# OPEN EPISTEMOLOGIES

## MACH, BACHELARD, FEYERABEND

*In honour of Zbigniew Kotowicz (1950-2017)*

Lisbon, 20-21 September 2019
Faculdade de Ciências da Universidade de Lisboa

# Book of Abstracts

Organization
Centro de Filosofia das Ciências da Universidade de Lisboa

# Presentation

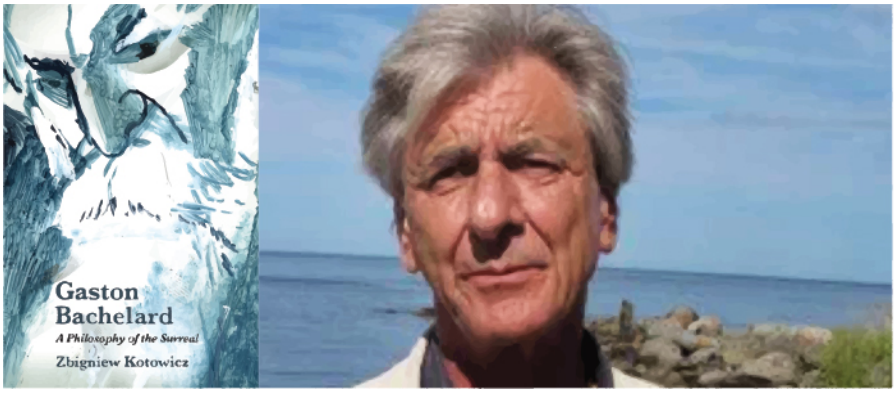
The problem of scientific method, important for scientists at least since the Renaissance, became crucial during the Enlightenment, generating debates that have extended to the present. An issue that remains relevant today is what happens when a pluralist methodology is adopted – what kind of science gets done, and/or not done? Ernst Mach (1838-1916), Gaston Bachelard (1884-1962) and Paul Feyerabend (1924-1994) argue that there are different ways to construct knowledge, considering that there is a need to disrupt old scientific methods. Can we assume that they are proposing "open epistemologies"?

Many philosophers have discussed scientific concepts and theories, but several scientist-philosophers also have questioned the scientific knowledge that they were constructing during their scientific life. Some of them have even elaborated epistemologies that undeniably reflect their experience of making science. This is not, of course, a reason to take their ideas for granted, but we believe that it is important to take them seriously and to discuss them. In addition to Mach, Bachelard and Feyerabend, throughout the 19th and 20th centuries it is possible to find scientists well known for their epistemological thinking, such as Henri Poincaré (1854-1912), Emile Meyerson (1859-1933), Ludwig Fleck (1896-1961), Michael Polanyi (1891-1976).

The science of the twentieth century has, in turn, put new epistemological problems in physics, biology and several other areas of knowledge from which emerges a deep philosophical reflection of scientists like Albert Einstein (1879-1955), Niels Bohr (1885-1962), Werner Heisenberg (1901-1976), Joseph Woodger (1894-1981) or Ernst Mayr (1904-2005). Some of their ideas as well as those of other scientists have echoed in the philosophy of science and have generated controversies until today.

This colloquium intends to create the conditions of lively discussions about the epistemologies of scientists around the works of several scientists-philosophers from Ernst Mach to the present. The colloquium is also aiming to honor our late colleague Zbigniew Kotowicz (1950-2017) and his work on Gaston Bachelard (Gaston Bachelard. A Philosophy of the Surreal, Edimburgh University Press 2016).

*Baudouin Jurdant, Elisa Maia, Isabel Serra*




ZBIGNIEW KOTOWICZ was born in London in 1950 and died in Lisbon aged 67. He was a rare, proud, sometimes solitary man with a gift for friendship. He wrote four acclaimed books: on the Portuguese writer Fernando Pessoa, on the neurologist Egas Moniz (originator of psycho-surgery), on the psychiatrist Ronald Laing and on the philosopher Gaston Bachelard. The books themselves are impressive, but their range more striking still. In an age of specialisation, Zbigniew was something of a polymath.

A love of literature took root early, as did a radical's commitment to the political left, broadly construed. Psychology and psychoanalysis followed. Then philosophy offered him a way to exercise his restless intelligence more freely. Its greatest gift was an introduction to the work of Bachelard, who became the point around which all his thinking turned.

Zbigniew Kotowicz worked at CFCUL between the 2011 and 2017, under a fellowship granted by the Fundação para a Ciência e Tecnologia. During this period, he published the books Psychosurgery – The Birth of a New Scientific Paradigm. Egas Moniz and the Present Day (2012, CFCUL), Bachelard, 50 ans après (2016, CFCUL), and Gaston Bachelard. A Philosophy of the Surreal (2016, Edinburgh University Press). He collaborated with the members of CFCUL in a number of research projects and participated in postgraduate teaching at the Department of History and Philosophy of Science of the Faculty of Sciences of the University of Lisbon.

*David Webb.*

# TRIBUTE TO Z. KOTOWICZ

## L'ÉPISTÉMOLOGIE OUVERTE DE ZBIGNIEW KOTOWICZ : DE LA PSYCHANLAYSE À LA PHISLOSOPHIE

Baudouin JURDANT
Université Paris 7, Paris
Centro de Filosofia das Ciência da Universidade de Lisboa

Après avoir travaillé pendant une dizaine d'années comme psychanalyste à Londres, Zbigniew Kotowicz a brusquement décidé de changer d'orientation professionnelle pour se consacrer désormais à la philosophie. Il s'est inscrit pour faire un doctorat sur l'un des aspects de la philosophie de Heidegger. Mais il est tombé ensuite sur un livre de Gaston Bachelard, *La poétique de l'espace.* Peut-on parler de coup de foudre philosophique ? C'est un peu dans ces termes que Kotowicz rendait compte de sa découverte de Bachelard. Il changea de sujet et s'attaqua à l'épistémologie de Bachelard dont l'ouverture lui paraissait essentielle pour définir l'horizon philosophique des sciences d'aujourd'hui.

# OPENING LECTURE

## D'UNE ÉPISTÉMOLOGIE OUVERTE À UNE ÉPISTÉMOLOGIE CRITIQUE

Jean-Marc LEVY-LEBLOND
Université de Nice

Je défendrai l'idée que la reconnaissance de l'intérêt des « épistémologies ouvertes » n'est que le premier pas vers le développement d'une conception épistémologique capable d'exercer une influence effective sur les pratiques scientifiques. A partir des notions de « rupture épistémologique » et de « refonte épistémologique » (qui trouvent leur source chez Bachelard, mais ont été développées par l'école althussérienne), je montrerai à la fois la nécessité et la possibilité d'une épistémologie critique. La discussion s'appuiera sur les considérations stimulantes mais inaccomplies de Bachelard et Feyerabend concernant la physique quantique.

# KEYNOTE COMMUNICATIONS

## SCIENCE AND IMAGINATION IN AN ABUNDANT WORLD: FEYERABEND'S OPEN EPISTEMOLOGY

Matthew J. BROWN
Center for Values in Medicine, Science, and Technology - The University of Texas at Dallas

In this talk, I provide an interpretation and defense of Paul Feyerabend's epistemological ideas on the background of his late metaphysical writings. I argue that Feyerabend provides a compelling critique of mainstream epistemology and philosophy of science as squelching the creativity and imagination necessary for scientific progress. Imagination and creativity are crucial elements of the scientific process, for Feyerabend, due to both the nature of the reality science seeks to explain and control, as well as to the limits of human thinking. This background picture (developed chronologically last in Feyerabend's thinking, in *Conquest of Abundance*) best explains Feyerabend's continued insistence on scientific imagination, his early attack on "conceptual conservatism," his epistemological anarchism (the argument against method), his "principles" of proliferation and tenacity, and his complex struggles with realism and relativism.

Feyerabend's metaphysics is ontologically pluralistic and antiessentialist. He claims that nature is abundant, ambiguous, incomplete, not structureless but rich with complex, overlapping, conflicting structures, a complex mix of determinacy and indeterminacy, safety and hazard for human life and thought. (Brown 2016). Nature is both pliable, admitting of multiple possible successful descriptions, as well as resistant, in that not all descriptions are equally successful (Tambolo 2014). Human perception and cognition must abstract away most of the complexity of the world around us, in order to be able to manage using limited resources. Science is a further development of our basic cognitive capacity to manage the abundance and complexity of the world. But abstraction is a vexed gift; the limits of any single perspective or framework tend to remain out of view, giving us a tendency towards closed-mindedness.

