

Bacon's Anthropocene: The Historical-Epistemological Entanglement of Power, Knowledge, and Nature Reassessed

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Аннотация: Нынешнее положение, характеризующееся беспрецедентным экологическим кризисом и новыми дебатами об антропогенно-технологической трансформации земной системы, требует переоценки историко-эпистемологического вопроса о связи между властью, знанием и природой. Фрэнсис Бэкон является признанным ориентиром для этого тематического кластера - связующим центром для исторических реконструкций и эпистемологических размышлений, объединяя тех, кто превозносит заслуги научного прогресса, и тех, кто его критикует и указывает на риски, связанные с его злоупотреблением. В начале этой статьи я рассматриваю эко-феминистскую интерпретацию Бэкона, предложенную Мерчант. Далее, я фокусируюсь на том, как Бэкон критикуется в качестве символа капиталистического доминирования науки ("Диалектика Просвещения" Адорно и Хоркхаймера). Обратная сторона учения Бэкона находит отражение в оценках нашего современного научного мира, в вопросе расширения прав и возможностей технологии, типичном для марксизма. Проблема «знания-силы» связывается с дискуссией об Антропоцене и, в частности, с темой трансформации мира в праксеологическом плане. В итоге анализ приводит к наиболее актуальному вопросу Антропоцена: нужно ли нам больше или меньше технонауки? Ответ на этот вопрос и общая оценка технонаучной капиталистической современности предполагает знание о том, являются ли экологические пределы роста внутренними пределами капитализма.

Abstract

The current predicament, marked by an unprecedented environmental crisis and novel debates on the anthropic-technological transformation of the earth-system, calls for a reassessment of the historical-epistemological question of the entanglement between power, knowledge, and nature. Francis Bacon is the classical reference point for this thematic cluster – a focal point for both historical reconstructions and epistemological reflections, for both those who extol the merits of scientific progress and those who criticize the risks posed by its abuse. I begin this essay by considering Merchant's eco-feminist interpretation of Bacon. Additionally, I briefly recount how Bacon is envisaged as a symbol of science as domination within the critique of capitalism provided in another classic, Adorno and Horkheimer's *Dialectic of Enlightenment*. I also consider the flipside of the reception of Bacon in assessments of our modern scientific world, namely the empowerment-and-emancipation discourse on technology, typical of much of Marxism. In this respect, I deem it expedient to mention the knowledge-power problem in relation to the Anthropocene debate, and in particular in relation to the theme of the transformation of the world in praxeological terms. These considerations, which deal with various assessments of techno-scientific capitalist modernity, are at the basis of my final remarks on the most urgent Anthropocene dilemma, namely, whether we need more or less technoscience. This concerns the historico-political question of whether the ecological limits of growth are an intrinsic limit of capitalism.

Keywords: Early Modern Anthropocene, Mastery of nature, Ecofeminism, Early modern political epistemology, Marxist epistemology, Science and power, Science and utopia

Introduction

Francis Bacon is a paradigmatic reference author on the interconnection between power, knowledge, and nature. This thematic cluster is of burning actuality today, in a time that is marked by a deep sense of ecological crisis and concerns about the uncontrolled anthropic transformation of the earth (Renn, 2020). To be sure, Bacon's theses on science as well as his dreams about technoscientific empowerment have been variously assessed. Critical theorists have stressed the contradiction that exists between the celebration of the 'advancement of knowledge' and the exercise of power over humans and nature in the context of capitalist modernity (Adorno and Horkheimer, 1944, chap. 1). Eco-feminist objections have emerged in connection with critiques of gender inequality and environmental destruction (Merchant 1980; more recently, in connection with black feminism, Yusoff, 2018). By contrast, earlier social historians of science (e.g., Zilsel, 1942) and the founding father of the sociology of science, John Bernal (Bernal, 1946), continued the Enlightenment celebration of Bacon as the prototype of the modern practice-oriented scientist. Various knowledge-power dimensions (related to the transformation/exploitation of nature, efficient socio-economic organization, and justice/inequality, along various identity axes) have emerged as crucial in the Anthropocene debate, especially in relation to the "Capitalocene" problem of bringing ecological and economic analyses together (Moore, 2016) and combining them with post-feminist views on the gendered character of exploitative logics under capitalism (Haraway, 2016). This essay reassesses some Bacon-centered debates on the logic of scientific dominion in modernity along ecological and economic-political axes. It tries to make a connection between them and the Anthropocene problem. A specific question that arises is: Does the solution to the environmental crisis imply the abandonment of capitalism's dynamics or can pragmatic and technocratic solutions be achieved through a restructuring of capitalism? In light of this problem, the ultimate question of the relation between knowledge and power shifts the focus from the object to the subject of transformation, that is, from the factual analysis and forecasting within a predetermined framework to ethical-political responsibility: What solution do we regard as worthy and satisfactory? Three Baconian themes look relevant to such questions: the mastery of nature, scientific empowerment, and utopian thought. The last theme is particularly important as it is connected with the question of the ideals and goals of science.

Bacon, Seen as the Champion of the Exploitation of Dead Nature

The concept of 'Anthropocene' has recently emerged from the earth sciences to designate a new geological epoch in which humankind has become a major force of the earth system. The neologism points out the impact, at a deep natural and global level, of our technological society. While stratigraphers of the Anthropocene Working Group appointed by the International Commission on Stratigraphy are still gathering and evaluating the 'evidence' for the ratification of this new geological time unit, interdisciplinary and public debates on the meanings and consequences of the concept transformed it into a broad cultural phenomenon. The environmental debate about the human-made world has brought

Bacon's legacy back to the fore, and especially the theme of the mastering of nature, which constitutes one of the most cherished features of Bacon's historiographic 'idol'.¹

Man, the servant and interpreter of nature, does and understands only as much as he has observed, by fact or mental activity, concerning the order of nature; beyond that he has neither knowledge nor power.

