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### FRANCIS BACON'S CRITIQUE OF DEDUCTIVE METHOD: THE CRITICAL JUNCTURE IN MODERN SCIENTIFIC METHODOLOGY

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#### Abstract

Man's quest for a certain, reliable, truthful and fruitful knowledge is a universal problem. On the method of acquiring such knowledge, scholars are polarized. While some embrace deductive method, others like Rene Descartes and Francis Bacon strongly believe that deduction, especially Aristotle's syllogism, can not lead one to true knowledge and must not only be jettisoned, but must be replaced with inductive method. Although inductive method, according to Bacon, has its problems which emanate from man's natural inclinations (prejudices and preconceptions), he insists that through scientific and systematic induction based on empirical observation and rigorous experimentation, man can acquire true knowledge with which to unlock the secrets of nature for the benefits of mankind. This research adopts historical analysis in its attempt to expose Bacon's contribution to scientific methodology. The paper not only acknowledges the fact that Bacon's philosophy (of science) recorded in his *Novum Organum*, paved the way for modern scientific revolution (especially in the area of methodology), it equally regards Bacon's methodic input as the turning point in the praxis of modern science. However, this paper calls for a more holistic and flexible scientific method which complements Bacon's inductive method. Also, rather than dominate nature with the instrument of Bacon's new experimental induction, man should instead, use his knowledge of nature to care for it; for he is part of nature.

**Keywords:** Francis Bacon, Deductive Method, Scientific Induction, Modern Science.

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## **Introduction**

The Englishman, Francis Bacon (1561-1626) and the Frenchman, Rene Descartes (1596-1650) were the most influential Renaissance precursors of the seventh century scientific revolution. These two great philosophers tackled the problem of Knowledge; “how it was possible for a human being to possess a certain, reliable, truthful and usable knowledge of the world of nature” (Obi-Okogbuo, *Modern Science* 155-6). Bacon and Descartes shared the skepticism of their time, and considered virtually all the beliefs of the preceding generations as worthless. They ridiculed the tendency of the modern men to rely on ancient books, especially the writings of Aristotle and other antique authorities for issues concerning the operations of nature. They criticized the earlier scholastic method of acquiring knowledge which they regarded as method of the “schoolmen.” Bacon and Descartes had similar thoughts:

They rejected medieval philosophy for being rationalistic and deductivistic; that is, for its procedure of starting with definitions and general propositions and from there(,) logically deducing further information about the particulars; this they saw as an erroneous method of discovering fruitful knowledge of nature (Obi-Okogbuo, *Modern Science* 156).

However, Bacon and Descartes went beyond doubts and criticism to propose constructive programmes for the restructuring of knowledge. This qualified them to be precursors of the modern scientific revolution; although their approaches differ. If Modern Philosophy is taken to mean the philosophy from the Renaissance period (which flourished between fourteenth to sixteenth centuries) to the end of the nineteenth century, it seems more appropriate to regard Francis Bacon as the father of Modern Philosophy (of Science). Consequently, this paper concentrates on the contribution of Bacon to scientific method. Nevertheless, while Bacon is regarded as the father of Modern Philosophy in Britain, Descartes occupies that position in the continent of Europe (Omogbe v-1).

## **Life and Works of Francis Bacon**

Bacon was an English philosopher, lawyer, statesman, essayist and scientific methodologist. Traditionally, he was regarded as the first important figure in the history of British empiricism and in the development of the modern scientific world-view (Mautner 59). He was born in 1561 in London and equally lived in London. He studied at Cambridge University. “Though he greatly influenced the conception and direction of modern science, Bacon was not a scientist ... but a man of law by training and profession, a philosopher, essentially a public figure .... He later achieved his ambition when he became the Lord Chancellor of England under James I” (Obi-Okogbuo, *Modern Science* 156). However, he lost his seat in the Parliament and retired to private life in 1621 after he was convicted for taking bribes in his official capacity as a judge. He died in 1626 (Butts 60; Omogbe 1). Although Bacon’s *Novum Organum* is said to be a book of great importance in the development of modern science and scientific method; he had planned to write a major work:

*Instauratio magna*, but only parts of it were completed. One, *Dignitate et augmentis scientiarum* 1623 (On the dignity and growth of the sciences) was a revised version of *The Advancement of Learning* 1605 (the first major philosophical work written in English ...). The title of another part, the *Novum Organum* 1620 (The new Organon), gave a clear hint that predominant Aristotelianism ought to be superseded. Science should aim at

collecting empirical data and use them for inductive generalization, instead of seeking explanation in terms of final causes (i.e. purposes) (Mautner 59).