The limited pliability of the world, along with the human tendencies towards abstraction and closed-mindedness, require an epistemology of imagination. Feyerabend worked throughout his career to defend such an epistemology. Science must freely exercise imagination to help us successfully manage the abundant world. It must also learn how to exercise that imagination responsibly to meet the challenges of our contemporary world.

Brown, Matthew J. (2016) "The abundant world: Paul Feyerabend's metaphysics of science." *Reappraising Feyerabend*, Special issue of *Studies in History and Philosophy of Science A* 57:142–154.

Feyerabend, Paul K. (2001) *Conquest of Abundance: A Tale of Abstraction versus the Richness of Being*. University of Chicago Press.

Tambolo, Luca (2014) "Pliability and resistance: Feyerabendian insights into sophisticated realism." *European Journal for Philosophy of Science* 4(2):197–213.

## MACH ON HISTORY AS PART OF SCIENTIFIC PRACTICE

María DE PAZ
Universidad de Sevilla

Ernst Mach is well known for his historical-critical analyses of several scientific disciplines, such as mechanics or the theory of heat. These works are usually appreciated for the historical presentation of the evolution of scientific concepts they contain. However, we think that they are more than historical documents. In our view, these works are directed to call scientist's attention to the historicity of certain concepts and, as such, provide a philosophical guide to the development of new scientific ideas. In this sense, we think that Mach conceived them to be incorporated to the scientist's background and, as such, to be used as part of scientific practice.

In order to explore this interpretation, in the first part of the talk we propose to analyze the notion of practice in Mach, in the light of recent philosophical approaches to scientific practice and after that, we will explain the role that history plays in it.

Our aim is to bring Mach's epistemology up to date by relating it to the recent practice-turn in philosophy of science and to argue in favor of the knowledge of history of science in scientific practice.

## ERNST MACH'S CONSTRUCTIVISM AND POST-EMPIRICISM

Pietro GORI
IFILNOVA, Lisbon

Aim of this paper is to explore Ernst Mach's constructivism about scientific concepts in the light of Mary Hesse's epistemology and her view of "theoretical explanation as metaphorical redescription of the domain of the explanandum" (Hesse 1980: 111). In her works, Hesse outlines a post-empiricist account of science based on the theory-ladenness of facts and their relationship with our interpretation of them. Within this framework, "truth is defined as coherence with the theoretical system and knowledge becomes socially institutionalized belief" (Hesse/Arbib 1986: 10). The mutual influence between scientific theories and the surrounding cultural and social thought is further stressed in Hesse's idea that our attempt to represent the world is a constructive enterprise involving the categories of language, which are "contingent on human interaction to the world and culturally relative" (Hesse/Arbib 1986: 160). Finally, Hesse argues that "no sharp dichotomy between the natural sciences and the social or literary hermeneutic sciences" should be posited, for, according to her constructivism, "the barriers between 'objective' science and nonscience" can be dissolved (Hesse/Arbib 1986: 171, and Hesse 1980: chapter 7).

As I will try to show, Mach can be related to an "open epistemology" of this sort. The anti-essentialist view of scientific concepts that he develops e.g. in the *Principles of the Theory of Heat* and in *Knowledge and Error* leaves space for a cultural approach to scientific knowledge. More precisely, if thoroughly explored, Mach's idea that scientific "description is a construction of facts in thought" (Mach 1986: 370) and that "concepts, influenced by the intellectual needs of humanity as a whole, bear the imprint of the culture of their period" (Mach 1976: 102) imply a reconception of the traditional dichotomy between facts and interpretations (theories) in science, which leads precisely to the picture outlined by Hesse.

M. Hesse (1980): Revolutions and Reconstructions in the Philosophy of Science, Indiana Univ. Press
M. Hesse and M. Arbib (1986): The Construction of Reality, Cambridge Univ. Press
E. Mach (1976): Knowledge and Error, Reidel
E. Mach (1986): Principles of the Theory of Heat, Reidel

## PSYCHOANALYSIS AND SCIENCE AFTER THE PRACTICE TURN

Andreas MAYER
Institute for Advanced Studies, Berlin

For a long time, psychoanalysis has been regarded as a failed or flawed attempt to establish a scientific approach towards human subjectivity. Neopositivistic but also structuralist epistemologies have obscured Freud's specific conception of science in historical and intellectual contexts.

In this contribution, I will propose a new formulation of the problem as it becomes possible after the turn to practice. Drawing on some recent studies, I will suggest an approach to contextualisation combining a sociology of the psychoanalytical movement and an anthropology of epistemic and therapeutic practices.

## HOW OPEN WAS MACH'S EPISTEMOLOGY?

John PRESTON
Department of Philosophy, The University of Reading, UK

*Erkenntnis und Irrtum* (*Knowledge and Error*) is remarkably little studied. Even if one doesn't think of it as Mach's *magnum opus* (which it has a good claim to be), it is certainly the mature statement of his epistemology.

There is plenty of evidence in *Knowledge and Error* that Mach could have endorsed the idea of an open epistemology. I detail aspects of that evidence, including: the historical *contingency* of scientific concepts; Mach's pluralism about modes of investigation; his idea that a plurality of worldviews is a pre-requisite for criticism (and science); the *all-encompassing* nature of his monism; and his tendency to treat all scientific theories and principles (including his own methodology and psychology) as provisional. The *kinships* Mach sees between instinctual thought, common-sense, and science might also be taken to support the idea that his epistemology was an open one.

I will argue, though, that Mach's epistemology is not as open as we might well think Feyerabend's was. Mach is no relativist about these matters. He clearly believes in 'the growth of knowledge', and he does not put scientific thought and ordinary common-sense thought on the same level. For Mach, science develops *from* ordinary thought, notably from manual skills and trades. And it typically develops away from immediate practical ends. But this development is to something on a higher epistemic level. Mach distinguishes between ordinary thought and science in various ways, and the ways in which makes that distinction elevate science *above* ordinary thought. I detail those ways.

Mach also distinguishes between science, on the one hand, and religious and mythological ideas on the other hand, pointing to their different origins. But here the story is more complicated. He does point to the need for phantasy (imagination) to be strong in science. He also points to the mythological origins of science, and to what he thinks of as mythological components of *existing* science. But his *critique* of existing science (mechanism, atomism, etc.) relies on him *contrasting* science with mythology (unlike Feyerabend), and he advocates the 'merciless criticism' of such monstrosities with a view to eradicating them.

Finally, I contrast the critique of abstraction in Feyerabend's *Conquest of Abundance* with Mach's critique in *Knowledge and Error*, and argue that the latter is again altogether more restrained than the former.

## THE END OF THE PHILOSOPHY OF SCIENCE AND THE IDEA OF OPEN EPISTEMOLOGIES

Henrique Jales RIBEIRO
Faculty of Letters of the University of Coimbra. Portugal,

This presentation discusses the philosophical connection between the idea of the end of traditional philosophy of science, as announced by Quine (1969), Kuhn (1996), Rorty (1991), Feyerabend (1987), and others in the second half of the 20th century, and the more recent, characteristically postmodern conception of "open epistemologies". In this presentation, "open epistemology" means a conception that involves renouncing the traditional founding role of philosophy as regards science that we have inherited from Descartes and Kant; and which admits that there is no universal, necessary model in that respect; on the contrary, different, possibly even conflicting epistemologies may play this role in novel ways. Quine's "naturalised epistemology", Kuhn's sociological approach after the impact of Quine's theories, Rorty's relativism, and Feyerabend's anarchism are, in varying degrees, examples of this kind of epistemology.

The major problem is knowing the extent to which this epistemology is able to meet the core objectives pursued in the past by the "philosophy of science". This particularly entails ensuring that a systematic investigation in philosophy is still possible, even if said investigation basically consists in presenting and describing the common characteristics of the different possible "open epistemologies". The question is: if, for one reason or another, science (mathematics and physics) no longer provides the basic framework from whose perspective human knowledge and action in general can be understood, as has happened from modernity (Descartes and Kant) to the present, what will the new, revolutionary and inevitably called-for framework consist in? In this presentation I will suggest some answers to this crucial question.

