FRANCIS BACON ON THE QUESTION OF KNOWLEDGE

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Thesis Abstract

Ilgın Aksoy, “Francis Bacon on the Question of Knowledge”

Francis Bacon stands out as the precursor of modern philosophy and modern science. His conception of knowledge, his ideas concerning science, experimentation, induction, methodology, Man’s dominion over Nature have become idiosyncrasies of what has been known as modern philosophy. This novel conception of knowledge has brought out an important shift from the traditional conception of knowledge developed by ancient and medieval philosophers on one hand, and it led to new epistemological problems in modern philosophy on the other.

This shift had huge practical and theoretical consequences. In this thesis we will try to assess the meaning of this shift and its consequences in the light of Horkheimer’s concepts of ‘Objective Reason’ and ‘Subjective Reason’. In the meantime, we will refer to Plato and Aristotle to illuminate Bacon’s disengagement from the philosophical tradition on one hand; and refer to Locke, Berkeley, Hume and Quine to clarify the problems promulgated from the Baconian conception of knowledge.

Tez Özeti

Ilgın Aksoy, “Francis Bacon ve Bilgi Sorunu”

Francis Bacon modern felsefe ve modern bilimin habercisi olarak göze çarpar. Bacon'ın bilgi tasarımı; bilim, deneycilik, tümevarım, metodoloji, İnsan'ın Doğa üstündeki tahakkümü hakkındaki fikirleri modern felsefenin hususi nitelikleri olagelmiştir. Bu yeni bilgi tasarımı, bir yandan antik ve orta çağ felsefecileri tarafından geliştirilmiş bilgi tasarımından ciddi bir kopuşa işaret ederken, bir yandan da yeni epistemoloik sorunlara yol açacaktır.

Bu kopuşun muazzam teorik ve pratik sonuçları olmuştur. Bu tezde Horkheimer'ın 'Objektif Aklı' ve 'Subjektif Akıl' kavramlarının ışığında bu kopuşun ve onun sonuçlarının anlamlarını tahlil etmeye çalışacağız. Bu kopuşu tarihsel olarak aydınlatmak için felsefe geleneğiyle olan ilişkisini incelemek üzere Platon ve Aristoteles'e başvuruken, Bacon'cı bilgi tasarımından neşreden sorunları ortaya çıkarmak için Locke, Berkeley, Hume ve Quine'a başvuracağız.

To the freedom of Gaia..

CONTENTS

I. Introduction

Francis Bacon represents an important moment in history. This is a moment of an important shift in the conception and function of knowledge. In order to understand this shift we should compare the Baconian conception of knowledge with the philosophical and scientific traditions before and after him; and in order to accomplish this task we must first explicate Bacon's conception of knowledge. In this thesis, we will study Bacon's conception of knowledge and the understanding of reason and science immanent to this conception as portrayed in the *Novum Organum* (2002).

For Bacon, knowledge has two independent elements, which are experience and reason. Experience in its simplest form consists of sense-data. Sense-data are private, subjective, contingent and contradictory. However, if augmented by reason and obtained through systematic experimentation it becomes public and objective. Reason, on the other hand, is a mental faculty having formal principles of its own. These principles constitute deduction on the one hand and induction on the other. There is general consent over the rules of deduction as collected under syllogistic logic. However, there is no such consensus over induction. One of the most important aims of the Novum Organum is to construct such rules, earn experience an empirical certainty and establish its objectivity, publicity and necessity.

In this framework, Nature stands as an entity outside experience and reason. It is the condition of possibility of objectivity, publicity and necessity in experience and can only be reached by the coordinated labour of experience and reason. That is to say, by collecting the content of knowledge via

exhaustive experimentation systematized by reason and inferring theories through regulated induction, the knowledge of Nature can be attained. Through this labour, the mechanism of Nature can be unravelled.

When evaluated from the point of view of this conception of knowledge, the scientific or philosophical traditions before Bacon have not even approximated knowledge. Proto-scientific disciplines lack and have not ever thought of constructing such a methodology as Bacon does. Instead, they proceeded through practice, and, therefore, Bacon characterised the progresses he observed in them as “chance”.

Philosophical tradition, on the other hand, has operated with an understanding of reason which was in sharp contrast to Bacon's. According to this understanding, reason is not a private, mental faculty but a structure inherent in Nature. Theologico-philosophical doctrines tried to achieve this structure through God's word, while secular philosophical doctrines tried to achieve it through subjective reason.

These philosophical doctrines are regarded as fabrications of reason by Bacon. When left to itself, when induction is not limited by rules, reason may produce many contradictory ideas. The sciences which promulgate from these doctrines are not verified by empirical data, but rather assimilate empirical data according to their own. In this sense, philosophical tradition is speculative and dogmatic according to Bacon.

In contrast to these traditions, Baconian science prescribes a methodology for experimentation and induction: Elaborate experiments should be devised and data, which will supply the content of knowledge, should be collected

from them, and a mechanism of regulated induction, which supply the form of knowledge acquisition, should be applied to these data. Eventually, this knowledge will provide Man's rightful dominion over Nature.

Similar conceptions of knowledge have been conceived since Bacon. Descartes' *Rules for the Direction of the Mind* (1954) is an important instance of the Baconian ideal of prescribing the limits of reason. However, when examined closely that ideal of devising what can be called "empirically verified knowledge" turns out to be not-so-reliable.

John Locke, in his *An Essay Concerning Human Understanding* (1999), starts with a similar premise as Bacon, namely, on the premise that all knowledge must be grounded on two valid faculties of the mind: sensation and reflection. However, if all our knowledge is grounded on these two mental and subjective faculties, then how can we say that objective knowledge can be acquired by the mind? This is a problem which cannot be solved either by Bacon or Locke, and it practically means that no competing theory can be judged with respect empirical data.

Furthermore, Hume in his *An Enquiry Concerning Human Understanding* (1988) later observes that if we confine our knowledge to facts and inferences made from these facts, then causality, induction and substance, in other words the most fundamental tools of science become untenable. This is because we can derive those tools neither from facts nor through reflecting upon our collection facts. This has become another problem which cannot be solved by modern philosophy.

So the Baconian conception of a system of empirically verified knowledge

becomes an inconsistent system. However, this is not to say that it is totally meaningless. By conceiving knowledge as inductive inference from experimental data about mechanical Nature, Bacon transforms knowledge to a shortcut of present practices in society. Of course, that society turns into a technocracy of scientists and engineers in time. With the claim that science is politically neutral, supported by the instrumental understanding of reason, the question of scientific practice is removed from the question of knowledge. Scientific endeavour is left at the hands of prevalent power structures and the scientists and engineers operating within those structures. Lives of people and the future of Nature are concealed behind those practices which promulgate from those endeavours.

II. Baconian Design of Science

In this chapter we will study Bacon's proclaimed opus for reconstructing science and knowledge from bottom to top, namely *The Great Instauration*. The work is never finished, but it nevertheless gives important insight into the Baconian design of science and its future inspirations.

The book was planned to consist of six parts:

1. The Divisions of the Sciences.

2. The New Organon; or Directions concerning the Interpretation of Nature.

3. The Phenomena of the Universe; or a Natural and Experimental History for the foundation of Philosophy.

4. The Ladder of Intellect.

5. The Forerunners; or Anticipations of the New Philosophy.

6. The New Philosophy; or Active Science.

In the *Novum Organum*, which constitutes the second part of "The Great Instauration", Bacon tries to elucidate how science and philosophy current in his time are misleading for a genuine understanding of Nature, which he calls *"Interpretation of Nature"*. To illuminate this *"Novum Organum"* or the new science, Bacon will first criticize the tradition of science and philosophy prior to his work, which advances with rush "*Anticipations of Nature*", and then he will explain how instead *Novum Organum* is possible.

During the course of this thesis, we will see how Bacon disengages from the tradition before him to re-engage with a new set of assumptions along with

the problems that arise from them. We will also see that a certain ideology, which reveals itself even in the title *"The Kingdom of Man"*, is implied by and underlies these assumptions. The expression, *"The Kingdom of Man"*, implies the underlying agenda of what can be called modern philosophy: to subordinate Nature to Man's will through science. The claim for truth and genuine knowledge always finds its justification and its methodology with respect to this agenda.

We will investigate Bacon's Novum Organum in three episodes: firstly, on how Bacon distinguishes it from philosophical and scientific tradition by unravelling his criticisms against them; secondly, on its epistemological (on how genuine knowledge is possible) assumptions and thirdly on its methodological (on how can genuine knowledge be acquired) assumptions.

II.I. Criticisms of Philosophy and Science

Bacon's design of a new science always holds hands with a critique of philosophy and of the old sciences. However, this critique is never directed to their contents but to their form. That is to say, Bacon does not criticize or reject any philosophy or science on the ground that they conceive the world falsely. He does think that they conceive the world falsely, but Bacon's fundamental criticism is on the methods they use in order to constitute these conceptions of the world. If the right methods are used, necessarily the right consequences will come. However, old methods should be fought first and, in this chapter, we are going to present Bacon's methodological rejection of

philosophy and science. This rejection includes Plato and Aristotle on the one hand and early modern scientists such as Paracelsus and Telesio on the other.[1]

II.I.I. Errors of Philosophy and Science

Bacon starts his criticisms with an analysis of the errors committed while constructing false theories. At the basis of these errors stands syllogism. Bacon observes that philosophy and sciences work with syllogism. However syllogism, in its nature, is merely formal. Its content comes from already established axioms, by which Bacon means the basic assumptions of a body of knowledge conceived as a kind of pyramid where axioms stand at the top. These axioms are composed of many notions and these axioms and notions are formed through certain prejudices, or *idola* in Bacon's terms.

Primarily, Bacon claims that syllogism is inadequate:

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> That this criticism was not unique to Bacon and was idiosyncratic to his era can be seen in the writings of Johannes Kepler:
> [....] there is a sect of philosophers, who (to quote the judgment of Aristotle, unmerited however, about the doctrine of the Pythagoreans lately revived by Copernicus) do not start their ratiocinations with sense-perception or accommodate the causes of the things to experience: but who immediately and as if inspired (by some kind of enthusiasm) conceive and develop in their heads a certain opinion about the constitution of the world; once they have embraced it, they stick to it; and they drag in by the hair [things] which occur and are experienced every day in order to accommodate them to their axioms. These people want this new star and all others of its kind to descend little by little from the depths of nature, which, they assert, extend to an infinite altitude, until according to the laws of optics it becomes very large and attracts the eyes of men; then it goes back to an infinite altitude and every day [becomes] so much smaller as it moves higher.
> Those who hold this opinion consider that the nature of the skies conforms to the law of the circle; therefore the descent is bound to engender the opposite ascent, as is the case with wheels.
> But they can easily be refuted; they indulge indeed in their vision, born within them, with eyes closed, and their ideas and opinions are not received by them [from valid experience] but produced by themselves. (as cited in Koyré, 1957, p. 59)

> As the sciences in their present state are useless for the discovery of works, so logic in its present state is useless for the discovery of sciences. (Bacon, 2002, p.35)

The problem with syllogism, according to Bacon, is that it merely supplies a form to make valid inferences. But since the basic axioms (that are the premature assumptions about nature, regulated to a certain extent by the notions given in language) in sciences are problematic and doubtful, the middle axioms derived from them using syllogism will be so too. Therefore if one works with syllogism, one may only derive consequences consistent with one's basic axioms, but one cannot override them and reach truth:

> The syllogism is not applied to the principles of the sciences, and is applied in vain to the middle axioms, since it is by no means equal to the subtlety of nature. It therefore compels assent without reference to things. (Bacon, 2002, p. 35)

The basic principles of sciences cannot be founded by syllogism either, for syllogism cannot give the content of the axioms:

> The syllogism is not applied to the principles of the sciences, and is applied in vain to the middle axioms, since it is by no means equal to the subtlety of nature. It therefore compels assent without reference to things. (Bacon, 2002, p. 35)

And the basic principles of sciences are wrong, for they are derived from defectively formed notions through speculation or an alleged intuition about the world:

> The syllogism consists of propositions, propositions consist of words, and

> words are counters for notions. Hence if the notions themselves (this is the basis of matter) are confused and abstracted from things without care, there is nothing sound in what is built on them. The only hope is true *induction.*
>
> There is nothing sound in the notions logic and physics: neither *substance,* nor *quality,* nor *action* and *passion,* nor *being* itself are good notions; much less *heavy, light, dense, rare, wet, dry, generation, corruption, attraction, repulsion, element, matter, form* and so on; all fanciful and ill defined. (Bacon, 2002, p.35)

The reason for these defectively formed notions are, according to Bacon, based on four kinds of prejudices or *idola* that condition human understanding:

> The *illusions* are false notions which have got a hold on men's intellects in the past and are now profoundly rooted in them, not only block their minds so that it is difficult for truth to gain access, but even when access has been granted and allowed, they will once again, in the very renewal of the sciences, offer resistance and do mischief unless men are forewarned and arm themselves against them as much as possible.
>
> There are four kinds of *illusions* which block men's minds. For instructions sake, we have given them the following names: the first kind are called *idols of the tribe*; the second *idols of the cave*; the third *idols of the marketplace*; the fourth *idols of the theatre.* (Bacon, 2002, p. 40)

The “idols of the tribe” refers to conditions immanent in human nature:

> *The idols of the tribe* are founded in human nature itself and in the very tribe or race of mankind. (Bacon, 2002, p. 41)

Bacon describes sensualism, dogmatism and speculation as the tendencies in

man which distort reality for a genuine understanding of Nature.

By sensualism is meant the reliance on sense data as a tool for acquiring knowledge. Bacon will criticize this reliance on the ground that genuine knowledge cannot be derived from senses, since the human faculty of sensation is a mis-representation of reality; it is not a blank sheet which passively receives rays from the world, but is like an 'uneven mirror' which distorts them:

> The assertion that the human senses are the measure of things is false; to the contrary, all perceptions, both of sense and mind, are relative to man, not to the universe. The human understanding is like an uneven mirror receiving rays from things and merging its own nature with the nature of things, which thus distorts and corrupts it. (Bacon, 2002, p. 41)

Dogmatism is a strict ontological commitment to a certain idea. The peculiarity of a dogma is marked by its un-falsifiability and its power of generality. What we mean is that a dogma can never be falsified, because whenever any theory is tested, it is tested along with other theories, which can be called auxiliary theories. And whenever the theory is falsified the whole set of auxiliary theories along with the main theory is falsified. Thus, by making certain modifications on the set of auxiliary theories, one can save the main theory. This attitude towards dogma is also supported by the generality it possesses. The solidity of a theory is promoted by the cases it explains. So if a theory explains a large number of cases and a large number of other theories can be reduced to it, then it seems to be a pretty strong theory. But there is no logical necessity as to which cases can a theory be

explanatorily related just as there is no logical necessity as to which theories are to be modified when the set is falsified.

Bacon observes that such is the case with the dogmatic slumber in philosophy and sciences in his age:

> Once a man's understanding has settled on something (either because it is an accepted belief or because it pleases him), it draws everything else also to support and agree with it. And if it encounters a larger number of more powerful countervailing examples, it either fails to notice them, or disregards them, or makes fine distinctions to dismiss and reject them, and all this with much dangerous prejudice, to preserve the authority of its first conceptions. So when someone was shown a votive tablet in a temple dedicated, in fulfilment of a vow, by some men who had escaped the danger of shipwreck, and was pressed to say whether he would now recognise the divinity of the gods, he made a good reply when he retorted: 'Where are the offerings of those who made vows and perished?' The same method is found perhaps in every superstition, like astrology, dreams, omens, divine judgements and so on: people who take pleasure in such vanities notice the results when they are fulfilled, but ignore and overlook them when they fail, though they do fail more often than not. This failing finds its way into the sciences and philosophies in a much more subtle way, in that once something has been settled, it infects everything else (even things that are much more certain and powerful), and brings them under its control. And even apart from the pleasure and vanity we mentioned, it is an innate and constant mistake in the human understanding to be much more moved and excited by affirmatives than by negatives, when rightly and properly it should make itself equally open to both; and in fact, to the contrary, in the formation of any true axiom, there is superior force in a negative instance.