Bacon's objective was "the total reconstruction of the sciences, arts and all human knowledge." His efforts at the reconstruction of knowledge were meant to be contained in his great book: *Instauratio Magna* (the *Great Instauration of Learning* or the *Great Renewal of Learning* or the *Great Plan for the Restoration of the Sciences to Their Dignity and Usefulness*). This book demanded for a total new start in science and civilization. The *Instauratio Magna* was to be divided into six parts, but unfortunately, only two parts were completed. Bacon's initial efforts were contained in the first part: *The Proficiency and Advancement of Learning* (1605) which serves as the introduction to the great book. It contains the need for a new science and it equally insists that such a novel science is possible (Obi-Okogbuo, *Modern Science* 156). The second part, *Novum Organum* (the *New Method* or the *New Instrument* 1620) is the most completed part of the great book. *Novum Organum* is Bacon's highest credential or claim to being a philosopher of science. It embodies the analysis of the new scientific method, the new method or instrument as he calls it. This new method is the inductive method (Obi-Okogbuo, *Modern Science* 157). Butts buttressed thus:

The method of induction to be employed is worked out in detail in his *Novum Organum* (1620). This new logic is to replace that of Aristotle's syllogism, as well as induction by simple enumeration of instances. Neither of these older logics can produce knowledge of actual natural laws. Bacon thought that we must intervene in nature, manipulating it by means of experimental control leading to the invention of new technology. (60)

Inductive method as conceived by Bacon, "derives axiom from the senses and particulars and rises gradually by unbroken ascent to the most general axioms last of all." This, for Bacon, is the true way which is yet to be tested. This new way/method is founded on experimentation. Bacon's new method was put forward to supplant Aristotle's now considered barren or unfruitful for the acquisition of the knowledge of nature (Obi-Okogbuo, *Modern Science* 157). Conscious of the significance and the boost this method will give to science and the role science could play in the life of mankind, Bacon gave momentum to it by analysing and defining this new science and its new methodology (although for some, Bacon was unaware of the future implications of his new method to science and mankind). Furthermore, Mautner (59) observed:

In a simile, he likens the proper scientific method to that of bees, who collect systematically and erect a structure, in contrast to ants (i.e. EMPIRICS), who amass a disordered heap, and spiders (i.e. speculative metaphysicians), who spin beautiful webs that have no contact with reality. The aim of inquiry is practical: knowledge of nature gives us power over it.

The supposed part three of the great book was to be an encyclopedia (a collection) of craft lore and experimental facts. The social order that should result from applied science is depicted in Bacon's *New Atlantis* (1627) (Butts 60). Here is described, the Bacon's Salomon's House – which is a fiction that portrays a perfect society where men enjoyed for the sake of their knowledge and control over nature. The Salomon's House forges co-operative endeavour that allows for the various kinds of minds to contribute equally to the progress of science:

Salomon's House is the island's scientific research center, a scientific utopia (science fiction), a perfect society where men enjoyed because of their knowledge and command over nature. This research center contained different kinds of men, those who merely thought, those devising experiments, those analysing results and drawing conclusions as well as men who merely observe facts and performed experiments at the direction of others .... This is a kind of democratization of the scientific enterprise. In the scientific endeavour, there are people who collect facts and there are people who use them, but it does not take the same kind of mind to collect and to use; so all kinds of people are needed in the scientific endeavour... (Obi-Okogbuo, *Modern Science* 162)

This contradicts the rationalistic enterprise which called for high intellectual powers. Bacon's *New Atlantis* prefigured the development of modern scientific communities. It is pertinent to note that Bacon equally wrote other works on natural history, natural philosophy and so on (Obi-Okogbuo, *Modern Science* 157).