Feyerabend, P. (1987), *Farewell to Reason*, London: Newleft Books;
Kuhn, T. S. (1996), *The Structure of Scientific Revolutions*, 3rd ed., Chicago: Chicago University Presss;
Quine, W. van O. (1969), *Ontological Relativity and Other Essays*, New York: Columbia University Press;
Rorty, R. (1991), *Objectivity, Relativism, and Truth: Philosophical Papers, Volume I*, Cambridge: Cambridge University Press.

## MICHAEL POLANYI, FREEDOM AND THE PURE SCIENCE

Leandro T. MUNIZ[1], Antonio A. P. VIDEIRA[2], and André L. O. MENDONÇA[3]
[1]Programa de Pós-Graduação em Filosofia/UERJ; [2]Departamento de Filosofia/UERJ
[3]Instituto de Medicina Social/UERJ

Michael Polanyi (1891-1976) is normally understood by the History of Science and Philosophy as one of the great thinkers of the 20th century. He is considered a heterodox and innovative philosopher. Polanyi is particularly recognized for his valorization of the notion of practice in scientific activity: to understand science rightly it would be necessary to analyze how science is constructed by its practitioners, the scientists.

Polanyi stood out as a fierce opponent of any external planning to science. From the first moment that theses were proposed in defense of state control of scientific activity, he was one of his greatest critics. It would not make sense to control the scientist's work externally. This political-administrative model would cause irreparable damage to the development of new technologies and scientific knowledge. He proposed a debate on conceptions of knowledge. The first type of knowledge (pure science) would collapse and become extinct if controlled externally. The second one (applied science) would be the main reason for the interest of private and state-owned companies. Conditioning the work of the scientist according to the interests of private and state-owned enterprises would divert science from its natural course. How, then, should the practice of the scientist be autonomously organized in order to prevent external organizations and elements from interfering in science?

In 1964, in the preface to *Personal Knowledge*, Polanyi recalled that this work is part of a long process of philosophical reflection and research, begun in 1939 with a critical review of J. D. Bernal's book *The Social Functions of Science*. In his book, Bernal defends Dialectical Materialism as fundamental to the new structuring of scientific knowledge based on the Soviet model of production.

Polanyi was opposed to any kind of totalitarianism. The freedom for the scientist to develop his/her work was fundamental for the emergence of new knowledge. Our goal in this communication is to understand how this freedom is linked to the scientific practice. Is it a condition of possibility for scientific practice? Or more than that, is it in scientific practice itself? How would it be possible to organize the scientific community in function of the idea of self-regulation?

## OPEN EPISTEMOLOGIES AND THE CLIMATE CRISIS: GASTON BACHELARD AND MICHEL SERRES

David WEBB
*Staffordshire University*

Gaston Bachelard proposes an epistemological pluralism in which concepts and methods are specific to particular sciences and disciplines within sciences. There is much to be gained from this approach, which helps us to avoid what he regarded as empty philosophical speculation.

However, I will argue that Bachelard's open epistemology may be insufficient when faced with phenomena whose scale or form prevent the scientist from treating them 'as a whole'. Bachelard himself writes that we cannot treat the universe as an object because we cannot stand outside of it to determine its limits. His response to this challenge is, I will argue, satisfactory only as long as the aim is to establish an approximation to a closed system, and thereby to reproduce something like 'objectivity'. Turning to the work of Michel Serres, it becomes clear that this is increasingly no longer the case and that we therefore need to reconsider our approach to certain phenomena.

Serres identifies features of the contemporary world that present a distinctive challenge to science. Foremost among these is the climate, and in particular the climate crisis. It has been known for a long time that the climate is complex, and also that we are inescapably 'in' it. What Serres recognises is that we cannot treat the climate as an object – not only because it is difficult to treat as a closed system, but also because it is not passive as we think an object should be. More than ever, the climate acts on us; that is, it has become a subject. The complexity and immersivity of the climate present new challenges to knowledge.

Drawing on Serres' work I shall argue that epistemology needs to be 'open' in three ways. First, it must support the sciences in their attempt to 'hear the voice' of the world and not merely to describe it as if it were an inert object. Second, in order to do this effectively, it must promote communication between sciences, no one of which alone can address the complexity of the climate as a whole. Moreover, because the climate is now a social, ethical, and political phenomenon, this communication should include both the so-called hard sciences and the human sciences. Third, as an extension of the last point, an open epistemology needs to accept a political responsibility to speak on behalf of the natural world, whose interests cannot be separated from our own. The paper will consider the challenges presented by these three possible developments and the extent to which Serres' work may help us to meet them.

# COMMUNICATIONS

## GASTON BACHELARD ET LA QUESTION DE LA MÉTHODE

Fábio Ferreira de ALMEIDA
Universidade Federal de Goiás, Brasil

L'un des aspects les plus frappants de l'épistémologie bachelardienne réside sans nul doute dans la thèse selon laquelle le nouvel esprit scientifique est non-cartésien. Ce non-cartésianisme se caractérise avant tout par une transformation radicale affectant fondamentalement la méthode formulée par Descartes qui inaugure la modernité dans les sciences. À partir de la fin du XXème siècle, la Science s'efforce, pour parler de manière très succinte, de partir du complexe, pour cheminer, non pas vers le simple (ce qui reviendrait à une simple inversion de la perspective cartésienne) mais vers le plus complexe encore, dans un effort croissant de complexification. C'est ce qui constitue la dernière rupture dans l'histoire des sciences, la brèche par laquelle émerge le nouvel esprit scientifique.

Le but de cette communication est de mettre en évidence cet aspect précis de la pensée épistémologique de Gaston Bachelard afin de montrer que celui-là fournit les thèmes les plus marquants de l'épistémologie historique dont le philosophe est certainement le principal initiateur. Nous pouvons par exemple alléguer, parmi ces thèmes, la notion de progrès scientifique qui ne peut se comprendre indépendamment de la notion de discontinuité de l´histoire des sciences, mais aussi le rationalisme ouvert, qui, pour Bachelard est caractéristique de la pensée scientifique contemporaine, sans oublier le surrationalisme dont Bachelard, dans le célèbre article de 1936, dit qu'il "a promu la raison polémique au rang de raison constituante". Cette pertinence du non-cartésianisme, élaboré dès les premiers travaux, sera entérinée dans les oeuvres publiées aprés la période consacrée à l'étude des images de la matière: *Le rationalisme appliqué* (1949), *L'activité rationaliste de la physique contemporaine* (1951), et *Le matérialisme rationnel* (1953).

Enfin, et conformément au thème général du colloque, il nous sera possible, en mettant l'accent sur la question de la méthode dans la philosophie bachelardienne, d'établir les contributions, chez Bachelard, de la physique mais aussi de la philosophie de Ernst Mach, comme le montre certains de ses travaux les plus importants, et de mettre à jour de possibles convergences entre son épistémologie et la "théorie anarchiste de la connaissance", proposée par Paul Feyerabend dans son livre *Contre la méthode*.

## SCIENCE'S EPISTEMIC AUTHORITY ON SCIENCE TEACHING IN THE LIGHT OF THE PHILOSOPHER PAUL FEYERABEND

Bárbara Simões Barreto de ARAUJO
Universidade Federal do Recôncavo da Bahia

As is known, science enjoys a place of high prestige in our society. When we affirm that something is "scientifically proven," this becomes automatically free of some forms of criticism to some part of our society. Such prestige, according to the literature, is due to its innumerable "successes" in medicine and technology. For instance, provided by the scientific method, science seems to has given us a predictive and explanatory power, boosting that prestige (Irzik, 2001). In some sense science has occupied a place once occupied by the Church, even occupying the formal space of education and bringing an illuminating knowledge. Scientists hold the respect and trust of religious leaders (Feyerabend, 2011). However, in those spaces, we need to deal with tremendous cultural and epistemic diversity, which brings conflicts to that form of prestige and epistemic authority inside science teaching classrooms.

In the classroom, students may come from cultures other than scientific, which have their cosmology and that may sometimes clash with scientific knowledge. What we find in these formal educational environments is a limit on our power to reflect and choose about science without had first adopted science as our guide (Alves, 2003; Feyerabend, 2011). Thus, we aim to analyze and discuss, from a Feyerabendian viewpoint, the place that science occupies in classrooms conception of nature. Also, debate its influence over processes of critical development of students about the formation of our beliefs without ceasing to teach science in a qualitative fashion. As a result, it is expected to grasp how the epistemic authority of science can interfere in the construction of student critical thinking and relations with other epistemologies.