(Bacon, 2002, p. 43)

Speculation is the human endeavour to revealing reality through intellect. Bacon observes that the tendency of man to transgress the limits of experience estranges him from Nature:

> The human understanding from its own peculiar nature willingly supposes a greater order and regularity in things than it finds, and though there are many things in nature which are unique and full of disparities, it invents parallels and correspondences and non-existent connections. Hence those false notions that in the heavens all things move in perfect circles and the total rejection of spiral lines and dragons (except in name). Hence the element of fire and its orbit have been introduced to make a quaternion with the other three elements, which are accessible to the senses. Also a ratio of ten to one is arbitrarily imposed on the elements (as they call them), which is the ratio of their respective rarities; and other such nonsense. This vanity prevails not only in dogmas but also in simple notions. (Bacon, 2002, p. 42)

The “idols of the cave” (an obvious allusion to Plato's allegory of the cave) refers to the problems caused by individual peculiarities. Every individual has a mind of its own, and in its mind distorts reality to a certain extent:

> *The idols of the cave* are the illusions of the individual man. For (apart from the aberrations of human nature in general) each man has a kind of individual cave or cavern which fragments and distorts the light of nature. This may happen either because of the unique and particular nature of each man; or because of his upbringing and the company he keeps; or because of his reading of books and the authority of those whom he respects and admires; or because of the different impressions things make on different minds, preoccupied and prejudiced

> perhaps, or calm and detached, and so on. The evident consequence is that the human spirit (in its different dispositions in different men) is variable thing, quite irregular, almost haphazard. Heraclitus well said that men seek knowledge in lesser, private worlds, not in the great or common world. (Bacon, 2002, p. 41)

The "idols of the marketplace" refers to the inadequacy of language in representing Nature. It is a critique of ordinary language. Bacon observes that the inadequacy in ordinary language is caused by poorly formed notions:

> The illusions which are imposed on the understanding by words are of two kinds. They are either names of things that do not exist (for as there are things that lack names because they have not been observed, so there are also names that lack things because they have been imaginatively assumed), or they are the names of things which exist but are confused and badly defined, being abstracted from things rashly and unevenly. Of the former sort are fortune, the first mover, the orbs of the planets, the element of fire and fictions of that kind, which owe their origin to false and groundless theories. Idols of this kind are easily got rid of; they can be eradicated by constantly rejecting and outdating the theories.
>
> But the other kind of idol is complex and deep-seated, being caused by poor and unskilful abstraction. For example, let us take a word ('wet' if you like) and see how the things signified by this word go together; it will be found that the word 'wet' is simply an undiscriminating token for different actions which have no constancy or common denominator. For it signifies both what is easily poured around another object; and what is without its own boundaries and unstable; and what easily gives way all round; and what easily divides and disperses; and

> what easily combines and comes together; and what easily flows and is set in motion; and what easily adheres to another body and makes it wet; and what is easily reduced to a liquid, or liquefies, from a previous solid state. Hence when it comes to predicating and applying this word, if you take it one way, a flame is wet; if in another, air is not wet; if in another, a speck of dust is wet; if in another, glass is wet; it is easily seen that this notion has been rashly abstracted from water and common and ordinary liquids only, without any proper verification. (Bacon, 2002, p.48-49)

Instead Bacon suggests "a method and manner for forming notions and axioms" (Bacon, 2002, p. 48). This attitude is similar to the endeavours of the twentieth century logical positivists of constructing a "formal language". Both Bacon and logical positivists tried to construct a language from bottom up, by fixing every term (whether a word or a proposition) to sense-data.

The “idols of the theatre” addresses philosophy. Bacon compares philosophy to theatre plays: as plays are fictions that resemble real life, but in a more eloquent and contemplated manner, so does philosophy resemble the world. Bacon divides philosophy into three types, which are sophistic, empirical and superstitious. But the basic problem with the three of them is that they all jump to conclusions without adequate empirical evidence:

> In general, for the content of philosophy, either much is made of little or little is made of much, so that in both cases philosophy is built upon an excessively narrow basis of experience and natural history, and bases its statements on fewer instances than is proper. Philosophers of the rational type are diverted from experience by the variety of common phenomena, which have not been certainly understood or carefully examined and considered; they depend for the

> rest on reflection and intellectual exercise.
>
> There are also philosophers of another type who have laboured carefully and faithfully over a few experiments, and have had the temerity to tease out their philosophies from them and build them up; the rest they twist to fit that pattern in wonderful ways.
>
> There is also a third type, who from faith and respect mingle theology and traditions; some of them have been unfortunately misled by vanity to try to derive sciences from Spirits and Genii. And so the root of errors and false philosophy is of three kinds: Sophistic, Empirical and Superstitious. (Bacon, 2002, p. 50)

For the first of these types, namely the Sophistic, Bacon gives Aristotle as the most obvious example. He claims that Aristotle postulates his axioms first and then adapts experimental results to his axioms arbitrarily, and he also adds that these axioms are not for understanding reality as it is but for explaining phenomena in discourse:

> The most obvious example of the first type is Aristotle, who spoils natural philosophy with his dialectic. [...] He was always more concerned with how one might explain oneself in replying, and to giving some positive response in words, than of the internal truth of things; and this shows up best if we compare his philosophy with other philosophies in repute among the Greeks. [...] Aristotle's physics too often sound like mere terms of dialectic, which he rehashed under a more solemn name in his metaphysics, claiming to be more of a realist, not a nominalist. And no one should be impressed because in his books On Animals and in his Problems and other treatises there is often discussion of experiments. He had in fact made up his mind beforehand, and did not properly

> consult experience as the basis of his decisions and axioms; after making his decisions arbitrarily, he parades experience around, distorted to suit his opinions, a captive. (Bacon, 2002, p. 51-52)

Bacon's account of Aristotle indicates the rupture Horkheimer presents explicitly. For Aristotle, philosophy, empirical sciences and ethics had a common ground; namely metaphysics. According to Aristotle, metaphysics as the first philosophy could be established through a certain intuition about the world. However Bacon excludes this type of knowledge (i.e. a knowledge that can be reached by a reason immanent to the objective world) from the realm of knowledge.

Bacon's critique of empirical philosophy is interesting. Almost foreseeing Hume's argument on the impossibility of validation of inductive arguments, he claims that since it is not possible to reach any conclusions directly from experiment, empirical philosophy is dangerous. Hence he will regard empirical conclusions as fallacious:

> The empirical brand of philosophy generates more deformed and freakish dogmas than the sophistic or rational kind, because it is not founded on the light of common notions (which though weak and superficial, is somehow universal and relevant to many things) but on the narrow and unilluminating basis of a handful of experiments. Such a philosophy seems probable and almost certain to those who are engaged every day in experiments of this kind and have corrupted their imagination with them; to others it seems unbelievable and empty. There is a notable example of this among the chemists and their dogmas; otherwise it scarcely exists at this time, except perhaps in the philosophy of Gilbert. However, we should not fail to give a warning about such philosophies.

> We already conceive and foresee that, if ever men take heed of our advice and seriously devote themselves to experience (having said goodbye to the sophistic doctrines), then this philosophy will at last be genuinely dangerous, because of the mind's premature and precipitate haste, and its leaping or flying to general statements and the principles of things; even now we should be facing this problem. (Bacon, 2002, p. 52)

Finally, in superstitious philosophy, Bacon observes that by canonizing the defectively formed notions, philosophies put them beyond any analysis or objective assessment of their value with respect to Nature:

> This kind of evil also occurs in parts of other philosophies by the introduction of abstract forms and final causes and first causes, and by frequent omission of intermediate causes and so on. We must give the strongest warning here. For the worst thing is the apotheosis of error; respect for foolish notions has to be regarded as a disease of the intellect. (Bacon, 2002, p. 53)

The final concept, which deceives Man's understanding of Nature, is the concept of final cause. Bacon assesses the idea of a final cause to be alien to Nature itself and that it has been falsely derived from human nature. It has no use in the effective understanding and manipulation of the world, so it must be excluded from the realm of knowledge.

It can be seen that in the modern era the idea of a final cause will be totally excluded from natural philosophy and science. Bacon shows this inclination with the claim that attributing final causes is only peculiar to human nature and extending this attribute to the Nature is an error:

> […] final causes, which are plainly derived from the nature of man rather than

> of the universe, and from this origin have wonderfully corrupted philosophy. It is as much a mark of an inept and superficial thinker to look for a cause in the most universal cases as not to feel the need of a cause in subordinate and derivative cases. (Bacon, 2002, p.44)

In another passage Bacon holds that final causes can explain nothing except human behaviour:

> [...] in fact [final cause] actually distorts the sciences except in the case of human actions. (Bacon, 2002, p. 102)

II.I.II. Erroneous Philosophical and Scientific Traditions

We have noted that Bacon's criticisms are aimed at ancient as well as early modern philosophical and scientific traditions. All these criticisms arise from the analyses and assessments of the concepts used in those traditions.

The first of these criticisms is directed at Aristotelian philosophy where a kind of axiomatic system can be seen. In this structure there are first principles at the ground of the system and all propositions concerning Nature are deduced -by means of syllogism- from these principles. First principles, on the other hand, are reached by means of an insight immanent to Nature. This capability is contained in human reason and can be enhanced to the point of understanding the objective reason in Nature since it is a part of it.

Bacon rejects the possibility of such a capability. According to him, reason merely consists of a formal capacity, and in the Aristotelian schema, it

means that only syllogism is possible within humane intellectual capabilities, in which case no possible intellectual capability may reach first principles. Rather, it may merely deduce propositions from them. Bacon presents Aristotle as the prototype of rationalist philosophers in this sense:

> Philosophers of the rational type are diverted from experience by the variety of common phenomena, which have not been certainly understood or carefully examined and considered; they depend for the rest on reflection and intellectual exercise. (Bacon, 2002, p. 51)

Aristotle proposed specific axioms for various scientific disciplines; however his thought was lacking in that it did not propose a master principle for the whole body of science. This lack is also effective in the contemporary science according to Bacon. This master principle in question here is what can be called methodology. Although sciences had come to make a certain leap as Bacon admits, this leap seems to be inadequate for him. Because sciences do not come from systematized investigation, but from chance and common experience:

> [...] the results which have been discovered already are due more to chance and experience than to sciences; for the sciences we now have are no more than elegant arrangements of things previously discovered, not methods of discovery or pointers to new results. (Bacon, 2002, p. 34)

Bacon extends this criticism to alchemy, magic and astrology as well as to his contemporary scientists such as Gilbert, Paracelsus and Telesio:

> Mechanic, mathematician, physician, alchemist and magician do meddle with nature (for results); but all, as things are, to little effect and with slender

> success. (Bacon, 2002, p. 34)

This second type of approach to knowledge is what Bacon calls empirical philosophy. While rationalist philosophy is explicated by an analogy to spiders, the empirical scientists are explicated by an analogy to ants. Rationalists, like spiders, spin webs and then make their sense-data comport to these webs; while empirical scientists merely collect sense-data randomly. However, the right method is that of the bee. The bee collects its material selectively and then makes its own product out of these materials:

> Those who have treated of the sciences have been either empiricists or dogmatists. Empiricists, like ants, simply accumulate and use; Rationalists, like spiders, spin webs from themselves; the way of the bee is in between: it takes material from the flowers of the garden and the field; but it has the ability to convert and digest them. (Bacon, 2002, p. 79)

These criticisms against philosophical and scientific traditions promulgate from a certain analysis of knowledge, and now we will take a look at this epistemology.

II.II. Epistemological Assumptions

The basic epistemological assumption, which prevails throughout Novum Organum is that understanding Nature is possible only by collecting facts and making valid inferences from them:

> Man is Nature's agent and interpreter; he does and understands only as much as he has observed of the order of nature in fact or by inference; he does not know and cannot do more. (Bacon, 2002, p. 33)

Thus, according to Bacon's way, the answer to "what is genuine knowledge" is basically axioms induced from a collection of facts. There is a two-legged process of knowledge acquisition: the first leg is the collection of facts, and the second is the classification of the collected data, inferring from them axioms and computation of and deduction from those axioms new data.

The former aspect of this process, namely collection of facts, determines the limits of experience. What Bacon understands from facts are sense-data augmented by experiment. As we have noted, he criticizes a crude sensualism. Senses are inconsistent and incomplete; they carry a lot of contradiction and errors. However, they also possess information about the structures and processes which engender those alleged contradictions and errors, which should be revealed through experimentation:

> [...] even when the senses do grasp an object, their apprehensions of it are not always reliable. (Bacon, 2002, p. 18)
>
> [...] we have many ways of scrutinising the information of the senses themselves. For the senses often deceive, but they also give evidence of their own errors; however the errors are to hand, the evidence is far to seek. (p. 17)
>
> [...] the subtlety of experiments is far greater than that of the senses themselves even when assisted by carefully designed instruments; we speak of experiments which have been devised and applied specifically for the question under investigation with skill and good technique. (p. 18)

The latter aspect of the process determines the limits of reason, which is reduced to a role of classification, inference, computation and deduction.

If experience transgresses its limits, it ends up with what may be called

mysticism; and if reason transgresses its limits, it ends up with speculation. However, by staying within their prescribed borders they constitute the body of science and can reveal the structures and processes which govern Nature.

In order to make reason stay within its borders and supply Man with good knowledge, science should have a methodology to prescribe rules on reason.

We can summarize Bacon's epistemology thus:

1. There is a strict distinction between experience and reason.
2. Experience is nothing but the totality of sense-data augmented by experimentation.
3. Reason consists of classification, inference, computation and deduction of data supplied by experience.
4. Experience and reason together constitute the body of science which reveals the structures and processes that govern Nature.
5. Science should have a methodology to prescribe rules on reason to fulfil its functions and hinder it from transgressing them.

Bacon's basic distinction between reason and experience foreshadows David Hume's distinction between *relation of ideas* and *matters of fact* and Immanuel Kant's distinction between *analytic* and *synthetic judgements.* In order to interrogate what Bacon's epistemology amounts to theoretically, it would be a fine labour to dive briefly into Hume’s and Kant's work.

For Hume, relations of ideas denote propositions which are grounded in the pure operations of reason; while matters of fact denote propositions which are derived from experience:

> All the objects of human reason or enquiry may naturally be divided into two kinds, to wit, Relations of Ideas, and Matters of Fact. Of the first kind are the sciences of Geometry, Algebra, and Arithmetic; and in short, every affirmation, which is either intuitively or demonstratively certain. [...]
>
> Matters of fact, which are the second objects of human reason, are not ascertained in the same manner; nor is our evidence of their truth, however great, of a like nature with the foregoing. The contrary of every matter of fact is still possible; because it can never imply a contradiction, and is conceived by the mind with the same facility and distinctness, as if ever so conformable to reality. (Hume, 1988, p. 28)

Propositions concerning geometry, algebra and arithmetic, according to Hume, are demonstrative truths which depend solely on the operations of reason. However any proposition concerning the world must come either from sense-data (i.e. *impressions*) or some material provided by sense-data (i.e. *ideas* or *thoughts*):

> [...] our thought [...] is really confined within very narrow limits, and that all this creative power of the mind amounts to no more than the faculty of compounding, transposing, augmenting, or diminishing the materials afforded us by the senses and experience (Hume, 1988 p. 21)

In Hume's conception, reason has the mere function of relating the most abstract features of experience and making necessary inferences on the one hand and augmenting on the material supplied by sense-data on the other. That is to say, reason is reduced to a merely formal function in the process of acquiring knowledge; it has no potential of ascertaining the content of truth, but only of augmenting the content supplied by experience.

Kant defines analytic and synthetic judgements in a similar vein:

> […] there is [...] a distinction between [judgments] according to their content, by dint of which they are either merely *explicative* and add nothing to the content of the cognition, or *amplicative* and augment the given cognition; the first may be called *analytic* judgments, the second *synthetic*. (Kant, 2004, p. 16)

> In all judgments in which the relation of a subject to the predicate is thought [...], this relation is possible in two different ways. Either the predicate B belongs to the subject A as something that is (covertly) contained in this concept A; or B lies entirely outside the concept A, though to be sure it stands in connection with it. In the first case I call judgment analytic, in the second synthetic. (Kant, 1998, p. 130)

Analytic judgements, according to this conception, depend solely on the linguistic and logical operations of reason. "All bodies are extended" is an analytic judgement. I have to know merely the meaning of "body" and "extension" in order to assess the truth of this judgement; the rest depends on the logical principle of identity.