### **Bacon's Critique of Deductive Method**

Bacon was of the view that all claims of knowledge before his time, especially science as practised in the medieval era, were doubtful because they were based upon wrong method of deduction. He vehemently attacked Aristotelian (deductive) syllogism. For Bacon, Aristotle's syllogism "is worse than useless since it can be used to confirm errors rather than establish truth because it is based on purely formal consistency rather than experience" (Omogbe 2). Bacon strongly believed that the mind could perceive or interpret reality correctly and attain true knowledge that can bring relief to man. Again, in order to understand and control nature (which for Bacon is the purpose of knowledge), the deductive method must be jettisoned. One must adopt the inductive method which is based on empirical observation of particular things; unlike the deductive method (Aristotle's syllogism) which "does not start with observation of particular things but with general principles from which conclusions are drawn in purely formal way without reference to experience. It can therefore not prove any empirical truth and is of no practical use to man in his effort to understand and dominate nature" Omogbe 2). Bacon's critique of both Aristotle's deductive method and induction by simple enumeration of instances is more pronounced in his discourse of the obstacles that affect the acquisition of true knowledge. These hinderances (false opinions, prejudices and preconceptions) are regarded by Bacon as idols.

### **The Four Idols**

The supremacy of induction notwithstanding, Bacon warns that one must be careful with the method of induction. This is because there are obvious hinderances that affect the acquisition of knowledge of causal laws. These hinderances (in the form of false opinions and prejudices) tend to anticipate nature rather than explain it. Bacon labels these hinderances as Idols (Butts 60).

To attain such true knowledge, the mind must rid itself of those prejudices, the proclivity, the tendency or disposition to error. In *The Advancement of Learning*, Bacon cartooned and caricatured the prejudices besetting the human mind with the metaphorical name idols. He categorized four of these idols: Idols of the Tribe (*Idola Tribus*), Idols of the Cave or Den (*Idola Specus*),

Idols of the Market Place (*Idola Fori*), and Idols of the Theatre (*Idola Theatri*).  
(Obi-Okogbuo, *Modern Science* 157)

In other words, in our interpretation of experience, we have to guard against the influence of prejudices and preconceptions, for these can distort our interpretation of experience and mar our knowledge. These prejudices and preconceptions which influence and distort the interpretation of man's experience are what Bacon called *Idols* (Omogbe 2).

### **Idols of the Tribe (*Idola Tribus*)**

These are fallibilities that have their foundation in human nature itself (i.e., tribe or race of men). They are "natural mental tendencies, ... the impulse to read our own desires and needs into nature" (Butts 60). In other words, they are the natural subjective elements, preferences, biases and idiosyncrasies (in man) which the mind brings into perception that render objective interpretation impossible. "It is the tendency or disposition of the human mind to postulate more uniformity or regularity in nature than actually exists" (Obi-Okogbuo, *Modern Science* 158). According to Omogbe:

The Idols of the tribe are certain tendencies in man which are obstacles to the search for true knowledge. There is, for example, the tendency to take things as they appear to the senses without taking the trouble to make further investigations into their real nature in order to find out whether they are really the way they appear to the senses. We cannot rely entirely on the senses because they are sometimes misleading and things should not be taken as they appear at first sight (2-3).

He continues; there is also the tendency to cling to what we believe already and to reject whatever seems to be contrary to these beliefs; the tendency to see things the way we want to see them; the tendency to see things as fixed and constant equally exists, whereas in reality, things are always changing. Lastly, there is the tendency to read finality into nature, and the tendency to take abstraction for reality (3). Since these subjective elements, which the mind brings into experience are *a priori*, native to our nature, anterior to perception, Bacon said; they ensue from the tribe or race of men. That is to say, "Idols of the Tribe are characteristics which all human share in common which interrupts and distort the objective perception and interpretation of reality" (Obi-Okogbuo, *Modern Science* 158).