[...]

Human knowledge and power come to the same thing, for ignorance of the cause puts the effect beyond reach. For nature is not conquered save by obeying it [...]. (NO I 1, 3: Bacon, 2004, pp. 64-65)

These are the famous theses one and three from the *Aphorismi de interpretatione naturae et regno hominis* [Aphorisms on the Interpretation of Nature and Man's Kingdom] in the *Novum Organum* [New Organon] (1620). They put 'man' – *homo* as the masculine representative of humankind – at the center as the *minister* (administrator and master) of nature. *He* can fully accomplish this role only insofar as he has exact knowledge of natural causes. Actually, domination and submission are here interrelated, as the expression "parendo vincitur" indicates – the military principle of domination through obedience. Knowledge is what enables one to channel natural processes toward one's goals and to create a 'second nature', a humanized world, as is said in another passage:

The work and aim of human power is to generate and superinduce a new nature or new natures on a given body. (NO II, 1: Bacon, 2004, pp. 200-201)

The mastering of nature through valid natural knowledge is a topic of direct concern for environmental politics. For this reason, Bacon has been of concern for many ecological thinkers. Most prominent among them is the eco-feminist critic of techno-scientific modernity, Carolyn Merchant. Her classic work in the eco-feminist history of science, *The Death of Nature: Women, Ecology and the Scientific Revolution* (1980), considered early modern scientific culture to be a crucial element in the capitalist transformation of our worldview in the direction of more exploitation of nature. At the turn of the Modern Age, the image of nature was reduced to that of a passive resource. Hence, as the title of the book suggests, the feminine living and life-giving nature of the vitalistic visions culminating in Renaissance philosophies died in the passage to the mechanized worldview that reached its acme in the Industrial Revolution. According to Merchant, the 'death of nature' corresponded to a program of complete world subjugation, which was perpetrated in close connection with the repression of the feminine in family relations, the public sphere, and imagery.

The *Death of Nature* especially looked at the justification of a modern exploitative logic through the analogy between nature and the female body at a time in which the environment was reduced to a reservoir of material resources. Merchant argued that philosophical justifications, in the form of mechanistic worldviews, ideologically backed the social construction "of nature and women as culturally passive and subordinate" (Merchant, 1980, p. xvi). The vision that was abandoned was that of nature as a living organism or nurturing mother. Such a vision, typical of classical antiquity and the Renaissance, posited nature as sacred and inviolable, and hence stood as a cultural bulwark against the unrestrained

¹ Giglioli 2013 instructively deals with the early-modern 'construction' Bacon's image or on "how Bacon became Baconian."

exploitation, use, and manipulation of natural resources, land transformation, and its re-engineering. Mining is a case in point. It was economically remunerative, but excavations had been long castigated as an impious intrusion into Mother-Earth's womb. By contrast, as Merchant argues, Bacon was instrumental to the fashioning of a new philosophy sanctioning the exploitation of nature (Merchant, 1980, p. 164), which became a crucial element in the scientific culture of the seventeenth century as part of the Royal Society's ideology.²

Merchant's historical account has intrinsic limitations and some significant flaws. She assumes that mechanistic philosophy exclusively drew on the metaphor of the dead mechanism to explain life, but actually it very often rested on a "philosophy of biology" *avant la lettre* for which medical experience and the reality of living beings (and living matter) were of paradigmatic importance. This was the case with Denis Diderot, for instance, as well as with those physicians who embraced mechanistic-vitalistic theories, such as the medical school of Montpellier (Wolfe, 2019). Even Descartes, the father of mechanistic philosophy, thought of mechanism more in terms of a living body than of a dead mechanism, thus blurring the boundary between the organism and the clock (Roux, 2017). Nonetheless, given the progressive marginalization of hybrid medical-materialistic approaches in the history of ideas in the age that culminated with Laplacian physics, the questions raised by Merchant are still relevant in spite of some simplification.

In her perspective, Bacon's philosophy is located at the intersection of the three problems of gender, the environment, and capitalism, all of which concern power relations. The text in which Bacon most clearly expresses his idea of the mastery of nature and women is the technoscientific and patriarchal utopia *New Atlantis* (posthumous, 1627). The hierarchical model of society this work fostered stands in stark contrast with other utopias. For instance, Tommaso Campanella's *Città del Sole* (*The City of the Sun*) (1602) was marked by egalitarian ideals that made gender and class distinctions disappear. By contrast, Bacon's ideal society enthroned men and assumed the centrality of the *pater familias*.