Synthetic judgements, on the other hand, are empirical judgements. "All bodies are heavy" is a synthetic judgement; I have to relate two distinct concepts to assess the truth of this judgement. According to Kant, we have to distinguish two types of synthetic judgements: *a priori* and *a posteriori*.

Kant uses the concepts of *a priori* and *a posteriori* in a novel sense. A priori means before experience and denotes truths which can be known without appealing to experience, while a posteriori means after experience and denotes truths which can be known by appealing to experience. The first

type possesses a universal and necessary truth, while the second type is private and contingent.

Now analytic judgements are obviously a priori. "All bodies are extended", when analysed, is a judgement similar to *A is A* and *A is A* is a universal and necessary truth. It can never be given in possible experience, yet it maintains a rule for any reasoning. It is devoid of any content, but any content may fit into it affirmatively or negatively. In this sense, it is pure form.

Likewise, synthetic judgements of the kind "Every alteration has its cause" are universal and necessary truths. They cannot be given in possible experience, yet they maintain the rules for all possible experience. They determine the limits of possible experience. They are devoid of content, but consist in pure form. These are called *synthetic a priori* judgements.

Synthetic judgements of the kind "All bag are heavy", on the other hand, are contingent truths. These are *synthetic a posteriori judgements.* They are given in experience, but conditioned by synthetic a priori judgements; their limits are determined by them.

In order for me to have synthetic a priori judgements, Kant continues, there must be certain faculties in my mind which makes them possible. These are: Intuition and Understanding which successively provide the forms of space and time and the categories.

I know objects in space and time a posteriori, however I know space and time themselves a priori. Space and time are conditions of possibility of

experience, for they are universal and necessary and any sense-data is given to me in the forms of space and time.

Likewise, I know the objects of causal relations for instance, a posteriori; however I know causality itself as a category a priori. The pure concept of causality is universal and necessary and I can understand any experience in the form of causality.

By denouncing the limits of legitimate knowledge as experience and the limits of experience as the forms supplied by reason, Kant shuts the door for any search of truth other than "scientific method". Therefore the pure concepts of reason may merely apply to experience and its application to anything independent of experience is illicit:

> [...] the pure concepts of the understanding can never be of transcendental, but always only of empirical use, and that the principles of pure understanding can be related to objects of the senses only in relation to the general conditions of a possible experience, but never to things in general. (Kant, 1998, p. 345)

We have noted that Hume confined knowledge to experience augmented by reason and experience to the totality of sense-data. In a similar vein with Kant, but with more rage, he commits any claim of knowledge which transgress these borders to flames:

> If we take in our hand any volume; of divinity or school metaphysics, for instance; let us ask, does it contain any abstract reasoning concerning quantity or number? No. Does it contain any experimental reasoning concerning matter of fact and existence? No. Commit it then to the flames: For it can contain nothing but sophistry and illusion. (Hume, 1988, p. 149)

Also in Bacon's criticisms of philosophy we have seen that the transgression of experience as sense-data augmented by experiment and reason's functions as categorization, inference, computation and deduction is regarded as a scientific heresy.

This tendency we see with these three philosophers of denying reason's capability of conceiving an objective content or denying it as a delusion or disease or madness[3] is actually an idiosyncrasy of modern philosophy. It excludes any search for truth other than "scientific method" from the field of knowledge although this search has been an integral part of philosophy until then. Philosophy always had a function of a search for some truth which cannot be given in possible experience but which can be reached by an intellectual transcendence of experience into the immanent reason of Nature. Now, however, with Bacon and later in Hume and Kant, we see that this possibility is abandoned.

Horkheimer wrote extensively on this rupture. He observes that reason used to connote an objective principle in reality, while according to the approach presented by Bacon reason is merely a formal faculty of the mind:

> This view [objective reason] asserted the existence of reason as a force not only in the individual mind but also in the objective world – in relations among human beings and between social classes, in social institutions, and in nature and its manifestations. (Horkheimer, 2004, p. 4)

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[3] This attitude can be explicitly observed in Hume:
"The utmost we say of [ideas], even when they operate with greatest vigour, is, that they represent their object in so lively a manner, that we could almost say we feel or see it: But, except the mind be disordered by disease or madness, they never can arrive at such a pitch of vivacity, as to render these perceptions altogether undistinguishable." (Hume, 1988, p. 20)

Although philosophy had a purpose of revealing this reason inherent in reality, with Bacon and his approach to philosophy, we see that this purpose is lost and even considered as a kind of heresy.

Instead, what we see with Bacon is a reason that has been reduced to a role of categorization, inference, computation and deduction of experimental work. As something completely alien to an objective understanding of reason, this is more or less what is going to be understood by science in modern philosophy:

> The philosophical systems of objective reason implied the conviction that an all-embracing or fundamental structure of being could be discovered and a conception of human destination derived from it. They understood science, when worthy of this name, as an implementation of such reflection or speculation. They were opposed to any epistemology that would reduce the objective basis of our insight to a chaos of uncoordinated data, and identify our scientific work as the mere organization, classification, or computation of such data. (Horkheimer, 2004, p. 9)

However when reason is reduced to such a formal role, Bacon's schema of inferring from sense-data to the hidden structures and processes which govern them becomes problematic. This problem is explicated by Hume.

We have treated of Hume's distinction between relation of ideas and matters of fact and stated that relation of ideas determine the truth of propositions concerning arithmetic, geometry, algebra or in other words the most abstract concepts of the mind. Matters of fact, on the other hand, determine the truth of propositions concerning what happens in this world.

Hence, if we think about a proposition such as "from any point to any point a straight line can be drawn"; its truth can be assessed through relations of ideas. If we think about a proposition such as "this road is a straight line", I have to appeal to my impressions about the object in question to assess its truth.

When it comes to a proposition such as "if you walk this road you will reach Edinburgh", though I have to appeal to my impressions about the object, I cannot assess its truth by merely doing this. Since the fact that walking on the road and finally reaching Edinburgh are given as impressions to me, that walking on the road causes reaching Edinburgh is not given in my experience:

> Let an object be presented to a man of ever so strong natural reason and abilities; if that object be entirely new to him, he will not be able, by the most accurate examination of its sensible qualities, to discover any of its causes or effects. (Hume, 1988, p. 30)

Its truth can neither be assessed by relation of ideas, since the idea of reaching Edinburgh does not consist in the idea of walking this road. It would not be possible to derive where a certain road leads up to through merely analysing their ideas:

> When we reason *a priori*, and consider merely any object or cause, as it appears to the mind, independent of all observation, it never could suggest to us the notion of any distinct object, such as its effect; much less, show us the inseparable and inviolable connexion between them. (Hume, 1988, p. 33)

And if assessing the truth of such a particular case as "if you walk this road

you will reach Edinburgh ", then it seems to be much harder to reach hidden processes or structures or universal laws such as "an object at rest remains at rest unless acted upon by a force". For in this case from particular matters of facts we leap to universal propositions. However, these universal propositions can never be given in experience and again cannot be derived from relation of ideas.

Then Bacon's claim for revealing the hidden processes and structures which govern Nature through collecting facts and for making inferences from those facts are at risk. No certain knowledge of those processes and structures as claimed by Bacon can be assessed within such an epistemology.

Although epistemologically Bacon's schema is contradictory and incapable of revealing the alleged hidden processes and structures in Nature, it is always supported by the pragmatical ideal of "Man's dominion over Nature". The core of this epistemology, namely its methodology, thus stands firm and finds its justification with respect to such an ambition. Manipulating the world is the aim of this methodology, and truth and utility even become the same thing:

> Truth therefore and utility are here the very same things, and works themselves are of greater value as pledges of truth than as contributing to the comforts of life. (Bacon, 1905, p. 298)

Therefore, in the next chapter, we will investigate this methodology and the kind of practice it imposes on this world.

II.III. How to Acquire Knowledge

Bacon's most significant emphasis is that science, as a whole, must possess some master principles which regulate the roles of reason and experience.[4] It should hinder them from transgressing their legitimate borders. After these borders are determined for sure, the whole body of knowledge from the most basic terms in language to the most fundamental axioms of all sciences will be reconstructed:

> We need a thread to guide our steps; and the whole road, right from the first perceptions of sense, has to be made with a sure method. (Bacon, 2002, p. 10)

Bacon's methodology derives from this design of knowledge and prescribes an exhaustive experimentation, which will be called "experimentalism" by Horkheimer[5]. This attitude, which can be called the “ideal of science”, assumes that by augmenting senses with organized experimentation and constraining the work of intellect to inducing theories from experimentation and reorganizing experimentation according to these theories, genuine structures which regulate phenomena can be revealed:

> [Our method] is to establish degrees of certainty, to preserve sensation by putting a kind of restraint on it, but to reject in general the work of the mind that

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[4] Approximately eight years after Novum Organum was published, Descartes started working on his *Rules for the Direction of the Mind*, in which he tried to prescribe the rules for legitimate method for acquiring knowledge in much the same sense with Bacon:
Rule IV
We need a method if we are to investigate the truth of things.
Rule V
The whole method consists entirely in the ordering and arranging of the objects on which we must concentrate our mind's eye if we are to discover some truth. We shall be following this method exactly if we first reduce complicated and obscure propositions step by step to simpler ones, and then, starting with the intuition of the simplest ones of all, try to ascend through the same steps to a knowledge of all the rest. (Descartes, 1954)

[5] "Francis Bacon, the great precursor of *experimentalism*" (Horkheimer, 2004, p. 34)

> follows sensation, and rather to open and construct a new and certain road for the mind from the actual perception of the senses. (Bacon, 2002, p. 28)

To establish such a method, one must "elicit axioms from sense and particulars rising in a gradual and unbroken ascent to arrive at last at the most general axioms" (Bacon, 2002, p. 36). This schematization denotes an *inductivist* methodology. Bacon holds inductivism as the only possible path to truth, while claiming that no truth can possibly come out of devising the first principles primarily and then making deductions from them.

Instead, Bacon devises a pyramidal schema for ascending from senses and particulars (which constitutes the base of the pyramid) to linguistic terms, then to theories concerning specific areas of Nature, and finally to universal axioms concerning hidden processes and structures which stand at the top of the pyramid and constant for all phenomena concerning Nature.

So the first step to the new science should be reconstructing linguistic terms purely out of experience and denying all given notions:

> There is no one yet found of such constancy and intellectual rigour that he has deliberately set himself to do completely without common theories and common notions, and apply afresh to particulars a scoured and level intellect. And thus the human reason which we now have is a heap of jumble built up from many beliefs and many stray events as well as from childish notions which we absorbed in our earliest years. (Bacon, 2002, p. 79)

This ideal of constructing concepts and axioms of sciences is familiar to us from positivism. Bacon suggests that science should collect its observation data systematically, reconstruct its linguistic terms in a precise manner, and

should derive its theories from these terms in a valid form. In this sense, it can be said that he is the predecessor of logical positivism of the twentieth century.

In order to accomplish this task we need new methods of experimentation and induction, for current methods of experimentation and induction at hand are polluted by common sense:

> Thus we must seek to acquire a greater stock of experiments, and experiments of a different kind than we have yet done; and we must also introduce a quite different method, order and process of connecting and advancing experience. For casual experience which follows only itself (as we said above) is merely groping in the dark, and rather bemuses men than informs them. But when experience shall proceed by sure rules, serially and continuously, something better may be expected from the sciences. (Bacon, 2002, p. 81)

Designating this method will be Bacon's main challenge from this point on:

> In forming an axiom we need to work out a different form of induction from the one now in use; not only to demonstrate and prove so-called principles, but also lesser and intermediate axioms, in fact all axioms. For the induction which proceeds by simple enumeration is a childish thing, its conclusions are precarious, and it is exposed to the danger of the contrary instance; it normally bases its judgement on fewer instances than is appropriate, and merely on available instances. (Bacon, 2002, p. 83)

Thus true induction should not make inferences out of a number of observed instances no matter how large that number is, but it should rather make experiments in order to reveal every possibility for a nature to be separated

out:

> But the induction which will be useful for the discovery and proof of sciences and arts should separate out a nature, by appropriate rejections and exclusions; and then, after as many negatives as are required, conclude on the affirmatives. (Bacon, 2002, p. 84)

Bacon is also the inventor of the concept "*crucial experiment*" for the axioms formed by this kind of induction with a view to check if an axiom does or does not transgress the observations for the given nature:

> In forming axioms by this kind of induction we need also to conduct an examination and trial as to whether the axiom being formed is only fitted and made to the measure of the particulars from which it is drawn, or whether it has a larger or wider scope. If it is larger and wider in scope, we must see whether, like a kind of surety, it gives confirmation of its scope and breadth by pointing to new particulars; so that we do not just stick to things that are known, nor on the other hand extend our reach too far and grasp at abstract forms and shadows, not at solid things clearly defined in the material. (Bacon, 2002, p. 84)

In order to achieve this, an adequate natural and experimental history first must be established and Bacon will give the prescriptions for establishing this history:

> First we must compile a good, adequate natural and experimental history. This is the foundation of the matter. We must not invent or imagine what nature does or suffers; we must discover it.
>
> A *natural* and *experimental history* is so diverse and disconnected that it confounds and confuses the understanding unless it is stopped short, and

> presented in an appropriate order. So *tables* must be drawn up and a *coordination of instances* made, in such a way and with such organisation that the mind may be able to act upon them. (Bacon, 2002, p. 109)

We see that the first step to true induction for Bacon is an organized collection of data. But, of course, it is not possible to derive axioms merely by organizing data. Thus a certain method must be used for derivation from these data:

> Even with these, the mind, left to itself and moving of its own accord, is incompetent and unequal to the formation of axioms unless it is governed and directed. And therefore, in the third place, a true and proper induction must be supplied, which is the very *key of interpretation*. (Bacon, 2002, p. 109)

Bacon says that the first step of induction, namely the experimental and natural history should be a presentation to the intellect concerning all known instances about a certain nature.

For establishing natural and experimental history, Bacon lists three steps. The first step is the *table of existence and presence*. Here, all the cases where the chosen concept is existent and present are listed. Bacon exemplifies this with the concept of heat and lists the situations where heat occurs.

The second step is the *table of divergence*. This is where one lists the instances where the absence of the chosen concept is observed. Bacon exemplifies this with observations of situations where heat is absent.

The third step is the *table of degrees* or *table of comparison*. Here one lists the observations of the chosen concept from lesser to greater and the

situations where it increases or decreases. Bacon exemplifies this with heat gain and loss.

After these three tables are established, Bacon starts implementing his method of induction on these organized data:

> After the *presentation* has been made, induction itself has to be put to work. For in addition to the *presentation* of each and every instance, we have to discover which nature appears constantly with a given nature or not, which grows with it or decreases with it; and which is a limitation (as we said above) of a more general nature. (Bacon, 2002, p. 126)

Bacon defines the task of induction as "to discover which nature appears constantly with a given nature or not, which grows with it or decreases with it; and which is a limitation (as we said above) of a more general nature" (Bacon, 2002, p. 126). To maintain this task, induction should produce propositions. But Bacon is aware that it is impossible to posit a proposition merely from collected data, however organized this data is. Bacon names this kind of derivation from data "affirmation" and claims that it is just speculation:

> If the mind attempts to do this affirmatively from the beginning (as it always does if left to itself), fancies will arise and conjectures and poorly defined notions and axioms needing daily correction, unless one chooses (in the manner of the Schoolmen) to defend the indefensible. (Bacon, 2002, p. 126)

Instead, Bacon claims Man can only reach truth by continuous negation:

> [Man] may proceed at first only through negatives and, after making every kind of exclusion, may arrive at affirmatives only at the end. (Bacon, 2002, p.127)

So the first step in deriving axioms from organized data is rejecting the situations in which the chosen concept is not related:

> The first task of true *induction* is the *rejection* or *exclusion* of singular natures which are not found in an instance in which the given nature is present; or which are found in an instance where the given nature is missing; or are found to increase in an instance where the given nature decreases; or to decrease when the given nature increases. (Bacon, 2002, p. 127)

Thus what Bacon means is that, as the first step of true induction, one should continuously reject all conjectures which contradict with observation data.

