). CHAPTER I. The socio-historical evolution of scientific information problems. In *Scientific Information and Society* (pp. 5-40). De Gruyter Mouton. https://doi.org/10.1515/9783110809206-003

Rusu, D.-C. (2021). Francis Bacon and His Fate in the History and Philosophy of Science, 2010–2020. *Epistemology & Philosophy of Science*, *58*(3), 206–220. https://doi.org/10.5840/eps202158353

Sawchuk, P. H. (2020). Dialectical materialist methodology for a mind-in-activity approach to work, learning and political economic consciousness. *Studies in Continuing Education*, *42*(2), 148–162. https://doi.org/10.1080/0158037x.2020.1738372

Sharpe, M. (2019). Bacon. In *Knowledge in Modern Philosophy*. Bloomsbury Academic. https://doi.org/10.5040/9781474258463.ch-001

Skordoulis, C. (2022). Dialectical Materialism (Materialist Dialectics). In *Encyclopaedia of Marxism and Education* (pp. 186–202). BRILL. https://doi.org/10.1163/9789004505612_012

Verburgt, L. M. (2021). *The Works of Francis Bacon*: A Victorian Classic in the History of Science. *Isis*, *112*(4), 717–736. https://doi.org/10.1086/717036

Werlin, J. (2020). Francis Bacon and the Art of Misinterpretation. *PMLA/Publications of the Modern Language Association of America*, *130*(2), 236–251. https://doi.org/10.1632/pmla.2015.130.2.236

Zinner, E. (2008). *Entstehung und Ausbreitung der copernicanischen Lehre*, Munich. https://www.deutsche-digitale-bibliothek.de/item/UCEZGMGE3HMBM3KJRVCFZLTVUNLNPHPC