According to Merchant, misogynistic attitudes shape Bacon's imagery at various levels, beginning with the title of a work like *Temporis partus masculus* (*The Masculine Birth of Time*) (1602), which promotes the enslavement of nature as a mark of progress toward truth. Knowledge is seen as a cumulative endeavor and coincides with empowerment, as the subtitle clearly stresses: *sive instauratio magna imperii humani in universum* (or, the great instauration of human dominion over the universe). The very idea that experimental mechanic instruments should be used to make nature speak, as Merchant contends, draws on experiences and images of torture machines, at a time in which extensive use of such forms of violence was being made during witch-hunts. Bacon was directly involved in such abuses, in keeping with the demonological concerns of his lord, King James VI and I (Merchant, 1980, p. 168). As a consequence of the analogy between the inquisition methods used in women's trials and the investigation of nature, Bacon used a gendered and sexually connoted language, which still looms large in current scientific discourse:

Here, in bold sexual imagery, is the key feature of the modern experimental method – constraint of nature in the laboratory, dissection by hand and mind, and the penetration of hidden secrets – language still used

² For more nuanced and complex readings of the interplay between ideas, mining practices, risks, and emotions see (among others) Asmussen, 2020. For a criticism of Merchant's historical accuracy, see Pesic, 2008.

today in praising a scientist's 'hard facts', 'penetrating mind', or the 'thrust of his argument'. The constraints against penetration in Natura's lament over her torn garments of modesty have been turned into sanctions in language that legitimates the exploitation and 'rape' of nature for human good. (Merchant, 1980, p. 171)

According to Merchant, these misconceptions entered modern scientific institutions such as the Royal Society, which realized the Baconian dream of a centralized science for the 'public good'. In the *New Atlantis* the administration of the city is based on a technocratic program led by a group of scientists who gather in "Salomon's House, long held to be the prototype of a modern research institute" (Merchant, 1980, p. 182). Additionally, Bacon conceived of the common good in non-egalitarian terms from the perspective of "the master craftsman, clothier, and merchant" and not from the bottom-up perspective of "the cottager, journeyman, and peasant" (Merchant, 1980: p. 179). In this sense, his views were consonant with "tendencies toward growth and progress inherent in early capitalism" (Merchant, 1980, p. 185).

It should be remarked that Merchant's views fit the Anthropocene paradigm only to a limited extent, as they came before the 'geological turn' of recent years. Since the proposal to introduce new geological epoch, the perspective of an integrated human-natural Earth system has become central for ecological thought (see, among others, Davies 2016).³ Nonetheless, Merchant's early work on the *Death of Nature* can prove relevant to the current debate, as it raises political-epistemological questions of particular relevance: firstly, the contribution of the history of science to our comprehension of the environmental problem; secondly, the relevance of the question of the origins of capitalism, its logic, and how it relates to science and scientific culture; thirdly, the socio-cultural dimension, including the link between gender, family structures, and ethical values, on the one hand, and the politics of science and nature, on the other.

The question of the relation between destructive and exploitative technoscientific biases and capitalism is certainly of fundamental importance, as current discussions on the label 'Capitalocene' versus 'Anthropocene' reveal. However, Merchant's radical opposition between modern science and eco-feminist justice (in which 'eco' refers both to the eco-logical and the eco-nomic spheres) leaves little room for an explicit program aimed at developing an emancipated form of science and technology. Several questions remain thus far unanswered: What would natural science and epistemology look like in an emancipated world? Moreover, Merchant is silent about socialist strands of reception of Baconian utilitarianism and practice-oriented science.

Bacon's Dialectics of the Scientific Mastering of Nature and Humans

Merchant was not the first to point out that Bacon's knowledge-power conception extended the mastering of nature to the political domination of others. Adorno and Horkheimer even anticipated the criticism of the gender dimension of power in Bacon's thought:

³ Merchant has most recently engaged with the Anthropocene problem. Yet, her contribution to it seems to rest more solidly on her past work than on her rather superficial treatment of the current debate in *The Anthropocene and the Humanities* (Merchant, 2020).

Although not a mathematician, Bacon well understood the scientific temper which was to come after him. The 'happy match' between human understanding and the nature of things that he envisaged is a patriarchal one: the mind, conquering superstition, is to rule over disenchanted nature. Knowledge, which is power, knows no limits, either in its enslavement of creation or in its deference to worldly masters. (Adorno-Horkheimer, 2002, p. 2)

The above quotation summarizes Adorno and Horkheimer's interpretation of both Bacon and techno-scientific modernity. Bacon is a symbol of the Enlightenment in its two-faced tendency toward *more* rationality (based on a demythologizing disenchantment of the world) and, at the same time, *less* rationality (through the mythologization of reason itself). The fetishization of science, as they argued, turns a powerful instrument of emancipation and empowerment into its dialectical opposite, that is, a means of dominion and alienation. The two tendencies, as Adorno and Horkheimer thought, were foreshadowed by Bacon's philosophy. For this reason, their corrosive criticism of modernity – the capitalist modernity that unfolded down to the emergence of Nazism and its monstrous techno-scientific mythologies – started with a long quotation from Bacon's *In Praise of Knowledge* (1592).

Imperial and colonial imagery dominates the famous frontispiece of Bacon's *Instauratio magna*, in which the vessels of knowledge pass the Pillars of Heracles in order to cross the Ocean. The image is reminiscent of the emblem of the Spanish empire, which made use of the same symbol (namely, Heracles's columns) to celebrate its Atlantic expansion. In Bacon's case, Biblical verses sanction the political, epistemological, and even sacred goals of the enterprise (Daniel 12:4): *Multi pertransibunt et augebitur scientia* (Many will cross it and science will be enlarged). In the *Advancement of Learning*, Bacon was adamant about the imperial intentions of his scientific and educational reform (Pimentel, 2001, p. 24). In his words to the sovereign, James VI and I, he compared himself to Aristotle, who had given valuable philosophical lessons to Alexander on how to establish a new world rule, in a passage in which he stressed the connection between the flowering of culture and the construction of empires:

Experience doth warrant, that both in persons and in times, there hath been a meeting, and concurrence in learning and Armes, flourishing and excelling in the same men, and the same ages. For as men, there cannot be a better nor the like instance, as of that payre Alexander the Great, and Iulius Caesar the Dictator, whereof the one was Aristotles Scholler in Philosophie, and the other was Ciceroes Rivall in eloquence. (Bacon, 2000, p. 10)

Adorno and Horkheimer's argument went one step further, as they stressed that domination is an essential aspect of mathematical abstraction, which is typical of modern physics. The reduction of the world to a quantifiable reality which is at our disposal for manipulation suited rising capitalism and the computation necessities of investment and accumulation. These ideas are consonant with Edmund Husserl's condemnation, in *Die Krisis der europäischen Wissenschaften und die transzendente Phänomenologie* (The Crisis of European Sciences and Transcendental Phenomenology) (1936), of the loss of meaning typical of a mathematical epistemology of nature that forgets its concrete roots in a world of historical subjectivities that comprises qualities and values. For Adorno and Horkheimer, following Husserl, the sacrifice of subjectivity through the reduction of the world to its objectified abstractions is

not merely an ethical-epistemological problem. Indeed, it is primarily a political problem, as it is linked to the exploitative and alienating agendas of capitalism:

Thought is reified as an autonomous, automatic process, aping the machine it has itself produced, so that it can finally be replaced by the machine. [...] Mathematical procedure became a kind of ritual of thought. Despite its axiomatic self-limitation, it installed itself as necessary and objective: mathematics made thought into a thing — a tool in its own terms. (Adorno-Horkheimer, 2002, 19)

In the spirit of Marx's denunciation of alienation in the Paris manuscripts of 1844, Adorno and Horkheimer argued that mathematical objectification is a form of reification, that is, the transformation of human relations into impersonal economic transactions based on exploitation.

The *Dialectics of Enlightenment* was sharp in its criticism of the exploitative bias of modern science, with its Baconian roots. However, it left unanswered the question of the possible emancipation of science, technology, and society. Should emancipation take place outside of science and the Enlightenment project? Husserl, at least, indicated an idealistic conception of reason as intellectuals' task, as the point of reference for a rebirth of culture, and condemned *positivism* as a misleading dogmatization of the results and methods of a particular science at its present stage of development. As a matter of fact, Husserl's incapacity to identify the practical-political contexts of the emergence of science, technoscientific world transformation, and ideology constituted an insurmountable obstacle to his full comprehension of the political *crisis* of the Thirties and of the need for practical emancipatory action. On the other hand, what did Marxist critical theory offer in terms of a political reflection on the emancipatory possibility of our techno-scientific modernity? Who is the subject of collective praxis and freedom?

It would be idle to search for a discussion and a solution to these questions in the overtly pessimistic *Dialectics of Enlightenment*. As Andrew Feenberg has recently pointed out, it is another thinker of the early Frankfurt School that we have to reassess in order to find a program for an emancipated form of science and technology (Feenberg, 2017), namely Herbert Marcuse. The author of *One-Dimensional Man* (1964) was particularly attentive to (and critical of) the techno-scientific consolidation of a consumerist and alienated society during the twentieth century. He criticized the connection of science and technology with exploitation in advanced industrial societies. By pointing to this problem, he paved the way for his pupil Jürgen Habermas's criticism of "science and technology as ideology" (Omodeo, 2019, pp. 21-23). Yet, while Habermas remained trapped in his own conception of technology and labor as prisoners to instrumental rationality, as opposed to emancipative communicative rationality, Marcuse did not dismiss science and technology in general. Rather, he considered their limits to be historical: more precisely, he saw them as coinciding with the limitations imposed on science and work by capitalist interests (Marcuse, 1965). By more optimistically looking at the possible chances for emancipation, Marcuse proved himself to be more progressive and revolutionary than Habermas, who could not even conceive of a scientific rationality freed from alienation. These considerations lead me to consider the other side of the two-fold Baconian legacy, namely the more optimistic reflection on the potential of science for humanity, despite its going hand in hand with growing responsibilities and dangers.

World Transformation: Bacon's Socially Oriented Science

In a German classic in the materialist historiography of science of the Seventies, *Naturtheorie und Produktionsweise (Natural Theory and Mode of Production)* (1978), which is still awaiting an English translation, Wolfgang Lefèvre argued for a socio-historical approach to the connection of science and capitalism that does not lead to the generalized dismissal of science in its entirety, nor to pluralistic relativism. To be sure, he sensed the need for a critical assessment of science and technology (one that does not forget Hiroshima and Nagasaki). Yet, he cautioned against defeatist nostalgia for a pre-modern world. He saw the lack of reflection on the emancipatory power of science as a limitation of much critical theory:

This context is marked by Max Weber's studies on 'Western rationalism', Freud's 'uneasiness in culture', Husserl's 'crisis' lectures. It also comprises the endeavor of 'critical theory' as well as Heidegger's critique of Descartes. What connects these various theories – which could hardly be more diverse from both a theoretical and a political viewpoint – is [...] their shared and fundamental distrust of the scientific spirit. (Lefèvre, 1978, 9-10)

For a positive (yet not positivistic) appraisal of practice-oriented science for the sake of humanity's emancipatory empowerment, Lefèvre looked back at Marxist thinkers who had addressed the political question of the function of science. He especially referred to Hessen, Borkenau, and Grossmann.