True induction starts, according to Bacon, with negating certain propositions, but it does not stop there. It stops when a proposition is affirmed as an axiom. Then after rejecting false propositions, one must try to reach a true proposition about the chosen concept. This first affirmative proposition is called the *first harvest* or *preliminary interpretation.*

Next, before reaching the final axioms, Bacon speaks of seven tools: first, *privileged instances*; second, *supports for induction*; third, the *refinement of induction*; fourth, the adaptation of the *investigation to the nature of the subject*; fifth, *natures which are privileged* so far as investigation is concerned, or which inquiries we should make first and which ones later; sixth, the *limits of investigation,* or a summary of all natures universally; seventh, *deduction to practice,* or how it relates to man; eighth, *preparations for investigation*; and finally the *ascending and descending scale of axioms*. (Bacon, 2002, p. 136)

After counting twenty-seven kinds of privileged instances, we come to the end of *Novum Organum*. As we have noted above the book is never completed, so we have no idea of what Bacon was to suggest as the ultimate method of induction. But we still have some important remarks about Bacon's methodology.

First of all, we can see that following his epistemological distinction between experiential and inferential knowledge, he makes a strict methodological distinction between *observation* and *theory*. He regards observation data as if they can be collected without any preliminary theory, and he does not describe how those observation data will be collected but just treats them as given.

Secondly, using these observational data scientific language should be disambiguated such that every linguistic term should be *precise* and carry *reference to observation*.

Thirdly, from those precise terms the axioms of science should be established by a certain method of *induction*.

Finally, he observes a *progress* in science with respect to approximation to *truth* and by truth Bacon understands what is real, where what is real is of *utility* to Man. This is obvious in Bacon's analysis of signs of true knowledge.

Firstly he speaks of the products of a body of knowledge. By “products” he means the practical outcomes:

> None of the signs is more certain or more worth noticing than that from

> products. For the discovery of products and results is like a warranty or guarantee of the truth of a philosophy. From these Greek philosophies and the specialised sciences derived from them, hardly a single experience can be cited after the passage of so many years which tends to ease and improve the human condition... (Bacon, 2002, p.60)

The second sign for true knowledge Bacon proposes is progress. By progress, he understands a certain growth of knowledge through experience. In this respect, he regards philosophical and scientific knowledge that have been established thus far as not progressing, since they are not submitted to the test of experience. They are posited in some place and time and never put through any experiment at all or very little. Mechanical arts, on the other hand, are progressing according to Bacon, because, unlike discursive knowledge, the knowledge of arts always exists in the world of practice. And, therefore, they are always tested in practice and progress in a pragmatic sense:

> Signs should also be gathered from the growth and progress of philosophies and sciences. Those that are founded in nature grow and increase; those founded in opinion change but do not grow. Hence if those doctrines were not completely uprooted like a plant, but were connected to the womb of nature and nourished by her, what we see has been happening now for two thousand years would not have happened: the sciences stand still in their own footsteps and remain in practically the same state; they have made no notable progress; in fact they reached their peak in their earliest author, and have been on the decline ever since. We see the opposite evolution in the mechanical arts, which are founded in nature and the light of experience; as long as they are in fashion, they

> constantly quicken and grow as if filled with spirit; at first crude, then adequate, later refined, and always progressing. (Bacon, 2002, p. 61)

These two signs of true knowledge give us evidence for Bacon's pragmatic orientation. Also, while explaining the causes of sciences' lack of progress, Bacon points that they do not aim at producing discoveries.

> [...] it is not possible to get around a racecourse properly if the finishing line is not properly set and fixed. The true and legitimate goal of the sciences is to endow human life with new discoveries and resources. (Bacon, 2002, p. 66)

Bacon proclaims scientific method, as we have summarized, is the only legitimate method for attaining knowledge; although this claim for legitimacy, as argued by Hume, is in question. However, this method, by reducing reason to a mere role of classification, inference, deduction and computation, reduces science itself to a mere tool of whatever end is designed for it. This end is defined as "dominion of Man over Nature" by Bacon and with the conception of an experimentalist methodology, this dominion unfolds as an exhaustive utilization of Nature for alleged human well-being.

By imposing scientific method as the only legitimate path to knowledge, Baconian philosophy and its reminiscents exclude the search for a reason immanent in this world as the ground from which science and ethics can promulgate together as well as proto-scientific practices which were in reconciliation with Nature such as magic, witchery, astrology, alchemy and so on.

III. Objective Reason & Subjective Reason

In this chapter, we will comment on the Baconian rupture with the philosophical tradition. In this respect, Horkheimer's concepts of *objective reason* and *subjective reason* will be our main guides. We will dwell upon the meaning of the shift between these two different attitudes toward reason, and upon the theoretical and practical implications of them. Then we will see historically how this change has occurred, and we will try to penetrate into the course of this change. Finally, we will articulate Bacon's role within this narration of history.

III.I. Horkheimer's Conception

Horkheimer detects that the rupture in modern philosophy is caused by a change in the understanding and practice of reason. This change is elucidated by Horkheimer through his distinction between objective reason and subjective reason. Here, subjective reason denotes merely a mental faculty while objective reason denotes a potency present in the objective world. Subjective reason is interested in adapting means to ends, that is to say, in dwelling upon how or by what methods a certain end can be accomplished. When encountered with a certain situation, subjective reason tries to solve it within given present conditions and purposes without dwelling upon the conditions and purposes themselves. And when it dwells upon itself, subjective reason is interested in determining the true form of thinking mechanism. It can be seen that this dwelling upon method is aimed

at coming up with an ultimate form which can be admitted for every sort of subject universally.

Thus reason in this sense is always related to the form of the thinking mechanism rather than the content. It never examines the conditions of a situation, neither the prevalent values one is born into nor the purposes at which means are aimed. Therefore subjective reason is deficient of producing objective values or purposes by itself and of conceiving a transformation in the prevalent values or purposes:

> [...] the force that ultimately makes reasonable actions possible is the faculty of classification, inference, and deduction, no matter what the specific content—the abstract functioning of the thinking mechanism. This type of reason may be called subjective reason. It is essentially concerned with means and ends, with the adequacy of procedures for purposes more or less taken for granted and supposedly self-explanatory. It attaches little importance to the question whether the purposes as such are reasonable. If it concerns itself at all with ends, it takes for granted that they too are reasonable in the subjective sense, i.e. that they serve the subject's interest in relation to self-preservation [...] The idea that an aim can be reasonable for its own sake—on the basis of virtues that insight reveals it to have in itself—without reference to some kind of subjective gain or advantage, is utterly alien to subjective reason [...] (Horkheimer, 2004, p. 3)

In opposition to this conception, there is objective reason, which is conceived as a potency in the objective world. This conception understands reason as a whole with its form and content, and therefore it admits reason's ability to reveal the meaning and purpose within the objective world:

> This view [objective reason] asserted the existence of reason as a force not only

> in the individual mind but also in the objective world—in relations among human beings and between social classes, in social institutions, and in nature and its manifestations. Great philosophical systems, such as those of Plato and Aristotle, scholasticism, and German idealism were founded on an objective theory of reason. It aimed at evolving a comprehensive system, or hierarchy, of all beings, including man and his aims. The degree of reasonableness of a man's life could be determined according to its harmony with this totality. Its objective structure, and not just man and his purposes, was to be the measuring rod for individual thoughts and actions. This concept of reason never precluded subjective reason, but regarded the latter as only a partial, limited expression of a universal rationality from which criteria for all things and beings were derived. The emphasis was on ends rather than on means. The supreme endeavor of this kind of thinking was to reconcile the objective order of the 'reasonable' as philosophy conceived it, with human existence, including self-interest and self-preservation. [...] The theory of objective reason did not focus on the co-ordination of behavior and aim, but on concepts—however mythological they sound to us today—on the idea of the greatest good, on the problem of human destiny, and on the way of realization of ultimate goals. (Horkheimer, 2004, p. 4)

There is a huge difference in the implications and practices which promulgate from these two different conceptions of reason. From the point of view of subjective reason, reason is a faculty peculiar to human mind, and the world is a 'chaos of uncoordinated data' (Horkheimer, 2004, p. 9). It is the subject which imposes regularity to these uncoordinated data through reason. Therefore reason, in this conception, is reduced to a mere role of regulating sense-data. This regulation is what is understood by 'theory' in the

modern sense. In this sense, theory is merely a tool for practice. It is a shortcut for manuals of existing practices. Horkheimer stresses this understanding of theory in his essay “Traditional and Critical Theory”:

> Theory is stored up knowledge, put in a form that makes it useful for the closest possible description of facts. Poincaré compares science to a library that must ceaselessly expand. Experimental physics is the librarian who takes care of acquisitions, that is, enriches knowledge by supplying new material. Mathematical physics—the theory of natural science in the strictest sense—keeps the catalogue; without the catalogue one would have no access to the library's rich contents. "That is the role of mathematical physics. It must direct generalisation, so as to increase what I have called just now the output of science." (Horkheimer, 1986, p. 188)

‘Theory’ has a certain rigid form in the modern sense, which can be traced back to Francis Bacon's conception of knowledge. In this form, we have, on one hand, sense-data and, on the other, propositions about a subject. These propositions are linked to each other in such a way that as a whole they should be consistent with the sense-data:

> Theory for most researchers is the sum-total of propositions about a subject, the propositions being so linked with each other that a few are basic and the rest derive from these. The smaller the number of primary principles in comparison with the derivations, the more perfect the theory. The real validity of the theory depends on the derived propositions being consonant with the actual facts. If experience and theory contradict each other, one of the two must be re-examined. Either the scientist has failed to observe correctly or something is wrong with the principles of the theory. In relation to facts, therefore, a theory always remains a hypothesis. One must be ready to change it if its weaknesses

> begin to show as one works through the material. (Horkheimer, 1986, p. 188)

In this conception, it can be seen that the idea that scientific knowledge is an objective knowledge acquired by sense-data is undermined, since, although theory is limited by sense-data, it is not necessitated by them. This is because scientist has a collection of sense-data on one hand and can conceive a variety of theories which are all in accordance with those sense-data on the other. In other words, sense-data supplies the necessary conditions for theory, but not the sufficient conditions. Quine acknowledges in 'Two Dogmas of Empiricism' that the limit set by sense-data cannot determine the theory, but that the theory may merely be under-determined by sense-data. One cannot derive a theory merely from sense-data, but one should always improvise on the data:

> The totality of our so-called knowledge or beliefs, from the most casual matters of geography and history to the profoundest laws of atomic physics or even of pure mathematics and logic, is a man-made fabric which impinges on experience only along the edges. Or, to change the figure, total science is like a field of force whose boundary conditions are experience. (Quine, 1961, p. 42)

Therefore there is always a gap between sense-data and theory. There is no necessary path from sense-data to theory as Bacon or positivism have conceived there to be. One should make a leap from sense-data to theory, and this leap is determined by the practices one has maintained and the purposes those practices serve within this world. Theory becomes the tool for retaining and improving those practices by storing Man's knowledge in an augmented form:

> What scientists in various fields regard as the essence of theory thus

> corresponds, in fact, to the immediate tasks they set for themselves. The manipulation of physical nature and of specific economic and social mechanisms demand alike the amassing of a body of knowledge such as is supplied in an ordered set of hypotheses. (Horkheimer, 1986, p. 194)

In the final analysis, theory helps calculating probabilities in order to adjust means to given ends:

> Ultimately subjective reason proves to be the ability to calculate probabilities and thereby to co-ordinate the right means with a given end. (Horkheimer, 2004, p. 4)

Since these ends cannot be determined objectively, they can be related to nothing but the subject, whether that subject is the individual or the society. Thus theory in the modern sense becomes a servant for the prevalent values of society:

> these functions [discernment and reflection] certainly contribute to the co-ordination of means and ends, which is, after all, the social concern of science and, in a way, the *raison d'être* of theory in the social process of production. (Horkheimer, 2004, p. 5)

In this conception reason can serve any purpose, because reason possesses no ability to determine purposes, but only the ability to regulate sense-data in an order which calculates probabilities and thereby coordinates means and ends. It can be said that according to the subjective conception, reason can serve any practice without an examination into whether that certain practice is good or bad. Subjective reason is made unable to pass any judgement on human behaviour:

> According to such theories, thought serves any particular endeavor, good or

> bad. It is a tool of all actions of society, but it must not try to set the patterns of social and individual life, which are assumed to be set by other forces. In lay discussion as well as in scientific, reason has come to be commonly regarded as an intellectual faculty of co-ordination, the efficiency of which can be increased by methodical use and by the removal of any non-intellectual factors, such as conscious or unconscious emotions. Reason has never really directed social reality, but now reason has been so thoroughly purged of any specific trend or preference that it has finally renounced even the task of passing judgment on man's actions and way of life. (Horkheimer, 2004, p. 7)

With this reduction of reason to a mere role of regulation, any question concerning ethics is pulled outside the field of reason:

> If the subjectivist view holds true, thinking cannot be of any help in determining the desirability of any goal in itself. The acceptability of ideals, the criteria for our actions and beliefs, the leading principles of ethics and politics, all our ultimate decisions are made to depend upon factors other than reason. They are supposed to be matters of choice and predilection, and it has become meaningless to speak of truth in making practical, moral, or esthetic decisions. (Horkheimer, 2004, p. 6)

The Kantian distinction between pure and practical reason for instance, promulgates from such a divided conception of the world according to which scientific and ethical knowledge indicate different realms.

However, reason in the objective sense used to connote more than the mere regulation of sense-data by calculating probabilities in order to coordinate means and ends. This is not to say that this regulating, formal and subjective aspect of reason was denied, but reason meant more than that. In the objective conception, reason was conceived as a tool for determining ends.

In other words, reason was able to put the practices present in a certain society into examination, criticize them and finally judge them, and it was able to conceive and propose different practices which are good in themselves. Reason possessed those abilities because it was conceived as being capable of determining ends:

> When the idea of reason was conceived, it was intended to achieve more than the mere regulation of the relation between means and ends: it was regarded as the instrument for understanding the ends, *for determining them*. (Horkheimer, 2004, p. 7)

The objective attitude posits that reason is immanent to the objective world, and that this reason, which belongs to the objective world, can be penetrated through reflection:

> The term objective reason thus on the one hand denotes as its essence a structure inherent in reality that by itself calls for a specific mode of behavior in each specific case, be it a practical or a theoretical attitude. [...] On the other hand, the term objective reason may also designate this very effort and ability to reflect such an objective order. (Horkheimer, 2004, p. 8)

In the objective conception of reason, scientific and ethical knowledge belonged to the same world. There was one sole ground on which scientific and ethical knowledge were grounded.

The objective attitude is in a strict opposition to the subjective one on the grounds pointed out above. The objective attitude would never agree to the reduction of reason to a mere function of regulation of sense-data by calculating probabilities in order to coordinate means and ends. The objective attitude conceives its basic propositions through speculation,

which is based on an insight into the objective world. Both the scientific theories, which coordinate means and ends, and ethical judgements, which determine the ends to pursue, are derived from these basic propositions supplied by objective reason. Thus, for objective reason, there is one sole ground from which science and ethics can be derived.