Alves, Rubem. (2003). *Filosofia da ciência:* introdução ao jogo e suas regras. São Paulo: Brasiliense.
Feyerabend, K. Paul. *Contra o Método.* 2ª Edição, Editora Unesp, 2011a.
Irzik, G. (2001). Universalism, Multiculturalism, and Science Education. *Science education*, v 85, I 1, p. 71-73

## THREE LIMITATIONS FOR ALGORITHMIC REASON

Paulo CASTRO
Centro de Filosofia das Ciências da Universidade de Lisboa

Following Marcuse claim that technology and science are ideological as a mean of men over Nature control and thus as mean of men over men control, I briefly emphasize the contemporary social empowering that algorithmic reason has provided to economical and political stances. Digital assessing techniques such as opinion mining and sentiment analysis, as well as permanent monitoring agencies for cybersecurity defense, define a surveillance capitalist society. The fact that our way of life has become so heavily depended on algorithmic procedures proceeds from an acritical trustfulness on the limitless powers of rational thought. However, such candid hardwired belief can be questioned before three observations concerning the nature of algorithmic thought.

The first one is that the Turing Test is undecidable with serious implications for the feasibility of a general theory about intelligence and thus for the feasibility of a general theory about rational agents. The second observation concerns the plausible impossibility of an universal algorithmic error correction machine, implying the contingency nature of algorithmic procedures, and possibly testifying for the absoluteness of human thought. Finally, the third observation is the hypothesis that every formal system always has inbuilt the conditions for its own inconsistency, which places algorithmic reason in a relativist ground. I conclude my presentation by open asking if the aforementioned limitations can have an impact for technology and science production, from epistemological and ethical points of view.

Castro P. 2017. Computing Machinery, Intelligence and Undecidability. Journal of Theoretical Computation Sci 4: 160.

Dieter Mersch: Digital Criticism. A Critique of "Algorithmic" Reason. (n.d.). Retrieved May 21, 2019, from http://www.diaphanes.de/titel/digital-criticism-5313

Marcuse, Herbert, One-Dimensional Man, Boston, 1964.

Parisi, Luciana (2015): Instrumental Reason, Algorithmic Capitalism, and the Incomputable. In: Matteo Pasquinelli (Hg.): Alleys of Your Mind. Augmented Intelligence and Its Traumas. Lüneburg: meson press, 125-137.

Petit, Marti, Towards a Critique of Algorithmic Reason. A State-of-the-Art Review of Artificial Intelligence, Its Influence on Politics and Its Regulation (April 16, 2018). Quaderns del CAC 44, vol. XXI - July 2018.

Zuboff, P. S. (2019). *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power*. S.l.: Profile Books.

## A CRITICAL STUDY OF MACH'S FOUNDATION OF MECHANICS

Ricardo LOPES COELHO
Departamento de História e Filosofia das Ciências
Faculdade de Ciências da Universidade de Lisboa;
Centro Interuniversitário de História das Ciências e da Tecnologia

Mechanics was the foundation of physics in the 19th century. Its own foundation was, however, problematic. Mach proposed a new foundation of mechanics. As we shall see, the cause of acceleration is no longer the force, which was the great problem at that time, but rather the mass. The definition of force, which is a reading of the equation of force, did not solve, however, the conceptual problem. If we want to know what force is and we require that force is $F$ in the equation $F=ma$, then we have to analyze $F$ and not define it through the other side of the equation, as it has been done. This analysis enables us to conclude that force stems from a mathematical manipulation; it is not something that we can find in nature. This conclusion, in turn, enables us to understand those authors who looked for force in nature and did not find it, as well as those who said that force is a mathematical fiction, a mere human concept, etc.

## "THE SHEER JOY OF CONTRADICTION": FEYERABEND'S CRITICAL HEDONISM

Matteo COLLODEL
Liceo Flaminio, Vittorio Veneto

Attempts at a comprehensive understanding of Feyerabend's epistemology cannot help noting the radically critical factor which seems inherent in most of his philosophical work. Indeed, throughout the 1950s and 1960s, Feyerabend insistently targeted the most popular currents in the philosophy of science, such as Carnap's logical empiricism as well as, though less dramatically so, Popper's critical rationalism and Kuhn's historicist position. In addition, from the late 1970s onwards, the entire methodological tradition that supported modernity's belief in the primacy of science came under Feyerabend's polemical scrutiny, earning him the reputation of an anti-scientific thinker. Some may see Feyerabend's sophisticated critical moves simply as the product of a brilliant contrarian personality or as the expression of an opportunistic but ultimately destructive or idle form of skepticism. More insightful commentators, however, have emphasized the close connection between Feyerabend's critical approach and his defense of pluralism, singling out the latter as the gist of his philosophical contribution. The aim of this paper is to highlight the ethical and political underpinning of Feyerabend's stance in order to appreciate the extent to which it should be considered a form of open epistemology.

In the second half of the 1960s, a crucial period of transition that would lead him from theoretical to epistemological pluralism, Feyerabend made explicit the ideals that were driving his methodological research and outlined his favorite "form of life". Such ideals, which were meant to provide "coherence and direction" and, accordingly, "proper justification for procedures in every domain", including science, focused on "the happiness and the full development of an individual human being" as "the highest possible value". Labelled "hedonism" after Popper's critical reception, Feyerabend's stance was designed to promote diversity through the cultivation of individual human beings' natural inclinations and capabilities and, vice versa, to rule out their condemnation, regimentation, or elimination based on traditionally entrenched or otherwise dogmatically imposed positions. Within the utopian "free society" envisioned by Feyerabend – a variant of Popper's "open society" – progress towards higher levels of individual human happiness is fueled by contradictions: the dialectic, tolerant and nonviolent, exchange of mutual criticisms. The basic principles of Feyerabend's methodological proposal of a theoretical pluralism for the scientific community, proliferation and tenacity, entailing the broadest open-mindedness with respect to any ides, however eccentric or idiosyncratic, coupled with an equal openness to criticism, were thus extrapolated to shape human society at large.

## THE "SCIENTIFIC" PREDICATE, A SOCIO-POLITICAL STATUS OR AN EPISTEMIC ASSESSMENT?

Stéphanie DEBRAY
Nancy, AHP-PReST, University of Lorraine.
AHP-PReST-Archives Henri Poincaré

What do we say when we affirm that a theory, a discipline or a decision is scientific? When we use the scientific predicate, do we learn something about the epistemic nature of the object we are describing, or do we just say something about its social and political status? If using the scientific predicate leads to a properly epistemic observation, the demarcation question is the responsibility of the philosopher. If the scientific predicate is only the mark of a social decision, then it is no longer within the domain of philosophy (Laudan, 1983). Nevertheless, if we adopt a value-laden ideal (Douglas, 2009), Laudan's argument is no longer relevant. The demarcation problem reappears.

The chief aims of this study are: i) to discern which values are involved in the demarcation question, ii) to determine who is best suited to deal with the demarcation problem, iii) to refine our understanding of the distinction between real science and pseudoscience. To do so, we will: 1° use Heather Douglas's contributions to philosophy of science so as to reply to Laudan, 2° improve in several ways the Topology of Values in Science proposed by Douglas (2009) in order to offer a better understanding of unacceptable practices (politicized science, fraud-science, junk-science, pseudoscience, badscience) and to identify more precisely steps of the research process during which it is appropriate to pay attention to non-academic discourses. Constructed knowledge does not necessarily hurt objectivity in science, but the distinction "epistemic values / non-epistemic values" seems not accurate enough to reveal it.

Douglas, H.E. (2009). Science, policy, and the value-free ideal. Pittsburgh: University of Pittsburgh Press.

Laudan, L. (1983). The Demise of the Demarcation Problem, Physics, Philosophy and Psychoanalysis, 111-127.

# DES EPISTEMOLOGIES AUX ONTOLOGIES OUVERTES : LE « TOURNANT PRATIQUE » D'ISABELLE STENGERS ET L'*ENQUETE SUR LES MODES D'EXISTENCE* DE BRUNO LATOUR

Nicolas DELFORGE
Université de Strasbourg, Université de Lorraine, CNRS, AHP-PReST UMR 7117

Dans son livre *La Vierge et le Neutrino*, Isabelle Stengers a donné sa propre interprétation du « tournant pratique » (*Practice Turn*). En s'inscrivant à la fois en continuité et en rupture avec la philosophie pragmatiste de John Dewey, elle a affirmé la nécessité de penser une « écologie des pratiques » au sein de laquelle chaque pratique − dont la pratique scientifique − pourrait se voir singularisée, étudiée et reconnue à partir de la chose/cause qui la meut. Dans cette perspective, le praticien ne se caractérise plus à partir d'une créativité liminaire présente chez tous les humains (comme chez Dewey) mais en fonction de *ce* qui oblige chaque praticien de façon toujours spécifique. Dans ce mouvement, l'étude des pratiques et de leurs savoirs associés devient une enquête *ontologique* puisqu'il s'agit de rendre compte de la création − ou de l'instauration − d'*êtres* divers (faits scientifiques, artefacts techniques, êtres religieux, concepts).