Boris Hessen, the Soviet father of the socio-economic history of science, extolled Bacon as a materialist reformer of thought and education in his famous *The Social and Economic Roots of Newton's 'Principia'* (1931). In his unpublished anthology of sources on the material history of science (which Lefèvre could not yet access in the 1970s), Hessen mentioned Bacon as an instance of the conflict between the new scientific desire for novelty and institutionalized forms of knowledge in a section tellingly entitled "Old Universities and the Struggle against the New Science." He also regarded Bacon as an educational reformer operating outside the educational settings which Hessen labeled as "feudal universities". He argued (undoubtedly, with rhetorical exaggeration) that modern science could only grow outside traditional institutions of learning:

Ratke, Bacon, Comenius and other advocates of progressive ideas of the seventeenth century conducted their work outside universities, which had little sympathy for new ideas. Neither the philosophers Descartes, Hobbes, and Locke, nor the scientists Harvey and Boyle, nor even Bacon (who represented both science and philosophy) were close to the university milieu. (Hessen, unpublished anthology)⁴

Today, we are in a better position to qualify Hessen's bold statements, as much scholarship in the history of universities has helped us to see the connection between educational institutions and 'research' ones

⁴ Transl. by Giuliano Vivaldi. Rose Luise Winkler and Peter McLaughlin have made a digitization of this unpublished work available. See: http://www.philosophie.uni-hd.de/md/philesem/personal/hessen_textbook.pdf (accessed February 6, 2021). Cf. Winkler, 2007. A transcription with a partial translation will appear in the open-access series *Verum Factum*, ed. by P.D. Omodeo and S. Winkler.

before the age of the Humboldtian research university (Schmitt, 1981; Feingold, 1984; Clark, 2006). Still, it is very important to keep in mind the relevance of the process of the institutionalization of science in early modernity and the fact that this more often than not occurred outside traditional places of education and culture through the emergence of new institutions, such as the Accademia del Cimento in Florence, the Académie des sciences in Paris, and the Royal Society in London (Giannini-Feingold, 2019).

A general appreciation of science as a means of progress was openly embraced by the Marxist historian of the Scientific Revolution, Edgar Zilsel, who saw Bacon as the obvious champion of this idea. As one reads in his best-known article, “The Sociological Roots of Science” (1942), Bacon “is the first writer in the history of mankind [...] to realize fully the basic importance of methodical scientific research for the advancement of human civilization” (Zilsel, 2000, 944). Bacon attacked idle forms of knowledge, such as bookish Scholasticism and narcissist Humanism. In a spirit similar to Galileo and Gilbert’s, Bacon contributed to the appreciation of empirical knowledge that stems from technology and practices. According to Zilsel, these three founding figures of modern knowledge contributed to the emergence of a new hybrid persona, the scientist, combining rationality (beyond Scholasticism), intellectual freedom (beyond Humanism), and practical-oriented knowledge (beyond the practical arts). What made Bacon unique was his rejection of individualism, including the most visible form of courtly literacy, in the name of a communitarian vision of knowledge acquisition and transmission for the common good of the body politic.

Bacon [...] was opposed to the ideal of individual glory. He substituted two new aims: ‘control of nature’ by means of science and ‘advancement of learning’. Progress instead of fame means the substitution of a personal ideal by an objective one. (Zilsel, 2000, 944)

Against this background, a novel conception of research collaboration within scientific academies was established.

Bernal is another important point of reference as regards the question of the function of science and a progressive conception of its history. In *The Social Function of Science* (1939), he raised the question of the double-binding of science and society, of how transformations of the former affect transformations of the latter and vice versa. The ancient model of knowledge as pure thought struck him as a Platonic perspective that is contradicted by the actual reality of science, as this emerged and became consolidated throughout modernity. In this respect, Bacon’s thoughts proved fundamental to shape and justify “the opposite view of science, that it was the means of obtaining practical mastery over nature” (Bernal, 1946, 6). Although Bernal fundamentally agreed with Bacon’s positive understanding of ‘science as power’, he was well aware that that power could be directed toward very different goals. From the very start, he pointed to the ‘disillusion’ generated by the most devastating experiences of the modern scientific world:

War, financial chaos, voluntary destruction of goods which millions need, general under-nourishment, and the fear of still other wars more terrible than any before in history, are the pictures which must be drawn to-day of the fruits of science. (Bernal, 1946, 7)

Are the fruits of science poisonous? Bernal thought that this was true only to the extent to which science responded to the capitalist logic of profit and exploitation and, even more so, if it was connected with the rise of fascisms. Hence, he did not abandon the optimistic expectation that science could and should foster a better society, but believed that this depended on the socialization of its material and intellectual means. New scientific mythologies, as he claimed, are the byproduct of fascism. They represent the opposite of the Enlightenment, rather than its fetishized fulfillment.