This implication is diametrically opposed to the subjectivist view that only regulation of sense-data (i.e. science in the subjective sense) falls into the field of reason, and that ethical judgements cannot be passed by reason:

> The philosophical systems of objective reason implied the conviction that an all-embracing or fundamental structure of being could be discovered and a conception of human destination derived from it. They understood science, when worthy of this name, as an implementation of such reflection or speculation. They were opposed to any epistemology that would reduce the objective basis of our insight to a chaos of uncoordinated data, and identify our scientific work as the mere organization, classification, or computation of such data. (Horkheimer, 2004, p. 9)

Therefore the subjective attitude leaves the field of ethics to established morality. From the point of subjective reason, it is impossible to make any comments on the field of ethics in an objective way. Subjective attitude overcomes this problem by separating the world into two distinct parts: the world of facts and the world of values. In this two-worldly conception, the rules are set differently. The standards for science, which subjective reason has set, cannot be applied to the ethical field, for the ethical field there must be other standards. In the subjective attitude, these standards are determined by completely different rules or they are totally left to the morality prevalent

in the society:

> The latter activities, in which subjective reason tends to see the main function of science, are in the light of the classical systems of objective reason subordinate to speculation. Objective reason aspires to replace traditional religion with methodical philosophical thought and insight and thus to become a source of tradition all by itself. Its attack on mythology is perhaps more serious than that of subjective reason, which, abstract and formalistic as it conceives itself to be, is inclined to abandon the fight with religion by setting up two different brackets, one for science and philosophy, and one for institutionalized mythology, thus recognizing both of them. For the philosophy of objective reason there is no such way out. Since it holds to the concept of objective truth, it must take a positive or a negative stand with regard to the content of established religion. Therefore the critique of social beliefs in the name of objective reason is much more portentous— although it is sometimes less direct and aggressive—than that put forward in the name of subjective reason. (Horkheimer, 2004, p. 9)

III.II. The History of Reason

The objective attitude was once the dominant force in philosophy. But, somehow, reason has destroyed its own objective content and became a mere tool of Man's will and ambitions for domination. However, this process did not happen just at once: subjective reason gradually became more and more distinct and, in the end, it has dominated the field, and the search for an objective reason is almost lost today:

> The relation between these two concepts of reason is not merely one of

> opposition. Historically, both the subjective and the objective aspect of reason have been present from the outset, and the predominance of the former over the latter was achieved in the course of a long process. Reason in its proper sense of logos, or ratio, has always been essentially related to the subject, his faculty of thinking. [...] The present crisis of reason consists fundamentally in the fact that at a certain point thinking either became incapable of conceiving such objectivity at all or began to negate it as a delusion. This process was gradually extended to include the objective content of every rational concept. In the end, no particular reality can seem reasonable *per se*; all the basic concepts, emptied of their content, have come to be only formal shells. As reason is subjectivized, it also becomes formalized. (Horkheimer, 2004, p. 6)

As we have noted, this subjectivization and formalization of reason ends up in the ejection of the question of purpose and ethics in general from the field of reason. Nonetheless, we have also noted that the objective attitude collects all knowledge -including ethical knowledge- under reason. Consequently, objective reason can criticize all kinds of tradition with respect to truth. However, subjective reason can merely criticize traditional values or practices in society with respect to individual/social preferences or scepticism. In most cases, these two different types of criticisms are interrelated, for in most cases the subjectivist criticism starts with a doubt about the basic principles of traditional values and then ends up with an assertion of the relativity of those values.

The traces of this strife between Objective Reason and Subjective Reason can be followed in Plato's Socratic dialogues. In this regard, "doxa" (*δοξά*)

would provide a remarkable concept. It can be said that “doxa” corresponds to any knowledge claim which emerges out of the relation between this world and language. In this sense, it is obvious that “doxa” has a much broader connotation than its conventional translations of “opinion” or “belief”. It extends from individual or social ethical or political knowledge claims to religious, metaphysical or scientific ones. Socrates, in most of the dialogues, reveals these inconsistencies and incompleteness of doxological knowledge claims, thus showing the inadequacy of the idea of reconstructing the world in language.

In the dialogue with Theaetetus, Socrates unfolds this inadequacy against three accounts of doxological knowledge put forward by him; namely that “[...] a man who knows something perceives what he knows, and the way it appears at present, at any rate, is that knowledge is simply perception” (Plato, 1997, p. 168), “[...] true judgment [is] knowledge” (p. 207) and “[knowledge] is true judgment with an account” (p. 223). Consequently, all three accounts end up with contradictory results, revealing the futility of a search for knowledge in doxa and that any knowledge thus established would be inconsistent and incomplete.

The inadequacy of doxological knowledge later reveals itself in the futile efforts of verificationism and confirmationism of twentieth century logical positivism. Popper's falsificationism emerges, in some sense, as an admission of this inadequacy.

The sublime goal, which disappoints the futile efforts of verificationism and confirmationism, and which will be later replaced by probabilism and

falsificationism, is the idea of certainty. The prescience that such a certain knowledge cannot be achieved on the level of doxological knowledge in Socratic dialogues is obvious. What then is doxological knowledge?

In the dialogue with Meno, Socrates demonstrates that there is practically and beneficially no difference between doxa and episteme (*ἐπιστάμε*):

> Socrates: But that one cannot guide correctly if one does not have knowledge; to this our agreement is likely to be incorrect.—How do you mean?
>
> Socrates: I will tell you. A man who knew the way to Larissa, or anywhere else you like, and went there and guided others would surely lead them well and correctly?—Certainly.
>
> Socrates: What if someone had had a correct opinion as to which was the way but had not gone there nor indeed had knowledge of it, would he not also lead correctly?—Certainly.
>
> Socrates: And as long as he has the right opinion about that of which the other has knowledge, he will not be a worse guide than the one who knows, as he has a true opinion, though not knowledge.—In no way worse.
>
> Socrates: So true opinion is in no way a worse guide to correct action than knowledge. It is this that we omitted in our investigation of the nature of virtue, when we said that only knowledge can lead to correct action, for true opinion can do so also.—So it seems.
>
> Socrates: So correct opinion is no less useful than knowledge?
>
> […]
>
> Socrates: Well then, is it not correct that when true opinion guides the course of every action, it does no worse than knowledge?—I think you are right in this too.
>
> Socrates: Correct opinion is then neither inferior to knowledge nor less useful in

directing actions, nor is the man who has it less so than he who has knowledge.—That is so.

Socrates: And we agreed that the good man is beneficent.—Yes.

Socrates: Since then it is not only through knowledge but also through right opinion that men are good, and beneficial to their cities when they are, and neither knowledge nor true opinion come to men by nature but are acquired—or do you think either of these comes by nature?—I do not think so.

(Plato, 1997, p. 895-896)

What comes up here is that doxological knowledge is sufficient for manipulating sense-perception, in other words, for determining the adequacy of means to ends. In this sense, doxological knowledge is a good instrumental knowledge.

The conspicuous character of sense-perception as mental and private entities is profoundly important in such a conception. Doxa becomes a claim of knowledge, to the extent that sense-perceptions are transferred to that which is public, i.e. language. The faculty of reason is what turns private sense-perceptions into judgements in language. Through language, sense-perceptions, which seem to be disconnected when left to themselves and denominated as “manifold” by Kant (1781/1998), are bound with judgements. Reason has a formal function within this conception and undertakes the task of transferring sense-perceptions into judgements in language.

This function of reason is elaborated by the sophists in the Socratic dialogues. Theaetetus presents one of Protagoras' claims for the definition of knowledge, namely, that knowledge is equivalent to private sense-

perceptions:

> Theaetetus: Well, Socrates, after such encouragement from you, it would hardly be decent for anyone not to try his hardest to say what he has in him. Very well then. It seems to me that a man who knows something perceives what he knows, and the way it appears at present, at any rate, is that knowledge is simply perception.
>
> Socrates: There's a good frank answer, my son. That's the way to speak one's mind. But come now, let us look at this thing together, and see whether what we have here is really fertile or a mere wind-egg. You hold that knowledge is perception?
>
> Theaetetus: Yes.
>
> Socrates: But look here, this is no ordinary account of knowledge you've come out with: it's what Protagoras used to maintain. He said the very same thing, only he put it in rather a different way. For he says, you know, that 'Man is the measure of all things: of the things which are, that they are, and of the things which are not, that they are not.' You have read this, of course?
>
> Theaetetus: Yes, often.
>
> Socrates: Then you know that he puts it something like this, that as each thing appears to me, so it is for me, and as it appears to you, so it is for you—you and I each being a man?
>
> Theaetetus: Yes, that is what he says.
>
> (Plato, 1997, p. 168-169)

It is obvious from this presentation that some kind of subjectivist epistemology has been held by Protagoras, and the role of reason in such a conception would obviously be merely the correlation between sense-perceptions and judgements.

Also in *Euthydemus,* Plato presents an argument ascribed to Protagoras, that "saying something false is impossible":

> So that if he speaks this thing, he speaks no other one of things that are except the very one he speaks?
>
> Of course, said Ctesippus.
>
> And the thing he speaks is one of those that are, distinct from the rest?
>
> Certainly.
>
> Then the person speaking that thing speaks what is, he said.
>
> Yes.
>
> But surely the person who speaks what is and things that are speaks the truth—so that Dionysodorus, if he speaks things that are, speaks the truth and tells no lies about you.
>
> Yes, said Ctesippus, but a person who speaks these things, Euthydemus, does not speak things that are.
>
> And Euthydemus said, But the things' that are not surely do not exist, do they?
>
> No, they do not exist.
>
> Then there is nowhere that the things that are not are?
>
> Nowhere.
>
> Then there is no possibility that any person whatsoever could do anything to the things that are not so as to make them be when they are nowhere?
>
> It seems unlikely to me, said Ctesippus.
>
> Well then, when the orators speak to the people, do they do nothing?
>
> No, they do something, he said.
>
> Then if they do something, they also make something?
>
> Yes.
>
> Speaking, then, is doing and making?

> He agreed.
>
> Then nobody speaks things that are not, since he would then be making something, and you have admitted that no one is capable of making something that is not. So according to your own statement, nobody tells lies; but if Dionysodorus really does speak, he speaks the truth and things that are.
>
> (Plato, 1997, p. 721)

In such a conception, the notions of truth and falsehood are ridiculed, and no kind of objective reality can be thought at all. Still, one can hold on to the instrumental aspect of doxological knowledge.

Thus, as far as the adequacy of means and ends (i.e. manipulating sense-perceptions) are concerned, doxological knowledge is on a par with the knowledge of the real. However, the sophistic claim of knowledge violates that character of doxological knowledge as instrumental knowledge in the sense that Socrates gives for the etymological definition of "doxa" in *Cratylus*: "the pursuit (*dioxis*) the soul engages in when it hunts for the knowledge of how things are" (Plato, 1997, p. 137). This is because the emphasis here is on the verb "are", although the sophistic knowledge claims are inclined to the verb "ought." By means of this leap from "what is" to "what ought to be", sophists justify themselves as preachers of '*arête*' (ἀρετή). What can arise from this leap, in the context of ethics, is merely a relativism which affirms the prevalent values in the society. Particularly in the thought of *Protagoras,* as portrayed by Plato, we see this tendency. Following the claim that what he teaches "is sound deliberation, both in domestic matters—how best to manage one's household, and in public affairs—how to realize one's maximum potential for success in political

debate and action" (Plato, 1997, p. 755), *Protagoras* presents an account of human civilizations through the myth of Prometheus and Epimetheus, justifying the prevalent values and conditions in his society with respect to protection of the self-preservation of humankind. Therefore according to this account, preservation of the prevalent social order is the goal of arete:

> They [humankind] did indeed try to band together and survive by founding cities. The outcome when they did so was that they wronged each other, because they did not possess the art of politics, and so they would scatter and again be destroyed. Zeus was afraid that our whole race might be wiped out, so he sent Hermes to bring justice and a sense of shame to humans, so that there would be order within cities and bonds of friendship to unite them. Hermes asked Zeus how he should distribute shame and justice to humans. 'Should I distribute them as the other arts were? This is how the others were distributed: one person practicing the art of medicine suffices for many ordinary people; and so forth with the other practitioners. Should I establish justice and shame among humans in this way, or distribute it to all?' 'To all,' said Zeus, 'and let all have a share. For cities would never come to be if only a few possessed these, as is the case with the other arts. And establish this law as coming from me: Death to him who cannot partake of shame and justice, for he is a pestilence to the city.' (Plato, 1997, p. 757-758)

However, in *Apology* Socrates insists that all values in the society, all that every human being is born into, should be put into examination:

> [...] if I say that it is the greatest good for a man to discuss virtue every day and those other things about which you hear me conversing and testing myself and others, for the unexamined life is not worth living for men, you will believe me even less. (Plato, 1997, p. 33)

From the doxological level, the ethical consequences that can arise from such an examination is either sophistic relativism or sceptical doubt; and Socratic examination reveals how this sophistic relativism disguises the ideological conservatism and how it is subordinated to personal interests. Later on in the *Apology*, Socrates exhibits a position opposed to sophistic relativism and ideological conservatism:

> Now I want to prophesy to those who convicted me, for I am at the point when men prophesy most, when they are about to die. I say gentlemen, to those who voted to kill me, that vengeance will come upon you immediately after my death, a vengeance much harder to bear than that which you took in killing me. You did this in the belief that you would avoid giving an account of your life, but I maintain that quite the opposite will happen to you. There will be more people to test you, whom I now held back, but you did not notice it. They will be more difficult to deal with as they will be younger and you will resent them more. You are wrong if you believe that by killing people you will prevent anyone from reproaching you for not living in the right way. To escape such tests is neither possible nor good, but it is best and easiest not to discredit others but to prepare oneself to be as good as possible. With this prophecy to you who convicted me, I part from you. (Plato, 1997, p. 35)

Sophistic relativism can said to be the primordial epiphany of subjective reason in the sense explained by Horkheimer. Along with the prevalent values of his society, Socrates turned his back to sophism too, and put it into criticism:

> Socrates died because he subjected the most sacred and most familiar ideas of his community and his country to the critique of the daimonion, or dialectical thought, as Plato called it. In doing so, he fought against both ideologic

> conservatism and relativism masked as progressiveness but actually subordinated to personal and professional interests. In other words, he fought against the subjective, formalistic reason advocated by the other Sophists. He undermined the sacred tradition of Greece, the Athenian way of life, thus preparing the soil for radically different forms of individual and social life. (Horkheimer, 2004, p.8)

Nevertheless, Socrates is not a sceptic either. He stands as a preacher of the epiphany of objective reason. The Socratic conception of knowledge and the position of reason in this conception becomes manifest in the concepts of 'episteme' and '*aletheia*' (*ἀλήθεια*).

Socrates defines "episteme" in *Republic V* as "by its nature set over what is, to know it as it is" (Plato, 1997, p. 1104). In other words, it can be said that episteme is to know reality as it is. Obviously, episteme -when defined as such- cannot be derived from sense-perception or linguistic investigation; i.e. within the doxological level. For we have seen how Socrates exposes the mediated and inconsistent character of doxological knowledge.

How then episteme, in its strict sense, can be grasped? In the *Phaedo*, Socrates asks the same question in just the way we have formulated:

> Then what about the actual acquiring of knowledge? Is the body an obstacle when one associates with it in the search for knowledge? I mean, for example, do men find any truth [*aletheia*] in sight or hearing, or are not even the poets forever telling us that we do not see or hear anything accurately, and surely if those two physical senses are not clear or precise, our other senses can hardly be accurate, as they are all inferior to these. Do you not think so?
>
> I certainly do, he said.

> When then, he asked, does the soul grasp the truth? For whenever it attempts to examine anything with the body, it is clearly deceived by it.
>
> True.
>
> (Plato, 1997, p. 56)

Before searching an answer for this question, we should investigate the concept of '*aletheia*'. Heidegger defines 'aletheia' as "that which is unconcealed, that which gets discovered or uncovered" (Heidegger, 1962, p. 57). In this sense '*aletheia'* differs from the concept of 'truth' in the doxological sense, for it is a value which can neither be attributed to the relation of correspondence between representation and reality nor to the functionality of the representation. *Aletheia* is the revelation of reality towards the subject. Obviously, this revelation cannot occur through the mediation of doxological knowledge as portrayed by Socrates. It can only come through reason:

> Is it not in reasoning if anywhere that any reality becomes clear to the soul?
>
> Yes.
>
> And indeed the soul reasons best when none of these senses troubles it, neither hearing nor sight, nor pain nor pleasure, but when it is most by itself, taking leave of the body and as far as possible having no contact or association with it in its search for reality.
>
> That is so.
>
> And it is then that the soul of the philosopher most disdains the body, flees from it and seeks to be by itself?
>
> It appears so.
>
> (Plato, 1997, p. 56-57)

Reason, in this conception, is a part of reality and thus the possibility of an

insight into reality. Through this insight one can disclose the real and know "what is, as it is"; that is to say, through this insight one can acquire *episteme*. The knowledge of the Just, the Beautiful and the Good as they are in the objective world also come along with this knowledge:

> What about the following, Simmias? Do we say that there is such a thing as the Just itself, or not?
>
> We do say so, by Zeus.
>
> And the Beautiful, and the Good?
>
> Of course.
>
> And have you ever seen any of these things with your eyes?
>
> In no way, he said.
>
> Or have you ever grasped them with any of your bodily senses? I am speaking of all things such as Bigness, Health, Strength and, in a word, the reality of all other things, that which each of them essentially is. Is what is most true in them contemplated through the body, or is this the position: whoever of us prepares himself best and most accurately to grasp that thing itself which he is investigating will come closest to the knowledge of it?
>
> Obviously.
>
> Then he will do this most perfectly who approaches the object with thought alone, without associating any sight with his thought, or dragging in any sense perception with his reasoning, but who, using pure thought alone, tries to track down each reality pure and by itself, freeing himself as far as possible from eyes and ears, and in a word, from the whole body, because the body confuses the soul and does not allow it to acquire truth and wisdom whenever it is associated with it. Will not that man reach reality, Simmias, if anyone does?
>
> What you say, said Simmias, is indeed true.