### **Idols of the Cave or Den (*Idola Specus*)**

These are predispositions of particular individuals. "The individual is inclined to form opinions based on idiosyncrasies of education, social intercourse, reading, and favoured authorities" (Butts 60). Here, Bacon deliberately refers to Plato's Allegory of the Cave (*The Republic*, Bk VII, 514a). Buttressing this point, Obi-Okogbuo states that "every person has his own microcosm, some psychological wall erected around him, accidental circumstances, subjective experience, social status, private worlds..." (*Modern Science* 158). Mellone captures Bacon's expression thus: "... every individual has his own cave or den which intercepts and corrupts the light of nature" (283). Idols of the Cave therefore, refer not to the limiting disposition of the mind but rather to the limiting power of each individual's private world, environment, subjective experiences or social status. "They point to the unwisdom of the prisoners of their own private worlds or caves or dens. These individuals have distorted views of the world as a result of their own private world which colour their perception of reality" (Obi-Okogbuo, *Modern Science* 158). Omogbe summarizes: "Idols of

the cave are the errors peculiar to each individual, arising from his temperament, education or other factors that influence his judgment and views of things” (3). However, to eradicate the idols of the cave or den, says Obi-Okogbuo, “we need to constantly balance the influences of our micracosm(sic) with those of the general macrocosm” (*Idols of the Human Reason* 14-15).

### **Idols of the Market-Place (Idola Fori)**

Bacon regards these idols as “the most potentially dangerous of all dispositions, because they arise from common use of language that often results in verbal disputes. Many words though thought to be meaningful, stand for nonexistent things; others, although they name actual things, are poorly defined or used in confused ways” (Butts 60). The idols of the market place, according to Omoregbe, “are errors due to the influence of language. The language in common use generally give fixed meanings to things as they are commonly conceived. But further investigation can show that the common notions expressed in language are inadequate or deficient. Language then becomes an obstacle to adequate conceptions” (3). For a better illustration, Bacon adopted the image of the market-place; He likened the ‘intercourse and association’ of men in society to that in the market-place and words to coins used in transactions. Just like counterfeit money; equivocal, obscure, vulgar or popular use of words conflict with the exact or denotative use and impedes or distorts understanding (Obi-Okogbuo, *Modern Science* 158). Bacon further observed that although it is true that reason governs words, but it is equally true that words turn back and determine understanding. This ability of words to turn back and determine understanding, “has rendered philosophy and the sciences sophisticated and inactive.” This is one of Bacon’s criticisms of previous learning. In solution to *Idola Fori*, Bacon admonished: “... in all controversies and disputations, to imitate the wisdom of the mathematician, in setting down in the beginning the definitions of our words and terms, ...” (Bacon qtd. in Harrison 353).

### **Idols of the Theatre (Idola Theatri)**

These idols are as a result of the influence of received theories. They are various products of human imagination in the form of systems of thought, philosophies, various doctrines, dogmas, and theories which enjoy long tradition and authority. “The mind receives some of these systems and often perceives through them as spectacles such that they colour reality” (Obi-Okogbuo, *Modern Science* 159). Similarly, according to Omoregbe, the idols of the theatre are the speculative philosophical systems of the past which are no better than stage plays representing unreal worlds created by man’s imagination (3). In Bacon’s words: “all these received systems are so many stage-plays, representing worlds of their own creation, after an unreal and scenic fashion” (Bacon qtd. in Mellon 284; qtd. in Obi-Okogbuo, *Modern Science* 159 and in *Idols of the Human Reason* 17). Bacon considered the ancient philosophies (of Plato and Aristotle), together with philosophies before him (scholasticism) as idols of the theatre. In fact, Bacon’s important motive was to dismantle the authority of these classical thoughts, especially that of Aristotle. The only authority possessed by these antecedent theories (of Plato and Aristotle) is that they are ingenious verbal constructions. The purpose, therefore, of acquiring genuine knowledge does not depend on superior skill in the use of words (rhetorics) but rather, on the discovery of natural laws (Butts 60). Further, Bacon enumerated three kinds of false philosophies: “first, there is the sophistical philosophy, the chief proponent of which is Aristotle. Second, there is the empirical philosophy based on few and obscure observations. Third, there is the superstitious

philosophy which introduces religion into philosophy, the chief representatives of which are the Pythagoreans and Plato” (Omogegbe 3).