Chaque pratique détient une ontologie et une normativité qui lui sont propres ; de ce fait, la pratique scientifique ne peut plus prétendre à imposer son modèle de façon hégémonique. Chez Stengers, le terme d'écologie désigne d'abord cette préservation de la pluralité et de la singularité des pratiques. Le projet d'une *Enquête sur les modes d'existence* de Latour comporte bien des affinités avec le travail de Stengers. En proposant une série de quinze valeurs (une notion à entendre de façon ontologique) auxquelles tiendraient les Modernes, il cherche lui aussi à ouvrir un espace au sein duquel chacune d'entre elle pourrait se retrouver reconnue et protégée dans l'institution qui lui convient. Je comparerai ces deux projets en explorant notamment la référence au tournant pratique et aux épistémologies ouvertes des années 1960.

Schatzki, T.R., Knorr Cetina, K., Von Savigny, E. (éd.), *The Practice Turn in Contemporary Theory*, Londres, Routledge, 2001.

Stengers, Isabelle, *La Vierge et le neutrino. Les scientifiques dans la tourmente,* Paris, Les empêcheurs de penser en rond / Le seuil, 2006.

Stengers, I., Latour, B., « Le sphinx de l'œuvre », *in* Souriau, E., *Les différents modes d'existence*, suivi de *De l'oeuvre à faire*, Paris, PUF, 2009, pp. 1-75.

Latour, B., *Enquête sur les modes d'existence. Une anthropologie des Modernes*, Paris, La Découverte, 2012.

## HOW OPEN IS BACHELARD'S EPISTEMOLOGY? RATIONALISM A POSTERIORI

Lucie FABRY
École Normale Supérieure, Paris, France

Jean-Claude Passeron (1991) praised Bachelard's requirement to study science a posteriori, and opposed his descriptive epistemology to traditional philosophy of science, which would judge scientific practices according to a preconception on what science is. He insisted, however, that this descriptive attitude did not prevent the search for normative criteria of scientificity, with a focus on what distinguishes science from non- and pre-scientific activities. Passeron, therefore, defined the practice of epistemology that Bachelard inaugurated by a specific combination of descriptive and normative considerations. Following Passeron's suggestion, I will interrogate Bachelard's specific use of philosophical concepts in the study of the historicity and diversity of scientific practices. I will show that his "rationalist commitment" (Bachelard 1972) manifests itself by a specific way of conceiving of such historicity and diversity.

First, I will study how Bachelard draws upon the history of science to support a rationalist interpretation of the conditions for scientific progress. I will consider, in that respect, along with Bachelard's insistence on the break with common knowledge, the use he made of the notions of dialectics and approximation.

I will then question Bachelard's way of acknowledging the synchronic diversity of scientific practices, with his concept of regional rationalisms. Focusing on the example of the relation between chemistry, physics and biology (Bachelard 1953), I will specify the kind of scientific diversity which was deemed compatible with the use of a unifying set of rationalist concepts to apprehend scientific spirit as a whole.

I will finally question Bachelard's position by taking a glance at the reception of his work, sketching an opposition between authors like Michel Serres and Bruno Latour, who assimilate Bachelard with a closed epistemology, bending the study of scientific practices into the shape of a universal reason, and writers like Jean-Claude Passeron, who claims that Bachelard offered a model for an open epistemology, that could be further opened when one seeks to apprehend the specificity of social sciences. Such controversy around Bachelard's work will reflect the paradoxical character of his attempt to elaborate an open rationalism (Bachelard 1940).

Bachelard, Gaston. 1940. La philosophie du non: essai d'une philosophie du nouvel esprit scientifique. Paris: Presses universitaires de France.
———. 1953. Le matérialisme rationnel. Paris: Presses universitaires de France.
———. 1972. L'engagement rationaliste. Bibliothèque de philosophie contemporaine. Paris: Presses universitaires de France.
Passeron, Jean-Claude. 1991. Le raisonnement sociologique: l'espace non-poppérien du raisonnement naturel. Paris, France: Nathan.

## FEAR OF "ANYTHING GOES"? WHY THE SEPARATION OF PLURALISM AND RELATIVISM DOESN'T WORK FROM A PERSPECTIVE OF EPISTEMIC PRACTICE

Mark FISCHER
Ruprecht-Karls-University of Heidelberg, Seminar of Philosophy

This paper compares two recent positions of either scientific pluralism or relativism separated from standard arguments of scientific realism: Hasok Chang's "active scientific realism" (Chang 2012, pp. 215–218) or "realism for realistic people" (Chang 2018, p. 176) which endorses normative, nonreductive pluralism based on some form of epistemic 'realism' and Martin Kusch's (2017a, 2017b, 2015) descriptive relativism which is at least not rejecting scientific monism as a natural practice of epistemic communities. From my point of view, both authors try to defeat the common counterarguments against one the best-known relativist scarecrow in the philosophy of science: Paul Feyerabend's and his radical approach of "anything goes" (2010 [1975], p. 12).

Therefore, Chang distinguishes his form of pluralism from relativism by a distinguished concept of 'truth' dependent on plural but as well successful scientific practices. Kusch argues for a socially accepted 'objectivity' by his relativism which at least accepts a tendency to monism in epistemic communities as a matter of necessity of actual practice. Nevertheless, I assume that both attempts must face serious challenges. Hasok Chang must tell if his nonreductive pluralism can hold on realist concepts as 'truth' and 'realism' at all. Martin Kusch must first deal with the questions about hidden normativity of SPR and then it must be explained why SPR makes any difference to monist realism in epistemic practice.

I argue that these theoretical difficulties can't be sufficiently solved if the separation of pluralism and relativism is a dogma of argumentation. From my point of view, relativism without pluralism appears to be 'sterile' and pluralism without relativism is somewhat 'hollow'. Instead, I'm convinced that there is better solution by endorsing a modest form of joint relativism and pluralism which wouldn't have to deal with these questions but doesn't mean syncretism either. This position is based on pluralist-relativism inspired by the work of Nelson Goodman (1995a [1978]) as well as adjustments of moderation to Paul Feyerabend's (2010 [1975]) theories.

Chang, Hasok: (2012): Is Water H2O? Evidence realism and pluralism. Dordrecht, Heidelberg: Springer (Boston Studies in the Philosophy of Science, Vol. 293).

Chang, Hasok (2018): Is Pluralism Compatible With Scientific Realism? In Juha Saatsi (Ed.): The Routledge Handbook of Scientific Realism. Abingdon: Routledge, pp. 176–186.

Feyerabend, Paul (2010 [1975]): Against method. 4. ed., new ed. London: Verso.

Goodman, Nelson (1995 [1978]): Ways of worldmaking. 7. print. Indianapolis, Ind.: Hackett

Kusch, Martin: (2015): Scientific pluralism and the Chemical Revolution. In *Studies in History and Philosophy of Science Part A* 49 (Supplement C), pp. 69–79. DOI: 10.1016/j.shpsa.2014.10.001.

Kusch, Martin (2017a): Epistemic Relativism and Pluralism. In Annalisa Coliva, Nikolaj Jang Lee Linding Pedersen (Eds.): Epistemic Pluralism. Cham: Palgrave Macmillan US (Palgrave Innovations in Philosophy Ser), pp. 203–228.