According to Grossmann – another major exponent of the Marxist historiography and sociology of science in the years of Hessen, Zilsel, and Bernal – Bacon’s contribution to the scientific culture of modernity did not merely concern the program to institutionalize science for the benefit of society at large, in accordance with a utopian vision connecting him with Thomas More (Grossmann, [1946] 2009, 161). Against interpretations of Bacon as someone embodying the model of top-down techno-scientific power, in “Descartes and the Social Origins of the Mechanistic Concept of the World” (1946), Grossmann saw Bacon’s project as rooted in the interests of the rising middle class and as directed toward a democratized science. Bacon passed on to the next generations an ideal of universalism which was not abstract but corresponded to widely shared (or shareable) concrete knowledge. The same ideal, according to Grossmann, is to be found in René Descartes’s method:

What is the meaning of Descartes’ universal science? In his eyes, it was a *universal method* applicable to all science. Originally Descartes planned to call his essays published in 1637 not *Discours de la méthode*, but *Le projet d’une science universelle* [...]. The universal science was to be universal not only in that it would be applicable in all the fields of science, but also in that it would be accessible to *all the people*, including the large masses. (Grossmann, 2009, pp. 158-159)

In Grossmann’s reading, Bacon gave Descartes another key idea, that of a *New Organon*, a universal method for reforming thought in order to make it productive. Out of this insight, Descartes developed the idea of a *mathesis unviuersalis*. “Descartes developed and deepened Bacon’s fundamental idea, which constitutes the real kernel of his *science universelle*, or algebra” (Grossmann, 2009, p. 164). Such an algebra serves not only mathematics but thought in general. It is a tool for the “mechanization” of thought that is analogous to the function of machines for labor and production. The historical consequences on intellectual labor and the organization of labor of the project of mechanized thought, in terms of both efficiency and alienation, escaped Grossmann, although Karl Marx had already discussed the consequences of Charles Babbage’s mathematics of thought for the organization of work and intelligence, in general. But these are topics that have been only recently readdressed, in connection with the idea of a carbon-silicon capitalism which unites industrial machine production (the carbon side) with algorithms of labor organization and artificial intelligence (the silicon side) (Pasquinelli, 2017). Thus, Grossmann reaffirmed the Baconian ideal of a domination of nature for the sake of humanity’s progress, in line with Marx’s emphasis on the world-transforming importance of knowledge:

With Thomas More, Francis Bacon and Descartes a new historical epoch begins. Under the influence of the needs and interests of the growing middle class [...] the new generation, on the basis of observation and experience, wanted not only to understand this reality, but also to *shape it rationally*. (Grossmann, 2009, p. 161)

Praxis and Utopia beyond the Anthropocene Dilemma

I have thus far considered two conflicting images of Bacon as a symbol of techno-scientific modernity. What they have in common is the idea of a transformation of the world through the mastering of nature. Where they disagree is in the evaluation of such a project: one sees it as expressing the subjugation of nature and other humans, and alienation; the other, the emancipation from necessity and the progress of humanity thanks to an accurate and operative knowledge of the world that is not limited to contemplation. It seems to me that this tension in the interpretation of Bacon is clearly representative of the fundamental tension in the environmental debate today. In the light of the unintended consequences of human technology for the planet's balance and our own survival, do we need more science or more collective politics? Do we need more objectivity or agency? Is there a conflict between the two poles?⁵

Félix Guattari discussed these questions as 1989. The problem is rooted in the ecological impasse that emerged after the end of the Cold War as the challenge of a new globalized society:

So, wherever we turn, there is the same nagging paradox: on the one hand, the continuous development of new techno-scientific means to potentially resolve the dominant ecological issues and reinstate socially useful activities on the surface of the planet, and, on the other hand, the inability of organized social forces and constituted subjective formations to take hold of these resources in order to make them work. (Guattari, [1989] 2000, p. 31)

I should now deal with this paradox, that is, the tension between an emancipatory tendency and a destructive tendency in Janus-faced science.

The current impasse represents the continuation, under new circumstances, of the century-long crisis of the idea of progress.⁶ It is often claimed that more science and technology are needed to fix the negative effects of technology and science. The Capitalocene debate has helped to frame the problem of the management of the planet as a socio-economic question and, in doing so, it has drawn attention to its political urgency. If science and technology are functional to a logic of exploitation, it is difficult to see how an acceleration of such a logic could fix the damage it has been producing instead of increasing it.

The Capitalocene does not stand for capitalism as an economic and social system. [...] Rather, the Capitalocene signifies capitalism as a way of organizing nature. [...] [It] captures the basic historical modern pattern of world history as the 'Age of Capital' – and the era of capitalism as a world-ecology of power, capital, and nature. (Moore, 2016, 6)

The Capitalocene concept suggests that the catastrophic tendencies of the Anthropocene are one and the same with those of capitalism, and also marks the limits of the latter. Personally, I do not share

⁵ For an overview of eco-Marxist problems in economy, technology and energy, see Hornborg 2014.

⁶ Arguably, the crisis of progress experienced a crescendo from the chemical warfare of the First World War to the horrors of the Second World War and the proliferation of atomic arsenals during the Cold War. Cf. Masco, 2004; Omodeo-Parkhowell, 2018.

such optimism. Indeed, if capitalism is founded on the mechanism of the accumulation of wealth and power, which has the tendency to colonize and subsume all spheres of existence (from natural resources to psychic attitudes) and to co-opt them into its logic as something instrumental to its own development, then not even ecological collapse necessarily entails its end. As has been often repeated – as a sort of mantra of the mental horizon of capitalist disenchantment – “it is easier to imagine the end of the world than the end of capitalism” (e.g., Fisher, 2009). The global societal halt determined by the Covid pandemic, with its shattering economic consequences, has not led to any major crisis of capitalism thus far but only to its re-adjustment to new circumstances, as has happened many times before (cf. Löwy, 2020).