(Plato, 1997, p. 57)

When the Just, the Beautiful and the Good as they are in the objective world are contemplated through reason, one will harmonize one's actions with them. When *episteme* is thus acquired, there is no way for man to ignore its consequences. This attitude can be seen in Socrates' argument against *akrasia* (*ἀκρασία*). *Akrasia* means acting against one's knowledge. In the *Protagoras,* Socrates claims such an act is impossible:

> Now, no one goes willingly toward the bad or what he believes to be bad; neither is it in human nature, so it seems, to want to go toward what one believes to be bad instead of to the good. And when he is forced to choose between one of two bad things, no one will choose the greater if he is able to choose the lesser. (Plato, 1997, p. 787)

One would not touch fire willingly, because of the knowledge that the tactile contact of human body with fire is not good for the body. However, one can be deceived if fire is concealed to one's sense-perceptions, or the knowledge that the tactile contact of human body with fire is not good for the body is concealed through some deficiencies of the mind. Then it can be said that *akrasia* occurs within the doxological level, because of its incomplete and inconsistent character. But actually this is not *akrasia,* since there is no knowledge in the sense of episteme, because if one acquires episteme, one will necessarily act according to it.

Thus, as Horkheimer notices, Socratic conceptions of knowledge and the function of reason within that conception envisions a holistic portrait of the world where all knowledge -including ethics- in the sense of "episteme" is immanent to the objective world:

> Socrates held that reason, conceived as universal insight, should determine beliefs, regulate relations between man and man, and between man and nature. (Horkheimer, 2004, p. 8)

In Aristotle's philosophy too one can see the manifestation of objective reason. According to Aristotle, first philosophy, or metaphysics, was the ground for both scientific and ethical knowledge.

Episteme in Aristotle's sense covers metaphysics along with empirical sciences. Episteme should explain the facts in the world with respect to causal relations. That is to say, it should explain what is superficial by what is more fundamental.

However this explanation is not a mere valid syllogistic deduction. There is more to an epistemic explanation than syllogism, though it includes syllogism. Aristotle calls this kind of explanation *demonstration.* A demonstration should provide understanding by drawing its conclusions from its premises. So Aristotle says in the *Posterior Analytics*:

> We think we understand a thing *simpliciter* (and not in the sophistic fashion accidentally) whenever we think we are aware both that the explanation because of which the object is is its explanation, and that it is not possible for this to be otherwise. It is clear, then, that to understand is something of this sort; for both those who do not understand and those who do understand—the former think they are themselves in such a state, and those who do understand actually are. Hence that of which there is understanding *simpliciter* cannot be otherwise. [...]
>
> If, then, understanding is as we posited, it is necessary for demonstrative understanding in particular to depend on things which are true and primitive and

> immediate and more familiar than and prior to and explanatory of the conclusion (for in this way the principles will also be appropriate to what is being proved). For there will be deduction even without these conditions, but there will not be demonstration; for it will not produce understanding. (Aristotle, 1991, p. 3-4)

Hence Aristotle's epistemology requires demonstration from more fundamental premises to more superficial conclusions. Then how should the demonstration begin? It seems as if there can be two answers: We can either advance from the superficial to more fundamental and from more fundamental to more and more fundamental endlessly, or demonstrate one of our fundamental premises with a superficial one circularly:

> For the one party, supposing that one cannot understand in another way, claim that we are led back *ad infinitum* on the grounds that we would not understand what is posterior because of what is prior if there are no primitives; and they argue correctly, for it is impossible to go through infinitely many things. And if it comes to a stop and there are principles, they say that these are unknowable since there is no demonstration of them, which alone they say is understanding; but if one cannot know the primitives, neither can what depends on them be understood simpliciter or properly, but only on the supposition that they are the case.
>
> The other party agrees about understanding; for it, they say, occurs only through demonstration. But they argue that nothing prevents there being demonstration of everything; for it is possible for the demonstration to come about in a circle and reciprocally. (Aristotle, 1991, p. 5-6)

Aristotle asserts here that the most fundamental first principles from which the whole demonstration derives are indemonstrable yet known

immediately:

> But we say that neither is all understanding demonstrative, but in the case of the immediates it is non-demonstrable—and that this is necessary is evident; for if it is necessary to understand the things which are prior and on which the demonstration depends, and it comes to a stop at some time, it is necessary for these immediates to be non-demonstrable. So as to that we argue thus; and we also say that there is not only understanding but also some principle of understanding by which we become familiar with the definitions. (Aristotle, 1991, p. 6)

The way to attain this immediate knowledge of the first principles is elucidated by Aristotle in detail in the *Posterior Analytics*. Basically what he describes is a kind of immediate intellectual apprehension of the first principles.

We have already noted that empirical sciences are also demonstrated by these first principles. This demonstration is made possible by Aristotle's four causes:

> *material* cause, "In one way, then, that out of which a thing comes to be and which persists, is called a cause, e.g. the bronze of the statue, the silver of the bowl, and the genera of which the bronze and the silver are species." (Aristotle, 1991, p. 23);
>
> *formal cause*, "In another way, the form or the archetype, i.e. the definition of the essence, and its genera, are called causes (e.g. of the octave the relation of 2:1, and generally number), and the parts in the definition." (Aristotle, 1991, p. 23);
>
> *efficient cause*, "Again, the primary source of the change or rest; e.g.

> the man who deliberated is a cause, the father is cause of the child, and generally what makes of what is made and what changes of what is changed." (Aristotle, 1991, p. 23);
>
> *final cause*, "Again, in the sense of end or that for the sake of which a thing is done, e.g. health is the cause of walking about. (‘Why is he walking about?’ We say: ‘To be healthy’, and, having said that, we think we have assigned the cause.) (Aristotle, 1991, p. 23)

The same is true also of all the intermediate steps which are brought about through the action of something else as means towards the end, e.g. reduction of flesh, purging, drugs, or surgical instruments are means towards health. All these things are for the sake of the end, though they differ from one another in that some are activities, others instruments." (Aristotle, 1991, p. 23).

These four causes are the necessary and sufficient conditions of any scientific explanation. However the last of them, namely the final cause, also extends to ethical practices. Final cause, in Aristotle's sense, signifies more than the purposeful acts of an intentional agent; it is neither a trait peculiar to human beings, nor a trait of a transcendent being which designs this world. Aristotle's final cause is immanent to this world.

Thus, in this conception, the final cause or the purpose of human life is not a subjective choice, but one immanent to this world and therefore has an objective reality. Aristotle calls this final cause of human life *eudaimonia*, which can be realized by actualizing our human capacities. *Eudaimonia* can be understood with respect to *ergon*, that is human function. Just like any

object in the world, human beings have a function peculiar to its own and it is acting with respect to the rational principle:

> [Eudaimonia], then, is something complete and self-sufficient, and is the end of action. [...]
>
> Presumably, however, to say that [eudaimonia] is the chief good seems a platitude, and a clearer account of what it is is still desired. This might perhaps be given, if we could first ascertain the function of man. For just as for a flute-player, a sculptor, or any artist, and, in general, for all things that have a function or activity, the good and the 'well' is thought to reside in the function, so would it seem to be for man, if he has a function. Have the carpenter, then, and the tanner certain functions or activities, and has man none? Is he naturally functionless? Or as eye, hand, foot, and in general each of the parts evidently has a function, may one lay it down that man similarly has a function apart from all these? What then can this be? Life seems to be common even to plants, but we are seeking what is peculiar to man. Let us exclude, therefore, the life of nutrition and growth. Next there would be a life of perception, but it also seems to be common even to the horse, the ox, and every animal. There remains, then, an active life of the element that has a rational principle [...] (Aristotle, 1991, p. 9)

For Aristotle, then, both empirical sciences and ethics derive from one soul ground, that is from first philosophy, which is acquired and implemented through a reason immanent to the objective world.

III.III. The Shift from Objective to Subjective Reason

Various and sophisticated epiphanies of objective reason have been

manifested since Plato and Aristotle. From the Stoic identification of God with *logos*, which is an objective reason immanent to this world[6], to Spinoza's God or Nature (*Deus, sive Natura*), from which everything in this world necessarily follows (1996), many can be counted amongst them. However, in an era, which is characterized by industrialization and colonization, we see the rise of subjective reason. Within this era, philosophy becomes more and more entangled with technological science and more and more contemptuous of the idea of the possibility of a reason immanent to the objective world and a capacity of a human intuition towards it.

Francis Bacon stands out as one of the touchstones of this process, both in terms of his conception of a formalized subjective reason and his criticisms of the pursuits of objective reason, but before all, because of his subordination of philosophy to the endeavours of the domination of Nature by Man and consequently to the modern purposes of industrialization and colonization.

With Bacon we see the denial of reason's objective content and this denial also serves the subordination of philosophy. This denial becomes clear in his criticism of scientific and philosophical traditions before him.

For the scientific tradition, Bacon’s criticisms are mainly methodological:

> As the sciences in their present state are useless for the discovery of works, so logic in its present state is useless for the discovery of sciences.

6

> They hold that there are two principles in the universe, the active principle and the passive. The passive principle, then, is a substance without quality, i.e. matter, whereas the active is the reason inherent in this substance, that is God. [...]
> God is one and the same with Reason, Fate, and Zeus. (Diogenes Laertius, 1925, p.134)

> Current logic is good for establishing and fixing errors (which are themselves based on common notions) rather than for inquiring into truth; hence it is not useful, it is positively harmful. (Bacon, 2002, p.35)
>
> There are, and can be, only two ways to investigate and discover the truth. The one leaps from sense and particulars to the most general axioms, and from these principles and their settled truth, determines and discovers intermediate axioms; this is the current way. The other elicits axioms from sense and particulars, rising in a gradual and unbroken ascent to arrive at last at the most general axioms; this is the true way, but it has not been tried. (p. 36)

Methodology is the formal shell of all sciences. It is assumed that methodology can discover the true form of all sciences, no matter what the specific content is. The discussion on methodology is the discussion on "the abstract functioning of the thinking mechanism" (Horkheimer, 2004, p.3). The discussion on methodology is the discussion on the true form of reason. Thus, methodology is the concern of subjective reason.

Especially, the whole second book of *Novum Organum* is reserved to the discussion on method. In the first chapter, we have seen how Bacon tries to establish a universal method for all sciences, and calls it interpretation of nature. This attitude is reminiscent of many other philosophers after Bacon starting from René Descartes' *Rules for the Direction of the Mind* to the positivist philosophers of the twentieth century.

This attitude is idiosyncratic to the subjective conception of reason according to Horkheimer. Since subjective reason is interested in the adequacy of means to ends and in the abstract principles for manipulating this world, what is important for it becomes the form; and the form with

whatever content can be designed according to pre-established goals. In Bacon's case this form is called method. In his discussion of methodology, one can easily notice the emphasis Bacon puts on the inadequacy of the current science for Man's domination over Nature.

We can see how Bacon exemplifies Horkheimer's case by drawing the discussion of science to a formal discussion. However, in Socrates, we have seen how Nature is understood through an insight which belongs to a reason inherent in the objective world. Science, in this conception, promulgates from this total understanding of Nature. By reducing the discussion of science to a mere formal problem, Bacon's criticism targets this total understanding of Nature and renders it impossible, for science now has an autonomy for deriving propositions out of sense-data without needing any pre-scientific outlook of the world.

Bacon's criticism of philosophical tradition always targets the objective content of reason. This is obvious in the critique of the idols of the theatre, and in the critique of Aristotle.

He criticizes the philosophical tradition in general on the ground that its basic assumptions are not based upon detailed experimentation, but rather upon meditation or reflection or contemplation, in other words upon the endeavours of the intellect to determine its own content. We have seen that Horkheimer testifies that the belief in this power of intellect is a part of the conception of a reason which is inherent in this world, is what distinguishes objective and subjective reason. By making a strict distinction between the mind and the world, and denying that the mind can have an insight into the

objective world, and criticizing the philosophical tradition on the ground that it searches truth in vain by relying merely on the power of intellect Bacon shows his position for sure:

> The cause and root of nearly all the deficiencies of the sciences is just this: that while we mistakenly admire and praise the powers of the human mind, we do not seek its true supports.
>
> The subtlety of nature far surpasses the subtlety of sense and intellect, so that men's fine meditations, speculations and endless discussions are quite insane, except that there is no one who notices. (Bacon, 2002, p. 34)

We have already commented on how the idea of purpose is lost with the dismissal of the objective content of reason. With the subjectivization of reason, the ends of any endeavour in this world are reduced to Man's arbitrary will. It is possible to observe this loss in Bacon's critique of final causes:

> The human understanding is ceaselessly active, and cannot stop or rest, and seeks to go further; but in vain. Therefore it is unthinkable that there is some boundary or farthest point of the world; it always appears, almost by necessity, that there is something beyond. Again it cannot be conceived how eternity has come down to this day; since the distinction which is commonly
>
> accepted that there is an infinity of the past and an infinity of the future can no way stand, because it would follow that there is one infinity which is greater than another infinity, and that infinity is being consumed and tends towards the finite. There is a similar subtlety about ever divisible lines, from thought's lack of restraint. This indiscipline of the mind works with greater damage on the discovery of causes: for though the most universal things in nature must be brute facts, which are just as they are found, and are not themselves truly

causable, the human understanding, not knowing how to rest, still seeks things better known. And then as it strives to go further, it falls back on things that are more familiar, namely final causes, which are plainly derived from the nature of man rather than of the universe, and from this origin have wonderfully corrupted philosophy. It is as much a mark of an inept and superficial thinker to look for a cause in the most universal cases as not to feel the need of a cause in subordinate and derivative cases. (Bacon, 2002, p. 44)

IV. Baconian Inspirations

In this chapter, we will dwell upon the inextricable problems implied by Baconian epistemology and its practical consequences. We will argue that such an epistemology may lead up to nothing but instrumentalism as Horkheimer puts it. In order to demonstrate our argument, we should present first, the impossibility of deriving theories from facts; secondly, that the empiricist argument which regards objective reason as dogmatism, speculation or mysticism on the ground that it presupposes a metaphysics which cannot be verified by facts, can also be applied to empiricism and science; thirdly, that as a claim of knowledge which cannot be verified by facts, science cannot be judged or understood realistically, but only instrumentally; and finally, that such a conception of science debases it to a tool for prevalent power structures and ideologies by reducing its role to formal functions of calculation, computation, inference and deduction.