Kusch, Martin (2017b): Epistemic relativism, scepticism, pluralism. In Synthese 194 (12), pp. 4687–4703. DOI: 10.1007/s11229-016-1041-0

## UNE ANTHROPOGÉNÈSE DE LA PHILOSOPHIE DES SCIENCES ?

Nasser Michaëlen GABRYEL
Enseignant chercheur à l'ICP ISTR

La méthode scientifique est conçue comme un modèle normative, immuable et universel avec des critères internes de légitimité (faits, correspondance, cohérence, démonstration) et externe (instituions, sociétés savantes et professionnelles). En effet, la philosophie de la science légitime la méthode de la science en tant qu'espace autonome, rationnel et axiologiquement neutre: elle suppose une approche délimité entre théorie et expérience, recherche théorique et application pratique. La contestation dans les années 1960 vise à contester ce « paradigme » méthodologique, les observations normatives, les correspondances, les interprétations linéaires: en effet il n'existe pas une seule méthode mais différentes façons de construire le savoir. Ces différentes façons déterminent des paradigmes interprétatifs (Thomas Kuhn). Pour Paul Feyerabend il n'existe pas d'histoire canonique des sciences et toute philosophie des sciences doit plaider pour une approche circulaire et non linéaire qui accepte la non correspondance entre faits et théories.

Une anthropogénèse suppose une non délimitation entre champs de recherche et une conception intégrative des philosophies. Il s'agit d'admettre les conditions de possibilité d'un cadre de dialogue entre plusieurs champs de la philosophie, La relation avec les philosophies du langage seraient aussi un élément de condition de possibilité d'une norme pluridisciplinaire.

La philosophie des sciences ne doit-elle pas se situer dans une anthropogénèse des sciences, un cadre pluri référentiel des sciences (humaines, sociales, physiques, biologiques, etc) ? Avec trois dimensions : Une dogmatique qui établit un espace éternitaire de savoirs légitime inscrit in abstracto dans les normes d'une cosmologie des sciences humaines et sociales ; Une approche historiciste qui institue une relativisation explicite qui s'apparente souvent à une déconstruction des savoirs en autant d'interrogations épistémologiques; Enfin une lecture dynamique : une anthropogénèse qui vise à rendre compte de la complexité des savoirs en tant que processus dynamique d'une part et en tant que fait social, politique et symbolique d'autre part. Cela induit de poser comme conception principale la nécessaire complémentarité des sciences humaines (Sciences humaines, sciences sociales, sociales) avec les sciences dites empiriques (mathématique, biologie, physique).

BOURDIEU Pierre "Science de la science et réfléxivité" Agone 2001
BOURDIEU Pierre "Méditation pascalienne" Le Seuil 2001
MENDELSOHN, E and ELKANA, Y [eds] Sciences and Cultures Sociology of the Sciences Yearbook, Vol. 5. Dordrecht and Boston, Mass.: Reidel. 1981

## PLAYING WITH, OR HACKING "NOISE"? PROBING *DIAGONAL* APPROACHES TO "*OPEN" AI*

Alexander GERNER
Centro de Filosofia das Ciências, Departamento de História e Filosofia das Ciências, Faculdade de Ciências, Universidade de Lisboa, 1749-016 Lisboa, Portugal

Taking basic concepts of Roger Caillois into account- as for example "play" and "diagonal science" this paper will explore an interdisciplinary approach towards "open" AI in rethinking paradoxes of *noise* as epistemic concept, metaphor and *play*. Adding noise in a deliberate manner to the parameters of policies might make an agent's exploration consistent across different timesteps. Even adding noise to action space might lead to unpredictable explorations which isn't correlated to anything unique to the preprogrammed parameters of an "agent". On the other hand Malaspina´s *An Epistemology of Noise* (2018) insists that "noise" necessarily provides for unpredictability inherent in information that innovates the state of given knowledge. Moreover, self-playing machines as for example, *parameter noise* might help algorithms explore their environments more effectively, and lead to higher scores and more elegant behaviors that will be probed as possibilities in how to re-orient the relation of order and noise in diagonal open AI. Algorithmic Self-play and human forms of play (Callois) will be put into diagonal paradoxes within the idea of *openness* but as well contrasted with *alterity* in epistemic praxis that can be called *diagonal hacking*. Hacking hereby is derived from Peter Samson (1958) as inventive activity that re-virtualizes actual technical objects for reuse close to the *edge of surrealism*: What happens when AI/machine learning programs have to handle "noise" or are affected by "silence" (John Cage)?

## EINSTEIN VERSUS BOHR — OPEN VERSUS CLOSED EPISTEMOLOGIES?

Ravi GOMATAM
Institute of Semantic Information Sciences and Technology, Mumbai

Epistemology is a first-person perspective, rooted in our use of ordinary language (OL) to describe our outer experiences. The premise of this paper is that OL has different, complementary ranges that can describe the same observation from different epistemological perspectives. To the extent physics allows a choice of OL, physics allows for open epistemologies. I shall argue that the famous Bohr-Einstein debate is better understood from this perspective.

Both Einstein and Bohr agreed that there are real quantum particles and that quantum mechanics (QM) yields correct statistical predictions about the observable behavior of ensembles, but not about the individual particle. They also recognized that an alternative way of looking at the *observations* is needed to get at the physical reality underlying QM. But they differed over whether such a new way is possible.

> Bohr: Only by experience itself do we come to recognize those laws… [about] phenomena. We must always be prepared to expect alterations in the points of view best suited for the ordering of our experience… [However] as a matter of course, all new experience makes its appearance *within the frame of our customary points of view and forms of perception.* [1934, p.1, italics added]
>
> Einstein: "Our present way of applying the causal principle is quite superficial…we are like a juvenile learner at the piano, just relating one note to that which immediately precedes or follows… scientists will arise who will have a much keener perception than the scientists of today… [Such] scientists trained in the laboratory will be able eventually to perceive the profound and manifold operation of causation in nature." [1931, p. 203, 220]

In other words, it is the possibility for new forms of perception and thereby open epistemologies embedded in OL that Bohr denied, and Einstein embraced. I shall analyze the dual role of OL in physical theory, to describe data and sustain scientific realism by analogy. I then introduce the idea of tandem realism — as theory progresses in physics, OL is also required to creatively evolve in tandem — and read the Einstein-Bohr debate in its light. Einstein turns out to be the more radical.

Bohr, Niels (1934), *Atomic Theory and Description of Nature*. New York: MacMillan
Planck, M. (1931), *Where is Science Going?* New York: Norton

## A PHILOSOPHY OF HEAP. ON MACH'S HISTORICAL EPISTEMOLOGY

Luca GUZZARDI
Università degli Studi di Milano

Mach's theory of the elements has been often qualified as "neutral monism" (e.g. by Popper in Objective Knowledge and Realism and the Aim of Science, and more recently by Erik Banks), signifying the world being formed out of a single species of stuff: a plurality of elements, which are neutral insofar as they are, by themselves, neither mental nor physical. Usual accounts of Mach's sui generis neutral monism discuss at length the ontological status of this kind of objects, mostly exploring some solutions to the mind-body problem that this perspective may suggest.

In this paper I emphasize an aspect that is largely ignored in such discussions – not that the elements are neutral but, first of all, that they are conceived as a plurality of objects of equal status (a heap, in Hume's terms), shaping coherent and relatively stable compounds – the bodies, the I… – because of certain physico-physiological mechanisms. This makes possible to analyze (i.e., to de-compose or de-construct) any complex phenomenon into more simple components, thus observing how it has been originated as well as the conditions of its next dissolution.

I contend that there is more than a parallel here with Mach's approach to the history of the sciences: When applied to the analysis of perceptual experience, this pluralistic-morphogenetic view gives rise to his neutral monism and to phrases such as "Das Ich ist unrettbar". When applied to the analysis of knowledge, it brings into being an epistemology which is naturaliter historical, since it is grounded on the idea that scientific concepts, theories and practices are relatively stable complexes that historians can try to "analyze" into more basic components. Finally, I claim that a "plural" historical epistemology of this kind is also naturaliter an open epistemology, since it tends to emphasize the plausibility of multiple and possibly counterfactual reconstructions of scientific concepts, theories and practices – a point that Mach already stressed in the introduction to The History and Root of the Principle of the Conservation of Work (1872), by stating that "science is unfinished and variable."

# CORRATIONALISME ET DENKCOLLECTIV : LA DIMENSION SOCIALE DE L'EPISTEMOLOGIE HISTORIQUE ENTRE BACHELARD ET FLECK

Gerardo IENNA
Università di Verona

La spécifié de la tradition dite de « l'épistémologie historique» est celle d'avoir construit une théorie de la connaissance sur la base d'une prise de conscience de crise de la raison scientifique. Cette crise amène à reconnaître une fragmentation du savoir scientifique tant du point de vue historique (i.e. le débat entre *continuisme/discontinuisme*) que du point de vue du *Régionalisme épistémologique* que représente la dimension plurielle des critères épistémologiques caractérisant les sciences (i.e. unité/désunité des sciences). A côté de ces aspects bien connu dans les débats dédiés à cette tradition, il a souvent été sous-estimé le rôle joué par *dimension sociale de l'épistémologie historique*.