### **Baconian Form and Scientific Induction: The Critical Juncture**

As soon as the above idols are eliminated, the mind is consequently free to seek knowledge of natural laws based on experimentation. Bacon opines that demonstration via experience supersedes abstract demonstration. If the best kind of demonstration is that of experience, it follows, according to Bacon, that the best method is induction – which aims to discover the *forms* of things. It is pertinent to underscore that Bacon’s conception of form is quite different from that of Aristotle, or form as understood by Plato. Bacon conceives form as “the law that governs a thing, the law that constitutes the nature of a thing” (Omogegbe 3-4).

Butts clarifies:

Bacon held that nothing exists in nature except bodies (material objects) acting in conformity with fixed laws. These laws are ‘forms.’ For example, Bacon thought that the form or cause of heat is the motion of the tiny particles making up a body. This form is that on which the existence of heat depends. What induction seeks to show is that certain laws are perfectly general, universal in application. In every case of heat, there is a measurable change in the motion of the particles constituting the moving body. (60)

In other words, the form of heat, “is the law of heat, the law that governs heat. To discover the form of heat therefore is to discover the law of heat, that is, the element that is essential to heat which if present there will be heat and if absent there will be no heat” (Omogegbe 4). Having understood what Bacon meant by form, the research now turns to the treatment of his procedure of scientific induction. Bacon presented two important stages of scientific induction: first, there must be observation of facts from which a working hypothesis is formed based on the observed facts. Secondly, “the hypothesis must be tested by further experimentation and observation” (Omogegbe 4). In other words, one must firstly look out for those cases where, “given certain changes, certain others invariably follow.” In the above example with heat:

... if certain changes in the form (motion of particles) take place, heat always follows. We seek to find all of the ‘positive instances’ of the form that give rise to the effect of that form. Next, we investigate the ‘negative instances,’ cases where in the absence of the form, the qualitative change does not take place. In the operation of these methods(,) it is important to produce experimentally ‘prerogative instances,’ particularly striking or typical example of the phenomenon under investigation. Finally, in cases where the object under study is present to some greater or lesser degree, we must be able to take into account why these changes occur. In the example, quantitative changes in degrees of heat will be correlated to quantitative changes in the speed of the motion of the particles (Butts 60).

The above explains, for instance, why “light can be present and yet heat will be absent as in the case of the moon and the stars, meaning that light is not the form of heat otherwise, where there is light there should be heat” (Omogegbe 4). The implication of Bacon’s scientific induction is that instruments need to be invented to measure changes in degree. Technological advancement is the byproduct of this implication – “Such inventions are of course the hoped-for outcome of scientific inquiry, because their possession improves the

lot of human beings” (Butts 60-61). Above all, Bacon’s elevation of scientific experimental induction over and against the traditional method of deduction – which led to technological inventions, is said to be the critical juncture. In other words, it is the turning point vis-a-vis the revolution of modern science with special reference to scientific (inductive) method.

### **Bacon’s Methodic Vision**

The motive behind Bacon’s critique of traditional (deductive) learning “was to wipe the slate of human knowledge clean and start all over again using a new method of assembling and explaining facts.” This new method, Bacon believed, will surely unlock the secrets of nature. In other words, “Bacon hoped to make the mind surface clean and smooth so as to supply it with new and adequate instruments with which it could observe and understand the universe accurately.” He hoped to achieve this by freeing science from entrenched traditional learning; “through separating scientific truth from the revealed truth of theology; through fashioning a new philosophy of science based upon a new method of observation and a new interpretation of nature” (Obi-Okogbuo 160). In order to achieve his lofty dream of correcting, restructuring or reorganization of traditional learning, Bacon employed two possible ways: organization of method and organization of men. The latter has been dealt with earlier in the discourse of Bacon’s *New Atlantis* (1627). The interest here, is on the former. Bacon began his project by setting forth a new method for the acquisition of knowledge; “a new scientific method that would help to ‘penetrate into the inner and further recesses of nature,’” against the speculations of the ancients. According to Bacon (Boas 252-53):