IV.I. Empiricist Manifestation of Subjective Reason

We have elucidated in the first chapter that the most fundamental maxim of Bacon is that knowledge should be derived from a collection of facts and established through an exhaustive experimentation, and we have seen that following his fundamental maxim Bacon has compelled a methodology on science. This methodology has been interpreted in various fashions. Gillies (1993) regards Bacon as an *inductivist*:

> Bacon was not content with urging that more scientific research should be

> carried out. He proposed a method which, if followed, would in his view result in an expansion of our knowledge of the natural world. Some of the precise details of Bacon's method – for example, his *Tables and Arrangements of Instances* – are no longer of great interest. However, his general approach still has supporters today. It is this general approach which I will call *inductivism*. (p. 5)

Popper (1992) is also amongst the ones who alluded to Bacon as a pioneer of inductivism:

> [...] Bacon's induction: too suggestive of his industrious gathering of the 'countless grapes, ripe and in season', from which he expected the wine of science to flow: of his myth of a scientific method that starts from observation and experiment and then proceeds to theories. (This legendary method, by the way, still inspires some of the newer sciences which try to practice it because of the prevalent belief that it is the method of experimental physics.) (p. 279)

Urbach (1982), on the other hand, depicts Bacon as a precursor to Popper's falsificationism:

> I shall however try to show that Bacon's ideal science would proceed by conjectures and attempted refutation and the conjectures may or may not correspond with the truth. Empirical support for a conjecture is obtained not through just any prediction of the theory but only by the confirmation of its improbable predictions. And explanations for phenomena must not be ad hoc but should survive independent tests. (p. 113-114)

Hacking (1983) emphasizes that it is not possible to label Bacon either as an inductivist or as a deductivist:

> [Bacon] saw that observation of nature teaches less than experiment. ('The secrets of nature reveal themselves more readily under the vexation of art than

> when they go their own way.') He was something of a pragmatist. (' Truth therefore and utility are here the very same things, 'and works themselves are of greater value as pledges of truth than as contributing to the comforts of life. ') He told us to experiment in order to ' shake out the folds of nature '. We must ' twist the lion's tail ' . He quotes no sage more than Solomon: ' The glory of God is to conceal a thing; the glory of the king is to search it out.' He taught that in the true meaning of this proverb, every inquirer is king. [...]
>
> Bacon, being a philosopher of experiment, does not fit well into the simple dichotomies of inductivism and deductivism. He sought to explore nature, for good or ill. 'No one should be disheartened or confounded if the experiments which he tries do not answer his expectation. For although a successful experiment be more agreeable, yet an unsuccessful one is often times more instructive.' Thus Bacon already knew the value of learning by refutation. He sees that the new science will be an alliance of experimental and theoretical skills. (p. 246-247)

Although there exists a variety of contradicting interpretations of Bacon's methodology, at the bottom of all of them lies the fundamental maxim of Bacon which has been the ground of seventeenth and eighteenth century empiricism along with later endeavours of rationalizing science. Now let us examine whether Bacon's maxim of deriving knowledge from a collection of facts is possible by unravelling its implications in empiricism and endeavours of rationalizing science.

Commencing from a very similar maxim with Bacon, Locke, in his *Essay Concerning Human Understanding* (1999), claimed that all ideas and knowledge come only from *sensation* and *reflection* which constitute the whole experience. The distinction is similar to Bacon's distinction of facts

and inference, Hume's distinction of matters of fact and relation of ideas, and Kant's distinction of analytic and synthetic judgements.

Sensation gives us information about the external world, while reflection gives insight into the operations of our own mind. All ideas are products of these two faculties and are rather simple or complex. Simple ideas are given by sensation and the human mind is completely passive in receiving them. By combining these simple ideas in various ways human mind comes up with complex ideas.

Locke claims that some of these ideas belong to objects themselves (such as existence in space), while others are peculiar to our minds though they are caused by the objects themselves (such as colour, smell, taste).

However, if all our ideas and knowledge are grounded in the subjective faculties of sensation and reflection how can we say that some of them belong to the objects themselves? If this is the case, then we are trapped in our own minds, and there is no way out.

Berkeley in his *A Treatise Concerning the Principles of Human Knowledge* formulates this question thus:

> It is indeed widely believed that all perceptible objects— houses, mountains, rivers, and so on— really exist independently of being perceived by the understanding. But however widely and confidently this belief may be held, anyone who has the courage to challenge it will—if I'm not mistaken—see that it involves an obvious contradiction. For what are houses, mountains, rivers etc. but things we perceive by sense? And what do we perceive besides our own ideas or sensations? And isn't it plainly contradictory that these, either singly or in combination, should exist unperceived? (Berkeley, 2007, p. 12)

Russell (1999) will later summarize this problem as follows:

> The problem we have to consider is this: Granted that we are certain of our own sense-data, have we any reason for regarding them as signs of the existence of something else, which we can call the physical object? When we have enumerated all the sense-data which we should naturally regard as connected with the table, have we said all there is to say about the table, or is there still something else--something not a sense-datum, something which persists when we go out of the room? Common sense unhesitatingly answers that there is. What can be bought and sold and pushed about and have a cloth laid on it, and so on, cannot be a mere collection of sense-data. If the cloth completely hides the table, we shall derive no sense-data from the table, and therefore, if the table were merely sense-data, it would have ceased to exist, and the cloth would be suspended in empty air, resting, by a miracle, in the place where the table formerly was. (p. 11)

Accordingly, following Bacon's maxim if we suppose that the only way to attain knowledge is by making derivations from facts, then we end up with the epistemological problem that we cannot talk about an inter-subjective reality, and practically this is to say that when two (or more) different theories are derived from the same collection of facts we cannot decide which one is true. We cannot evaluate which theory is the correct representation of reality merely with respect to facts.

Furthermore, later with Hume, we will see that if we confine our knowledge to facts and inferences made from these facts[7] then causality, induction and substance, in other words the most fundamental tools of science become

[7] For the assessment of Hume's concepts of *matters of fact* and *relation of ideas* see p. 22-23

unattainable. Since we cannot derive those neither from facts nor through reflecting upon our collection facts:

> The contrary of every matter of fact is still possible; because it can never imply a contradiction, and is conceived by the mind with the same facility and distinctness, as if ever so conformable to reality. *That the sun will not rise to-morrow* is no less intelligible a proposition, and implies no more contradiction, than the affirmation, *that it will rise*. We should in vain, therefore, attempt to demonstrate its falsehood. Were it demonstratively false, it would imply a contradiction, and could never be distinctly conceived by the mind. (Hume, 1988, p. 18)
>
> [...] every effect is a distinct event from its cause. It could not, therefore, be discovered in the cause, and the first invention or conception of it, à priori, must be entirely arbitrary. (p. 21)

Thus Bacon's maxim of deriving knowledge from a collection of facts renders itself impossible; for, as we see implicitly in Locke and explicitly in Hume, there is no necessary derivation from facts to theories, it is not possible to attain necessary causal connections between facts, it is not possible to derive universal and necessary propositions from a limited collection of facts. Consequently, it can be said that there is a gap between facts and theories as conceived by Baconian empiricism. Henri Poincaré observes this gap between theory and fact:

> [...] science [...] will always be incomplete [...] As long as the mind is distinct from its object it will not be able to know it perfectly, since it will never see it except from the outside. (as cited in Horkheimer, 1986, p. 37)

The main problem of twentieth century philosophy of science was to reconcile facts with theories in order to close this gap. Logical positivists

tried in vain to discover a criterion for a necessary inference from facts to theories (Carnap, 1947).

Others, such as Bertrand Russell, realizing the vanity of these endeavours appealed to probabilism emphasizing its use. According to Russell, although there is neither a criterion of a necessary inference from facts to theories nor to verify theories by facts, there is a uniformity in Nature and it is possible to capture this uniformity with theory:

> We know that all these rather crude expectations of uniformity are liable to be misleading. The man who has fed the chicken every day throughout its life at last wrings its neck instead, showing that more refined views as to the uniformity of nature would have been useful to the chicken. (Russell, 1999, p. 43)
>
> It must be conceded, to begin with, that the fact that two things have been found often together and never apart does not, by itself, suffice to prove demonstratively that they will be found together in the next case we examine. The most we can hope is that the oftener things are found together, the more probable it becomes that they will be found together another time, and that, if they have been found together often enough, the probability will amount almost to certainty. It can never quite reach certainty, because we know that in spite of frequent repetitions there sometimes is a failure at the last, as in the case of the chicken whose neck is wrung. Thus probability is all we ought to seek. (p. 45)

However, probabilism is not adequate for satisfying empiricist ideals of rationalizing science. Popper agrees with Russell that there can be no criterion of inferring or verifying theories from facts, but he cannot be content with the uncertainty of probabilism. So he comes up with falsificationism according to which scientific theories cannot be confirmed

but only rejected. That is to say, we cannot establish a theory's truth neither through inference nor factual data, yet we can establish its falsity if its consequences contradicts the latter (Popper, 2002).

Popper's idea is similar to Bacon's idea of crucial experiment for sure[8]. This concept envisaged that there can be such experiments which can decide between challenging theories, that is to say, experiments which can falsify one theory while confirming the other. However Pierre Duhem, in his *The Aim and Structure of Physical Theory* (1991) shows that such an experimentation is impossible.

According to Duhem's thesis, whenever a scientific theory T is tested it will need to be augmented by a set of auxiliary assumptions {T1, T2, T3...}, such as theories about the techniques for conducting experiments or for the use of instruments. So whenever a scientific theory is tested, it is tested along with a set of assumptions and if the theory gets falsified this actually means that its set of assumptions is falsified. One can save the theory T by making a modification in T1 or T2 or T3 etc. Where in this set will the scientist make a modification is an ad hoc choice. Therefore no crucial experiment can possibly falsify one theory as Bacon or Popper conceived to be.

This situation can be illustrated in the discovery of Neptune. The orbit of planet Uranus did not cope with the calculations of Newtonian physics. However Newtonian scientists did not give up on Newtonian theory though according to Bacon's conception of crucial experiment they should have.

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[8] For the assessment of Bacon's concept of crucial experiment see p. 34-35

Instead they made a modification in the assumptions concerning the number of planets and posited that there is an unobserved planet which caused the apparent defection in the motion of Uranus. Thus, instead of making a modification in the theory, they made a modification in the observation which led to the discovery of a new planet, Neptune.

Later, Willard Van Orman Quine in the *Two Dogmas of Empiricism* (1961) demonstrates that this problem is also valid for auxiliary assumptions concerning arithmetic, geometry, logic and metaphysics. This means that there is a set of assumptions operating under every scientific theory, and this set includes metaphysical assumptions too. These metaphysical assumptions cannot be derived from or verified by factual evidence; however the whole system of physical, arithmetical, geometrical, logical and metaphysical theories make sense of facts.

Hence, Bacon's critique against objective reason that it presupposes a metaphysics which cannot be derived from or verified by factual evidence can also be held against his own theory of science as well as science itself.

IV.II. Metaphysical Presuppositions of Empirical Science

In the *Two Dogmas of Empiricism* Quine analyses two assumptions of empiricism which lack empirical justifications: (i) the presupposition of a distinction between analytic-synthetic propositions (or the distinction between fact and inference as conceived by Bacon) and (ii) the presupposition that “each statement, taken in isolation from its fellows, can admit of confirmation or infirmation at all” (Quine, 1961, p. 41).

The distinction between analytic-synthetic propositions is grounded in each case on notions (e.g. Synonymy, interchangeability, semantical rules) as ambiguous as the notions of analytic and synthetic themselves. The verifiability principle, on the other hand, seems to save this problem by appealing to *statement synonymy*, which says that "statements are synonymous if and only if they are alike in point of method of empirical confirmation or infirmation" (p. 37). This is to say that if two different propositions restrict us at making the exact same observations for their confirmation, then they are synonymous and if a statement is synonymous with a logically true statement then it is analytic. However, we have to presuppose that statements can be confirmed or infirmed by sense-data to accept this definition of analyticity:

> So, if the verification theory can be accepted as an adequate account of statement synonymy, the notion of analyticity is saved after all. However, let us reflect. Statement synonymy is said to be likeness of method of empirical confirmation or infirmation. Just what are these methods which are to be compared for likeness? What, in other words, is the nature of the relation between a statement and the experiences which contribute to or detract from its confirmation? (p. 38)

Quine recognizes that our statements are never put into an examination as single entities. As a collective endeavour science is dependent upon language and experience for sure; yet it is impossible to trace the linguistic component and experiential component in particular propositions:

> My present suggestion is that it is nonsense, to speak of a linguistic component and a factual component in the truth of any individual statement. Taken

> collectively, science has its double dependence upon language and experience; but this duality is not significantly traceable into the statements of science taken one by one. (p. 42)

Then when a scientific theory is put into examination not the theory itself but the whole assumptions in our knowledge, including mathematical and logical assumptions, enter into the examination:

> The totality of our so-called knowledge or beliefs, from the most casual matters of geography and history to the profoundest laws of atomic physics or even of pure mathematics and logic, is a man-made fabric which impinges on experience only along the edges. Or, to change the figure, total science is like a field of force whose boundary conditions are experience. A conflict with experience at the periphery occasions readjustments in the interior of the field. Truth values have to be redistributed over some of our statements. Re-evaluation of some statements entails re-evaluation of others, because of their logical interconnections -- the logical laws being in turn simply certain further statements of the system, certain further elements of the field. Having re-evaluated one statement we must re-evaluate some others, whether they be statements logically connected with the first or whether they be the statements of logical connections themselves. But the total field is so undetermined by its boundary conditions, experience, that there is much latitude of choice as to what statements to re-evaluate in the light of any single contrary experience. No particular experiences are linked with any particular statements in the interior of the field, except indirectly through considerations of equilibrium affecting the field as a whole. (p. 42)

Quine's diagnosis is a huge impact on the Baconian empiricist critique directed at objective reason regarding it dogmatism or speculation. For it

shows that the argument that objective reason is grounded on dogmatic assumptions which cannot be derived from or verified by factual evidence is also valid for empiricism itself. In this sense, empiricism is grounded on such dogmatic assumptions as an alleged distinction between analytic and synthetic judgements, the presumed givenness of facts and that facts can confirm or reject propositions.

Likewise science, as conceived by Bacon, is grounded on certain dogmatic assumptions; the epistemology it presupposes is dogmatic, its methodology is dogmatic and its ontology is dogmatic. Thus the Baconian criticism against the old science and philosophy, that they do not derive their theories from facts, but rather accommodates facts to theory, is also valid for Baconian epistemology and science. Epistemologically there is no difference between magic, metaphysics or science as pointed out by Quine:

> Physical objects are conceptually imported into the situation as convenient intermediaries -- not by definition in terms of experience, but simply as irreducible posits comparable, epistemologically, to the gods of Homer. [...] in point of epistemological footing the physical objects and the gods differ only in degree and not in kind. Both sorts of entities enter our conception only as cultural posits. The myth of physical objects is epistemologically superior to most in that it has proved more efficacious than other myths as a device for working a manageable structure into the flux of experience. (p. 44)

If epistemologically magic, metaphysics or science are on a par with each other, by what virtue modern science has come to prevail over the others? This is the question we are going to try to answer in the next chapter.

IV.III. The Prevalence of Modern Science

Greek cosmology (with the exceptions of Herakleides and Aristarchus) conceived Earth to be at the centre of the universe[9]. The immobile Earth is surrounded by nine concentric, transparent spheres, each having a greater radius from centre to periphery. Each sphere carries a planet and revolve around the Earth as their centre. (See Fig. 1)

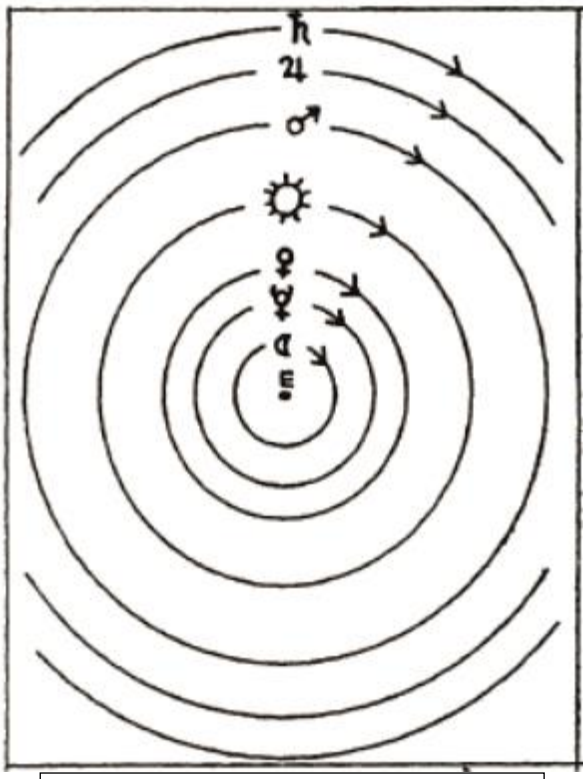

Fig. 1: Classical Geocentric System

However there was a disability of this cosmology. It could not account for two different phenomena: first the stations and retrogressions of the planets, and secondly the variations in the size and brightness of them.