Avec cette intervention je me propose de reconstruire la façon dans laquelle Bachelard et Fleck —deux parmi les plus représentatives auteurs des années '30— ont pu construire leurs épistémologies et leur méthodologie en histoire des sciences à partir d'une analyse de la façon collective de construire par laquelle le savoir scientifique se constitue. J'ai choisi ces deux auteurs parce que, tout le deux, ont développé un modèle épistémologique que, tout en reconnaissant la dimension historique et sociale (en bref située) de la connaissance scientifique, ils n'ont pas succombé aux sirènes du relativisme.

De son côté Bachelard a développé dans le *Rationalisme Appliqué* une théorie du *Corrationalisme* entendu comme «l'union des travailleurs de la preuve» qui composent «la cité scientifique». Dans ce contexte il travaille à la formation d'une épistémologie *non-cartésienne* visant à passer de la subjective dimension du *cogito* à celle intersubjective du *Cogitamus*. De l'autre côté, Ludwik Fleck dans *Genèse et développement d'un fait scientifique* développe la célèbre théorie du *Denkstil* [*style de pensé*]. Cependant ce concept n'est indépendant de celui de *Denkcollectiv* [*collectif de pensée*] donnant à la constitution du *style* une dimension sociale. Également il décrive aussi la science comme composé par des cercles *ésotériques* et cercles *exotériques* qui structurent la communauté scientifique et les dynamiques de circulation du savoir dans cette dernière. Pour terminer je vais faire quelque référence à la sociologie historique des sciences sur le modèle développé par Pierre Bourdieu —bien marqué par l'influence de l'épistémologie bachelardienne— qui me semble parmi les modèles contemporains parmi ceux qu'ont développé cette façon d'enquêter la raison scientifique.

L'analyse de cette tradition permet aujourd'hui de se dégager du relativisme caractérisant la tradition des *Science and Technology Studies* du « turn to practice » sans pour ça devoir renoncer à une analyse locale des façons par lesquelles le savoir scientifique est le résultat d'un complexe ouvre de négociation sociale. Tout de même, en utilisant les méthodes développés par Bachelard et Fleck on peut se dégager aussi de la sociologie mertonienne —que vise principalement à une « sociologie externaliste des institutions scientifique»— nous permettant de rentrer dans l'analyse des contenus de la connaissance.

# MANIPULATING TIME AND SPACE THROUGH SERIAL PHOTOGRAPHY AT THE TURN OF THE NINETEENTH CENTURY: ERNST AND LUDWIG MACH'S IDEAS AND EXPERIMENTS

Maria Estela JARDIM, Nádia Vera JARDIM
CFCUL, CQE, University of Lisbon

In 1887, Ernst Mach(1838-1916) and Peter Salcher(1848-1928), published an article where they presented photographs of a bullet moving at a speed higher than that of sound waves , depicting the disturbances caused by the projectile in the surrounding atmosphere, using electric sparks as a light source (Mach,1887). This work caused great impact because of the remarkable results of the experiment (Hoffmann & Métraux, 2016). Electric sparks were later used in early twentieth century by Lucien Bull (1876-1972) in high-speed cinematography in Paris (Bull,1904). Bull was an assistant of Etienne-Jules Marey (1830-1904), the leading French physiologist of the time, whose original researches on motion using chronophotography, were acknowledged by Mach. One year after Mach did the experiment on projectiles, he published an article on the scientific application of photography (Mach, 1888), where he argues that "*all scientific knowledge proceeds from sense perception*" and considered photography as a tool for "*temporal expansion*" or for "*temporal diminution*" as means that enhanced and expanded sensual perception.

These ideas were followed by his son Ludwig Mach (1868-1951) who describes an experience "*on the principle of the temporal diminution in serial photography*" using this technique to demonstrate that principle for a rapidly growing plant during a certain period, concluding that these type of experiments would be useful for "*special biological investigations, and photography would again win a new place among the tools that promote scientific knowledge*" (Mach, 1893). This idea would be later tested using time-lapse microcinematography by the biologist Julies Ries, among others, when studying the embryonic development of the sea urchin (Ries,1909).

In this paper we will examine the potential of serial photography as well as emergent cinematographic techniques at the turn of the nineteenth century and the role both E. Mach and L. Mach played in this scientific development.

Bull, L. (1904). Application de l'étincelle électrique à la chronophotographie des mouvements rapides, *Comptes Rendus de l'Academie des sciences*,138:755–757.

Mach, E., Salcher P. (1887). Photographische Fixirung der durch Projectile in der Luft eingeleiteten Vorgänge. *Sitzungsberichte der mathematischnaturwissenschaftlichen Klasse der Kaiserlichen Akademie der Wissenschaften [Vienna]*, Part II, 95:764–780.

Mach, E. (1888). Bemerkungen über wissenschaftliche Anwendungen der Photographie. *Jahrbuch für Photographie und Reproductionstechnik*, 2:284–286.

Mach, L. (1893). Ueber das Princip der Zeitverkurzung in der Serienphotographie. *Photographische Rundschau,*7: 121–128.

Hoffmann, C., Métraux, A. (2016). Working with instruments: Ernest Mach as material epistemologist, a short introduction. *Science in Context*, 29(4): 429-433.

Ries, J. (1909). Kinematographie der Befruchtung und Zellteilung. *Archiv fur MikroskopisheAnatomie*,74:1-29

## FEYERABEND'S *MALLEUS MALEFICARUM*

Reinhard KAHLE
*Theorie und Geschichte der Wissenschaften, Universität Tübingen & CMA, FCT, Universidade Nova de Lisboa*

The 15th century book *Malleus Maleficarum* (Hammer of Witches) is one of the most infamous books of western culture, providing a justification of witch-hunting incompatible with the slightest modern standard of human rights. Thus, some people are astonished to find Paul Feyerabend apparently defending this book as highly scientific. In this talk we will give a reading of Feyerabend´s evaluation of the book as a *modus tollens* argument: if you believe in scientific standards, you have to accept the *Malleus Maleficarum* as a "good book". As it is, obviously, not a "good book", you better abandon scientific standards. In this perspective (which is, to our knowledge, not given by Feyerabend himself), his evaluation of the *Malleus Maleficarum* is just another support for his contempt of scientific method(s). There is, however, another twist in our rending of the argument: in the first part "good book" could only be understood as "good" in terms of the – doubtful – scientific standards. In the second part, it will be our ethical standards dismissing the *Malleus Maleficarum* as "good book". Feyerabend has stressed that "anything goes" would only be the reaction of a (naïve) rationalist to history of science. Ethical standards, which does not make part of the rationalist´s toolbox and which force us to dismiss the *Malleus Maleficarum*, are exactly the type of side conditions which prevent Feyerabend to subscribe for himself any "anything goes"; even more, they are conditions which should go ahead of purely "rational" guidelines in philosophy of science.

## OPEN REALISM: A NEO-FEYERABENDIAN ALTERNATIVE TO MONISTIC REALISMS

Rory D. KENT
Department of History and Philosophy of Science, University of Cambridge

An important and ongoing debate in the philosophy of physics (and in the philosophy of science more broadly) concerns the underdetermination of metaphysics by physics, or metaphysical underdetermination. Our metaphysical commitments, i.e. those about the nature of reality, are not fully determined by our best physical theories. A paradigm case is presented by quantum mechanics and its numerous metaphysical interpretations: standard quantum theory does not by itself tell us how we should view the nature of reality. For example, quantum mechanics does not tell us whether we should view the wavefunction as a fundamental ontological entity, or simply as a convenient representational device for tracking experimental outcomes. For scientific realists, this poses a serious problem: what—if anything—in our best physical theories should we be realist about, if the theories themselves are silent on what is real and what is not?