World War I and the Wall Street crash of 1929 had already sparked intense debates about the limits of capitalism. Was the geographical end of the colonial race of the European powers the sign of an impending collapse of capitalism, as Rosa Luxemburg had argued (cf. Luxemburg, 2003)? Henryk Grossmann, with the pessimistic lucidity typical of the Frankfurt Institute of Social Research, which he had joined, argued that no external limitation can really make capitalism break down, because its driving force resides in its intrinsic socio-economic logic of exploitation and accumulation (Grossmann 1929). He looked back at the centennial history of mercantile, financial, and industrial capitalism to argue that neither plagues nor war or natural calamities had ever stopped its advance but only determined, in some cases, a transfer of power from one center to another one, from the bold maritime republics of late-medieval and Renaissance Italy to the new financial and colonial centers north of the Alps, especially in the Netherlands and Great Britain. As he remarked (and as more recent ideological-sociological considerations by Boltanski and Chiapello have emphasized: Boltanski-Chiapello, 2001), the protean nature of capitalism makes it adaptable to the worst scenarios without any need to fix them. Does capitalism really need to solve the environmental problem? Quite on the contrary, it seems that the more the environmental situation escapes our control, the more we become dependent on the techno-scientific structures and power that guarantee both our survival and the worsening of the quality of our lives.

Is there no way out of this predicament? I do not think so. As Bacon clearly realized, science is a means of control and domination, but at the same time it is also a means of empowerment. The dichotomy of destruction and emancipation is not, so to speak, a metaphysical polarity residing in the ‘essence’ of science, but rather a cultural-historical circumstance. In order to overcome it, we need to develop a correct understanding of the contexts of science and technology. Destruction and empowerment are a dialectical couple. They belong together, therefore their apparent opposition cannot be solved in theory. Rather, it should emerge from concrete actions fostering a new non-destructive and emancipatory paradigm.

At the meta-level of knowledge theory, the ‘dialectics of epistemology’ is located today at the intersection of expert knowledge and political praxis, as witnessed by post-truth debates on the arbitrariness or reliability of scientific facts (Oreskes-Conway, 2012; Kusch, 2020). Hungarian Hegelian-Marxist philosopher, György Lukács, for one, envisaged a solution to the opposition between two opposite philosophical attitudes: celebrating the absolute nature of scientific facts and asserting the relativism that springs from spiritual freedom. On the one hand, the passivity of scientism posited the necessity of natural and societal processes as independent of our interaction with the world; on the other hand, intellectualist attitudes posited the individual freedom of the spirit as separate from material

constraints. This aporia, as Lukács called it (actually a ‘bourgeois antinomy’) can only be solved by a philosophy of action:

When theory and practice are united it becomes possible to change reality and when this happens the absolute and its ‘relativistic’ counterpart will have played their historical role for the last time. (Lukács [1923] 1971, p. 189; cf. Feenberg, 2014, p. 56)

Worldly knowledge is intrinsically linked to transformation, not speculative contemplation. The practical meaning of objectivity, derivable from Marx’s theses on Feuerbach, has informed much of what we call the philosophy of praxis (Feenberg, 2014; Omodeo, 2020).

Along a similar line of thought, early twentieth-century reflections on science and politics stressed the importance of praxeology, as a perspective that enhances the role of practice and brings science back to its socio-economic and political roots. In a famous speech held in London in 1931, in front of an academic public of historians of science, the Soviet leader and head of a delegation of Soviet historians of science, Nikolai Bukharin, argued for the superiority of a Bacon-inspired ‘praxeology’ versus Berkleyan-inspired dreams of a *science pour la science*:

There is ‘epistemology’. But no learned men have yet thought of inventing some special ‘praxeology’. Yet one passes into the other, and Bacon himself quite justifiably spoke of the coincidence of knowledge and power, and of the interdependence of the laws of nature and the norms of practice. (Bukharin, 1931, 14)

In a more humanistic vein than Bukharin, Italian historicist Marxist Antonio Gramsci developed a “filosofia della prassi,” a philosophy of praxis that looks at science as a problem of hegemony, at the level of ideology and cognition as well as at that of the transformation of reality. In his prison notebooks, he posited labor – envisaged as a collective activity – as the basis of scientific experience and, vice versa, experimental science as the basis of a praxeological conception of reality:

One might say that the typical unitary process of reality is found here in the experimental activity of the scientist, which is the first model of dialectical mediation between man and nature, and the elementary historical cell through which man puts himself into relation with nature by means of technology, knows her and dominates her [...] Scientific experiment is the first cell of the new method of production, of the new form of active union of man and nature. (Gramsci, 1971, 446)

An articulated philosophy of the connection of science, labor, and society was developed, in those years, by the Russian philosopher, scientist, and Bolshevik intellectual, Alexander Bogdanov. It was a labor-centered epistemology and ontology. According to Bogdanov, cognition is based on experiences. These experiences are never individual, because they are mediated by the social and technological capacity of a given society to interact and transform its environment (Bogdanov 2016, 201-206). Hence, knowledge is a historical matter which can never be reduced to a purely abstract relation between an individual mind and an external world. Polish immunologist and historical epistemologist, Ludwig Fleck called the misleading (neo-positivistic) isolation of a pure subject contemplating an object an *epistemologia imaginabilis* (that is, an epistemology of the imagination, Fleck, 1979, 21) that has never

existed and will never exist, since the subject-object relation is always mediated by culture (Zittel, 2010). From a praxeological perspective à la Bogdanov this mediation is practical. The two poles of the epistemological relation between knower and known are held together by collective material practices. On this basis, Bogdanov developed his own ‘futurology’, a vision of knowledge for the future, which he announced as the emergent scientific ‘paradigm’ connected with the collectivization of the goals of science (Bogdanov, 2016, 236-247. For the context, cf. Kremontsov 2011).