... experiment was the one truly necessary ingredient of scientific endeavour; without it ... natural philosophy was no better than metaphysical speculation and the scientists no better than the metaphysician who spun webs of *a priori* hypothesis out of his own inside. With experiment, the scientist possessed the key he needed to unlock the secrets of nature....

Due to the idols (false opinions, prejudices and preconceptions) associated with the sense perception, it is not surprising that Bacon advocated for experimentation so as to correct the errors of observation. This is because he believed that “the subtlety of experiments is far greater than that of sense itself.” It must be pointed out that Bacon’s idea of experiment and his method of observation relied too much upon pure induction; that is, “upon the possibility of deriving ‘laws’ from the simple observation of the particulars, and their series and order.” Therefore, his method involves “enumerating observations and visible events and drawing conclusions from these observations by induction.” Bacon’s notion of the scientific method “was essentially experimental, qualitative and inductive” (Obi-Okogbuo, *Modern Science* 161); hence, he distrusted the deductive logic of mathematics. The method at hand ensures a union between the theoretical interpretation and the practical control of nature; a true and lawful marriage of the empirical and rational faculties. Any asunder to this holy marriage throws the affairs of the human family into commotion. When experience has learned to read and write, says Bacon, better things are expected. “Bacon’s vision was of science as a product of methods of *reasoning* from experience, methods which present scientific claims as conclusions rationally drawn from empirical data and thus as rationally justified conclusions” (Ndianefoo 21). In the final analysis, Bacon wished for a scientific experimental method that will bring about “a natural philosophy that would produce ‘a line and race of inventions that may in some degree subdue and overcome the necessities and miseries of humanity.’ A natural science that would endow and benefit man’s life; bring about a more

true and real illumination concerning causes and axioms than is hitherto attained” (Obi-Okogbuo, *Modern Science* 161).

### **Conclusion: Critique of Bacon’s Philosophy of Science**

Amongst the important shortcomings of Francis Bacon’s efforts was his inability to clearly grasp the modern scientific meaning of hypothesis. “He thought that by looking at enough facts, a hypothesis would spontaneously suggest itself. On the contrary, modern scientists often first have a hypothesis before examining facts. This hypothesis acts as a guide in the choice of the facts to inspect.” Secondly, Bacon underestimated the relevance of mathematics to science. Again, for the fact that Bacon was not a professional scientist, he was not abreast with the scientific progress of his time, and therefore, had a naive idea of scientific experimentation. Contemporary Environmental Ethicists like Aldo Leopold, have criticized Bacon’s end or purpose of induction – which is to understand and dominate nature. This research agrees with Environmental Ethicists who opine that the purpose of knowledge or understanding of nature is not necessarily to dominate nature for man’s benefits, but to care for nature, because man is part of nature. Therefore, to exploit or destroy nature is a form of self destruction. The above criticisms notwithstanding, Bacon extricated the grip of scholastic thought on learning and thus, provided the impetus for modern scientific revolution (Obi-Okogbuo, *Modern Science* 162). Finally, despite Bacon’s efforts, this paper calls for a more holistic and flexible method; an inductive method that opens its door for mathematical deduction – an empirical (experiential) and rational (experimental) induction; a systematic induction, and not mere empirical unsystematic induction (i.e., induction by simple enumeration of instances). More importantly, scientists must understand that scientific method is related to and determined by the type of object under investigation. The implication is that scientific method is bound to change or vary according to the scientific subject. Scientific method properly understood refers to the totality of the procedures the scientist employs in his discovery of natural uniformities and explanation of these uniformities (Ndianefoo 23).

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