Eudoxus resolved the first of these problems by assigning a unique movement to each sphere. Although in an imprecise attitude, Eudoxus' astronomy could now account for the movements of each planet. However, it was still incapable of explaining the second of these phenomena, for, if the planets move on spheres with Earth at their centre, how can their distance from it can change? And if their distance do not change, how can

[9] For a detailed investigation of the history of astronomy see Koestler, 1959.

the variations in their size and brightness come to be?

These problems were to be solved by Ptolemaic astronomy, which introduced three important concepts to Eudoxus' astronomy: *deferent*, *epicycle* and *equant*. The orbits of planets around the Earth in Eudoxus' astronomy are now called deferent and centred in the mid-point between Earth and the equant. The circular orbit of planets embedded in deferent, centred on a point in the deferent is called epicycle.

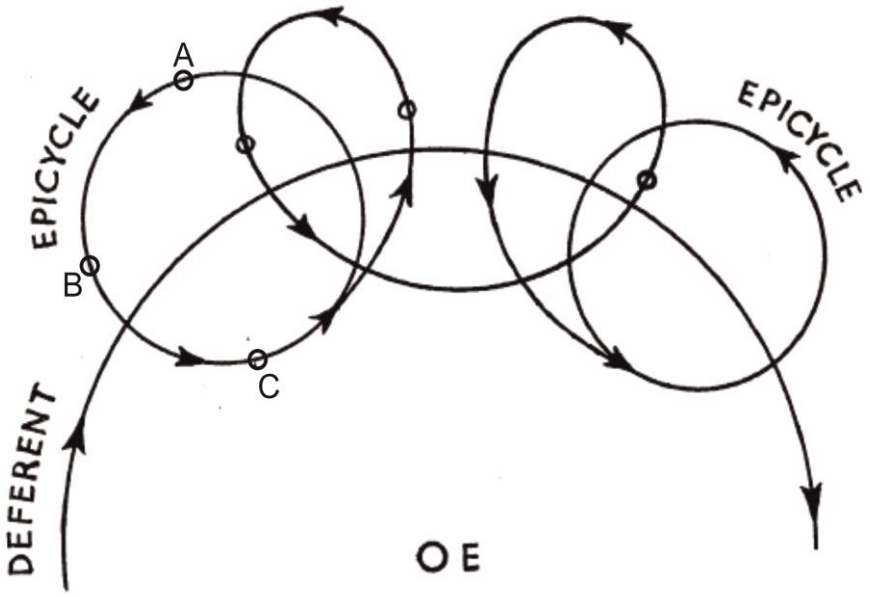

Fig. 2: Ptolemaic System

Ptolemaic astronomy accounts for both the stations and retrogressions of planets and the variations in their sizes and brightness. It explains both of these phenomena with the help of epicyclic motion. As the planet starts its motion from point A to point B (See Fig. 2), an observer from the Earth sees it as moving from east to west as its size and brightness increases. However, from the point B to point C the observer sees the planet as moving from West to East while getting bigger and brighter. As it moves on, the stations

and retrogressions along with the variations in size and brightness continue uniformly.

When Copernicus came up with his heliocentric system, the Ptolemaic system was still more successful in explaining the heavens then the Copernican system although it was deficient of accounting for certain phenomena. Its deficiencies could have been sorted out by making certain modifications in the system, as Ptolemy has done to Eudoxus' system. However, this did not happen. Instead, despite the apparent contradictions of heliocentric system with common sense observations,[10] the heliocentric system surpassed the geocentric.

This surpassing, which has been called the Copernican Revolution, was a process of modifying the whole body of what has been known as natural science. Copernican theory did not account for the motion of celestial objects, so Kepler revised it with his three laws. Copernican theory was contradicting with the common sensical observations of the dynamics in this world (those used by Aristotelians to refute the motion of the Earth), so Galileo augmented it with a relativistic physical theory.

The classical geocentric system was not in accordance with facts; however, it was augmented by modifications in its auxiliary assumptions up to Ptolemy to the point that it was able to account for facts. Likewise, the heliocentric system was not able to account for facts; again, it was augmented by modifications in its auxiliary assumptions to end up with

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[10] The two most popular examples of these are:
i. If Earth is moving then this motion would have caused *parallax* of stars, however no such phenomena was observed until the nineteenth century.
ii. If Earth is moving then the objects on the Earth should have fall behind. This idea was going to change with Galileo's basic principle of relativity.

Newtonian physics.

The point is, none of these theories were verified by or put into crucial experiments as Bacon or Baconian philosophers of science have prescribed. The very ideas of geocentrism or heliocentrism did not arise from facts or got promoted by facts. Heliocentric system obviously did not surpass the geocentric one due to factual evidences. Rather, the so-called Copernican revolution was a battle between prevalent powers using rhetoric, propaganda and above all the changing practices in the society. The final product of this process was Newtonian physics, which covered up the whole modifications made by Copernicus, Kepler and Galileo in three simple, mathematical laws.

How did modern science prevail after a process initiated by the Copernican revolution? How did it become the ultimate answer for questions concerning Nature if not by virtue of its objective truth provided by factual evidence? The answer to these questions are to be found in modern science's abilities of collection, classification, inference and deduction. Empiricist epistemology maximizes these abilities by reducing the legitimate method of attaining knowledge to these faculties, by continuously attacking and finally abandoning a reason immanent to Nature with ethical and political implications. This conception provides modern science an autonomy with respect to religions and philosophies of objective reason.

Modern science, according to this conception, can merely reconcile facts with theories continuously modifying auxiliary assumptions or observation results. Therefore it cannot claim for an epistemological objectivity and

prominence over other claims of knowledge, but only for a practical one. 'Theory' is the key concept for this practical prominence of modern science. On the one hand stands observation and experimentation, on the other, stands the process of theorizing. Experimentation is carried out in order to reveal how some practices can be executed or enhanced. In this sense, experiment is never objective, but preconditioned with the aims, ideas and language of the experimenter. Poincaré stresses this aspect of experiment:

> It is often said that experiments should be made without preconceived ideas. That is impossible. Not only would it make every experiment fruitless, but even if we wished to do so, it could not be done. Every man has his own conception of the world, and this he cannot so easily lay aside. We must, for example, use language, and our language is necessarily steeped in preconceived ideas. (Poincaré, 1905, p. 143)

Poincaré compares science to a library which expands eternally with the collection of facts. The experimental physicist is the librarian who makes the purchases; while the Mathematical supplies the catalogue through which one can search through the collection easily. Theory is the catalogue in this analogy:

> I may be permitted to compare science to a library which must go on increasing indefinitely; the librarian has limited funds for his purchases, and he must, therefore, strain every nerve not to waste them. Experimental physics has to make the purchases, and experimental physics alone can enrich the library. As for mathematical physics, her duty is to draw up the catalogue. If the catalogue is well done the library is none the richer for it ; but the reader will be enabled to utilise its riches; and also by showing the librarian the gaps in his collection,

> it will help him to make a judicious use of his funds, which is all the more important, inasmuch as those funds are entirely inadequate. That is the role of mathematical physics. It must direct generalisation, so as to increase what I called just now the output of science. (Poincaré, 1905, p. 144-145)

Thus, by categorizing and inferring through the data acquired by experimentation, theory becomes the shortcut for how some work will be carried out. The Engineer is the executer of theory, who deduces and computes his actions for how a certain work will be executed from theory. If we carry Poincaré's analogy further, the engineer is the reader in the library who acts according to what he reads.

As Horkheimer observes, theory becomes the tool for accomplishing tasks that are established in the scientific society. It becomes the tool for manipulating Nature according to Man's subjective aims:

> What scientists in various fields regard as the essence of theory thus corresponds, in fact, to the immediate tasks they set for themselves. The manipulation of physical nature and of specific economic and social mechanisms demand alike the amassing of a body of knowledge such as is supplied in an ordered set of hypotheses. (Horkheimer, 1986, p. 194)

Consequently, within empiricist epistemology, science can merely calculate probabilities in order to adjust means according to ends:

> Ultimately subjective reason proves to be the ability to calculate probabilities and thereby to co-ordinate the right means with a given end. (Horkheimer, 2004, p. 4)

III.IV. The Meaning of Modern Science

The experiments carried out by experimental physicist are determined with respect to certain concerns. They execute certain experiments rather than others. As Poincaré points out, the experimental physicist has limited funds; so he cannot just experiment anything, he should rather design his experiments selectively. This selection is of course not dependent on the subjective preferences of the experimental physicist; it is a social process primarily determined by the prevalent powers in the society.

Experiments are carried out in order to reveal or discover some fact. This revelation or discovery of facts are pursued not for their own sakes, but rather for the sake of executing or enhancing some practice. Therefore experimentation and observation is always part of a greater project and is determined by the interests of the funders of a project. Galileo's project was funded by the rising bourgeois family, the Medicis; Kepler was first the assistant of the aristocrat Tyco Brahe and then the imperial mathematician to Holy Roman Empire.

As empiricist epistemology commends, science should make inferences from these data from experimentation and observation. Although there are disputes over how the question of how this inference is possible, even the loosest of empiricist programmes tries to rationalize the inference or at least the justification processes from sense data to theory. However as we have argued so far, there can be no possible rational inference or justification process from sense data to theory.

So, what remains at hand is the instrumental aspect of theory. In this sense,

theories are shortcuts to collections of sense data. They are shortcuts which relate and supply the engineer with the information of how to manipulate some phenomena in this world.

Science is above all an instrument for manipulating Nature according to pre-established aims of prevalent power relations in a society. It is one amongst other means of production. Empiricist epistemology misses this aspect of science says Horkheimer:

> The positivists seem to forget that natural science as they conceive it is above all an auxiliary means of production, one element among many in the social process. Hence, it is impossible to determine a priori what role science plays in the actual advancement or retrogression of society. Its effect in this respect is as positive or negative as is the function it assumes in the general trend of the economic process. (Horkheimer, 2004, p. 41)

Empiricist epistemology applauds science as the paramount of progress by regarding every other understanding of Nature as subordinate to itself; thus canonizing it and concealing its deficiency of developing an understanding immanent to this world and its mere character of instrumentality. Empiricist glorification of science, in the final analysis, a glorification of technology and the ideology which grounds it: Man's dominion over Nature. Engineer is the practitioner of technology; the executioner of modern science. And therefore, the manipulator of Nature according to the interests of prevalent powers in his society as Horkheimer expresses precisely:

> Positivist philosophy, which regards the tool 'science' as the automatic champion of progress, is as fallacious as other glorifications of technology. Economic technocracy expects everything from the emancipation of the

> material means of production. Plato wanted to make philosophers the masters; the technocrats want to make engineers the board of directors of society. Positivism is philosophical technocracy. It specifies as the prerequisite for membership in the councils of society an exclusive faith in mathematics. Plato, a eulogist of mathematics, conceived of rulers as administrative experts, engineers of the abstract. Similarly, the positivists consider engineers to be philosophers of the concrete, since they apply science, of which philosophy—in so far as it is tolerated at all—is merely a derivative. Despite all their differences, both Plato and the positivists think that the way to save humanity is to subject it to the rules and methods of scientific reasoning. The positivists, however, adapt philosophy to science, i.e., to the requirements of practice instead of adapting practice to philosophy. For them thought, in the very act of functioning as ancilla administrationis, becomes the rector mundi. (Horkheimer, 2004, p. 41)

Modern science is just a tool of practice among others. It is a way of understanding the world. However, it is a dominating and exhaustive one due to its systematic experimentation, observation and categorization, computation skills. These skills are expanded to their ultimate forms in science; while reason is reduced to them; and as reason is reduced to some skill it becomes an instrument; and as far as reason is an instrument, it is an instrument of prevalent powers in the society. Also as it is reduced to some skills, it becomes incapable of understanding Nature in itself. With its instrumentality of prevalent powers and incapability of understanding Nature in itself, science becomes a very dangerous tool of dominating and exhausting the world we live in.

Empiricist epistemology, by ignoring this character of modern science and by

canonizing it as the champion of progress, repudiates other forms of understanding the world. However, these were in use before modern science was and they presented a much deeper understanding of the world.

V. Conclusion

Today, if we ask any scientist or engineer what science is, we will get the answer that it is the knowledge of Nature. And if we examine a bit more what that means, we will see that science is understood as a knowledge independent of and neutral to the forms of relating to this world and practices in this world. The independence and neutrality of this knowledge is justified by the claim that it is grounded on objective empirical data and necessary inferences made from them.

The malices which have developed from science and technology, on the other hand, will not be regarded as an essential problem with science and technology, but with the power holders which use and manipulate them according to their will.

In order to liberate science and technology from those power holders, the argument will follow, science and technology should have autonomy over its studies and practices. With this autonomy, scientists and engineers should implement science and technology towards the well-being of humanity.

In the last analysis, this idea will end up in a projection of a regime which is independent of and neutral to the forms of relating to this world; a regime governed by scientific technocrats. It will even be argued that in such a government, power will not be held by the technocrats, the actual persons, but by science itself. The governors stand as the executives of science, and they stand there merely because they possess its knowledge.

This is more or less how Bacon outlines a vision of a group of elites governing according to scientific rationality in the *New Atlantis* (1998); and

this idea is justified by Bacon in the *Novum Organum* (2002), by its claim that scientific knowledge is the representation of Nature acquired through empirical data obtained from systematized experimentation and mechanized inductive inference made from them.

However, the ground of this Baconian claim that scientific knowledge is empirically verified knowledge is substantially problematic and its consequences are extremely dangerous. We have explicated the problems depicted by Locke, Berkeley, Hume and Quine and how these problems have turned out to be inextricable problems about the alleged empirical verifiability of scientific knowledge.

Along with the problems depicted by Locke, Berkeley, Hume and Quine the de facto existence of different and challenging scientific claims diminish the claim that scientific knowledge is empirically verified knowledge. If that were so, there would not be Aristotelian physics, Newtonian physics and Einsteinian physics denoting the same objects but connoting contradicting theories.

On the contrary, as Horkheimer points out, scientific knowledge promulgates from the form of relating to this world and practices in this world. It is immanent to the certain form it is a part of; it is shaped within that form and developed to sustain that form. Its purposes are determined by the power structures of that form. Aristotelian physics promulgates from an understanding which strives to understand the purposes of this world in itself. Newtonian physics is immanent to a world where massive buildings are erecting and satellites are sent to the Earth's orbit. However, in a world

where nano-technology is the pre-eminent form of relation, Newtonian physics is useless.

Nevertheless, claiming that science is independent of and neutral to forms of relating to this world and practices in this world means nothing but concealing its relations to this world, its pragmatics, its politics, which ends up in securing scientific knowledge's position as an instrument for prevalent power structures.

Taking Newtonian physics, for instance, as the true representation of this world or as the objective and empirically verified knowledge of Nature or as the universal and necessary condition of our experience means canonizing it along with the whole form of relations and practices which allows that knowledge. That canonizing is actually an imposition of certain forms of relations and practices.

Science today is not produced independently or neutrally. Academia is subordinate to corporate interests and to the will of centralized governments. What is going to be studied, what is going to be researched, what practices to be enhanced in the academies are determined by fundings of corporations and governments. The scientific knowledge produced thus is nothing but shortcuts for those practices.

However, academia and the scientific knowledge it produces preponderated over other forms of relations and practices. Bacon and the Baconian discourse operated for justifying this preponderance. They annihilated witchery, occultism, alchemy, voodoo and other forms of knowledge using discourse, propaganda and sheer violence.

Let us close our words about the imposition of scientific knowledge with the words of Paul Feyerabend:

> [...] I want to make two points: first, that science can stand on its own feet and does not need any help from rationalists, secular humanists, Marxists and similar religious movements; and, secondly, that non-scientific cultures, procedures and assumptions can also stand on their own feet and should be allowed to do so, if this is the wish of their representatives. Science must be protected from ideologies; and societies, especially democratic societies, must be protected from science. This does not mean that scientists cannot profit from a philosophical education and that humanity has not and never will profit from the sciences. However, the profits should not be imposed; they should be examined and freely accepted by the parties of the exchange. In a democracy scientific institutions, research programmes, and suggestions must therefore be subjected to public control, there must be a separation of state and science just as there is a separation between state and religious institutions, and science should be taught as one view among many and not as the one and only road to truth and reality. There is nothing in the nature of science that excludes such institutional arrangements or shows that they are liable to lead to disaster. (1993, p. vii)

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