Among non-Marxist thinkers, structuralist philosopher of science, Thomas Kuhn later also defended the idea that scientific revolutions are future-oriented. As he remarked in *The Structure of Scientific Revolutions* (1962), Galileo’s defense of the Copernican system vis-à-vis his Scholastic and theological opponents, while depending on a missing proof, could not be reduced to anything like an *experimentum crucis* (to consider a Baconian problem). As Kuhn argued, the choice of a scientific paradigm, including heliocentrism, is not about today’s science but rather about the science of tomorrow, the new problems that scientists will legitimately be dealing with rather than the solutions that are already at their disposal thanks to a new theory:

Paradigm debates are not really about relative problem-solving ability, though for good reasons they are usually couched in those terms. Instead, the issue is which paradigm should in the future guide research on problems many of which neither competitor can yet claim to resolve completely. A decision between alternative ways of practicing science is called for, and in the circumstances that decision must be based less on past achievement than on future promise. (Kuhn, 1996, pp. 157–158)

In this perspective, scientific progress has a clear utopian dimension. Science depends on ideals and decisions. Bogdanov associated this aspect with the revolutionary potential of ‘heresy’ – including his own position with respect to Marxist party ‘orthodoxy’. He drew this idea from the same historical case of scientific heresy as Kuhn, namely Copernicus’s heliocentric turn (Bogdanov, 2016, p. 214). Bogdanov thought of the science of tomorrow, perhaps in too narrow terms, as a ‘tektology’, or a science of organization and self-organization at the epistemological level of the cognitive coordination of experiences as well as at the ontological level of natural history.

The environmental crisis also raises paradigmatic questions: What should the science of tomorrow look like? What kind of science can face the challenges of the Anthropocene? A recent research article on the quantification of planetary boundaries begins with the following call for an epistemological shift:

There is an urgent need for a new paradigm that integrates the continued development of human societies and the maintenance of the Earth System in a resilient and accommodating state. (Steffen et al. 2015, p. 736)

If the endurance of the humanized world depends on the stability of new technologically induced cycles, as Peter Haff’s concept of the ‘technosphere’ suggests (Haff, 2019), then the prosperity of humanity depends on the development of a non-destructive science (Suvin, 2010). The need for it does not depend on any quest for a ‘pure knowledge’ of nature – since we are part of this world and its rhythms – nor on any survival imperative – which would amount to a biological externalization of ethics. Rather, the need

for a non-destructive science depends on an ethical imperative. It implies a shift from the object (nature considered as an objective entity independent of us) to the subject of transformation (humans as the actors that who have become fully conscious of their own world-transformative agency) – that is, from the factual analysis (and predictions based on predetermined factual conditions) to ethical-political responsibility. The relevant question ceases to be a merely technical one concerning the best way to make the machine-Earth function. It is rather the question of what solution we regard as worthy and satisfactory.

Spinozist Hegelian-Marxist Evald Ilyenkov once proposed the vision of a cosmological mission of humanity aimed at spiritual-technological universal regeneration – a “Cosmology of the Spirit,” as he called it (Ilyenkov, 2017). In the age of the Anthropocene, such a vision becomes a very concrete and immediate task, namely, that of emancipatory geopolitics. This has to counter the three-fold problem of environmental pollution, the deterioration of societal bonds and mental alienation (that is, Guattari’s three-fold ecology, in Guattari, [1989] 2000). Bacon’s technological-messianic dreams cease to coincide with a selfish appropriation of resources and are enriched by the perspective of the global construction of a harmonized cultural-natural earth.⁷

The two-sidedness of Bacon’s legacy – as the hero of scientific empowerment and as the denigrated champion of domination – is not a matter of taste reflecting the biases or positions of his readers. Rather, the two apparently irreconcilable lines of reception of his thought reflect the deep ambivalence of modern science. As it is always the case with dialectically opposite positions, the solution of the antithesis cannot take place at the abstract level of theory. In the present, the most urgent antithesis corresponds to the fundamental techno-scientific dilemma: Do we need more techno-science to fix the reality that techno-science produces and reproduces? But this is not an abstract question that requires theoretical solutions. The Baconian science-power nexus of yesterday and today calls for a theoretical-practical solution. While the geologists working to ratify (or not) the Geological Time Unit of the Anthropocene are still gathering the stratigraphic evidence that might help draw the line between the end of the Holocene and the beginning of the Anthropocene (Zalasiewicz, 2019), the environmental crisis cannot wait for a new paradigm to emerge. Rather, we should anticipate and foster a change of mentality through future-oriented actions. As Kuhn argued, paradigm shifts are a bet on the future. The praxeological lesson is that we need to know in order to transform the world, but we know reality by transforming it. As for the question of what direction this action should take – of what choices are worthy and satisfactory – the Baconian link between science and utopia proves crucial. Utopia, an important element in Bacon’s philosophy, opens up the scientific-ethical horizon for the establishment of a fruitful connection between knowledge and ideals of – and in – the interesting times we live in.

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⁷ Such an alternative utopian perspective resonates with the ideal of Bacon’s Calabrese alter-ego, the heretic friar Tommaso Campanella, whose utopia was supported by a vision of human history as part of a cosmic drama unfolding in the direction of greater equality, justice, and freedom. To gain such a perspective, one should read Campanella’s *Città del Sole* together with the other two works of his that were penned at about the same time, around 1600, that is *Monarchia di Spagna* [or *The Monarchy of Spain*] and *Articoli prophetales*. Cf. Ernst, 2002 and Hadley, 1997.

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