In this essay, I argue that metaphysical underdetermination is not a problem when we take a neo-Feyerabendian attitude to the growth of scientific knowledge. Paul Feyerabend argued for theoretical pluralism with his Principle of Proliferation; according to the Principle we ought to 'proliferate' incompatible theoretical alternatives to any given view, so that we can draw on the plurality of views when interpreting the world. Hence, for Feyerabend, metaphysical underdetermination is not a problem; rather, it is a precondition for scientific progress. By reconstructing two of Feyerabend's arguments in favour of proliferation, I argue that a neo-Feyerabendian attitude motivates a new form of scientific realism—open realism—which presents the scientific realist with a genuine alternative to methodologically 'monistic' realisms, i.e. those that aim for convergence on a single picture of reality. Further, I argue that open realism is ultimately preferable to at least two of its monistic competitors: James Ladyman's ontic structural realism and Alyssa Ney's neo-positivist metaphysics.

Peter Lewis, Quantum Ontology: A Guide to the Metaphysics of Quantum Mechanics (Oxford: Oxford University Press, 2016): 50-71.

Paul K. Feyerabend, Realism, Rationalism & Scientific Method: Philosophical Papers Volume 1 (Cambridge: Cambridge University Press, 1981), 105.

James Ladyman and Don Ross, Every Thing Must Go: Metaphysics Naturalized (Oxford: Oxford University Press, 2007); Alyssa Ney, "Neo-Positivist Metaphysics," Philosophical Studies 160, no. 1 (August 2012): 53-78.

## OPEN EPISTEMOLOGY FOR THE PARADIGMATICALLY HUMAN FORMS OF EXPERIENCE

Krzysztof KORŻYK
Jesuit University Ignatianum
Krakow, Poland

Many of the paradigmatically human forms of experience are not accepted in communities with a distinctive system of values and a low level of tolerance. A special position among these experiences is occupied by those that result in a distortion of the subject's perception of the relationship with the world, with oneself and with others, and oftentimes involve a crisis of identity and communication disorders. Some specialists consider such phenomena as manifestations of a "mental disorder" requiring psychiatric attention, but representatives of existentially or phenomenologically oriented psychology and (anti)psychiatry interpret such symptoms as a signs of mental health and a testimony to intellectual, emotional and spiritual growth.

It is also often pointed out that one of the main tasks of psychiatry is to classify and balance goals and values – which are not infrequently mutually contradictory – as well as the means by which these values and goals could be best implemented, harmonized or disregarded. In practice, however, both the causes of "mental disorders" and the means of alleviating them are sought not in the sphere of interpersonal interactions and social relations, where these values usually clash with each other, but in medical procedures, allegedly free from inaccuracies related to resolving ethical or moral issues. Still, physicians and therapists interpreting these phenomena – in spite of their often declared impartiality – are not independent in their assessments from commitments to their values and standards – medical, methodological, psychosocial, ethical, legal etc.

Moreover, the specific tension between the experimental nature of medical sciences, whose research is to serve the general public, and the practical need of proven, effective therapeutic procedures, requires both an epistemology sensitive to diversity of forms of border experience and the awareness that methodological standards of resolving, what really are those mental phenomena, are entangled in the collective styles of thinking and interpretation.

Concurrently, referring to the proposals of exponents of open epistemology (P.K. Feyerabend, L. Laudan, L. Wittgenstein) and engaged epistemology (R.G.T. Gipps, B. Fulford, J.H. Jenkins), particularly well suited for shaping research practice in disciplines dealing with paradigmatically human forms of experience, I will examine the possibility of applying elements of these methodologies to unbiased and reliable interpretation of such phenomena and try to propose strategies for determining which elements of explanations regarding idiosyncratic psychic phenomena are statements about facts, and which are only *ad hoc* interpretations.

# ENCORE UN EFFORT POUR ETRE PLEINEMENT RATIONALISTE : L'HERITAGE BACHELARDIEN DE JEAN-CLAUDE PASSERON

Philippe LACOUR
Université de Brasilia (Brésil) /Collège International de Philosophie (France)

Dans les années 60, nombreux sont les philosophes qui se sont risqués à étendre l'épistémologie de Bachelard aux sciences humaines : Gilles-Gaston Granger, Jean-Claude Pariente, Jean-Claude Passeron, Chamboredon, Bourdieu, par exemple –tandis que d'autres exploraient des voies alternatives (Michel Foucault, Gilbert Simondon). J'aimerais ici souligner la fécondité du parcours de Jean-Claude Passeron, considéré dans son ensemble, dans sa recherche obstinée d'une épistémologie qui rende pleinement justice aux sciences sociales et à leurs gestes spécifiques de connaissance, au risque d'une nécessaire redéfinition de la rationalité, qui ne va pas sans polémique.

D'une part, par son attitude à la fois rationnelle et libérale, Passeron se rattache à l'esprit scientifique bachelardien, décrivant, par-delà des méthodologies particulières, une disposition mentale inventive, donc une épistémologie plus ouverte et propice aux comparaisons entre disciplines. Ainsi bien souscrit-il à une définition large de l'esprit scientifique, conçu comme disponibilité active au renouvellement des langages de l'abstraction. Et c'est de cette même libéralité du rationalisme appliqué qu'il se réclame pour souligner la dimension scientifique du raisonnement sociologique, en dépit de sa mixité (va-et-vient argumentatif entre raisonnement statistique et contextualisation historique), en arguant qu'une « science située à mi-chemin entre deux démarches scientifiques n'est pas une science située à mi-chemin de la science ». C'est d'ailleurs par « esprit scientifique » que le raisonnement sociologique vise le contrôle et la « vigilance méthodologique », ce qui le différencie d'avec les raisonnements de sens commun, qui sont eux aussi naturels.

D'autre part, je montrerai que Passeron a tenté d'assouplir la rationalité bachelardienne en l'ouvrant à un jugement diagnostic interprétatif sur les singularités (individus, mais aussi événements ou situations historiques). Il a en outre essayé d'expliquer que cette connaissance originale n'est ni complètement objectivable (par modélisation formelle), ni totalement théorisable (de façon fixe et rigide), mais, fondamentalement casuistique – tel est le sens profond du « raisonnement naturel ».

Bachelard Gaston, *Le nouvel esprit scientifique*, Paris, PUF, 1934.
__, *Le rationalisme appliqué*, Paris, PUF, 1949.
__, *L'engagement rationaliste*, Paris, PUF, 1972.
Lacour Philippe, *La nostalgie de l'individuel. Essai sur le rationalisme pratique de G.G. Granger*, Paris, Vrin, 2012
__, *La raison au singulier. Réflexions sur l'épistémologie de Jean-Claude Passeron*, Paris, Presses Universitaires de Nanterre, 2019 (à paraître).
Passeron Jean-Claude, *Le raisonnement sociologique*, Paris, Albin Michel, 2006.

# L'A PEU PRES PHENOMENOLOGIQUE ET LES TECHNIQUES D'APPROXIMATION STATISTIQUE. Du concept de « connaissance approchée » entre Husserl et Bachelard.

Carlos LOBO
Collège International de Philosophie, Paris

Dans la conclusion de son essai de 1921, Bachelard conclut sur un programme d'une phénoménologie profonde qui n'a pas retenu toute l'attention qu'il mérite et met en perspective la phénoménotechnique. S'en tenir à « la superficie du phénomène », c'est en effet ne pas tenir compte de la *subjectivité à l'œuvre*, faire « *comme si la référence même n'était pas frappée de subjectivité* » [1]. A la suite de Weyl auquel il se réfère [2], Bachelard condamne par exemple une phénoménologie pressée de déterminer l'essence de l'espace sur la base d'une simple intuition exemplaire. *A contrario*, il promeut une phénoménologie attentive aux médiations techniques : dispositifs techniques et symboliques de détection, d'observation et de mesure. Tout phénomène étant « absolument inséparable des conditions de sa détection », c'est par les méthodes et techniques de localisation, d'observation et de mesure qu'il faudra le caractériser. C'est là une « dimension nouvelle, en profondeur, à la phénoménologie » obligeant l'épistémologie à prendre en compte les « quanta d'interaction » (entre cette subjectivité et de son champ thématique).

Or cet approfondissement de la corrélation (noético-noématique) est au cœur de la réflexion husserlienne depuis les années 20, comme on l'a démontré récemment [3]. Il devient absolument central dans la *Krisis* [4], qu'il n'est plus possible de réduire à une opposition caricaturale entre science exacte et monde de l'à peu près, auquel il faudrait faire retour. Bien plutôt, Husserl promeut une théorie de la science en tant que connaissance approchée. La quête de précision — qu'il faut distinguer du mythe de l'exactitude absolue – contraint la science à prendre en charge cet à-peu-près science et à donner une place de plus en plus fondamental aux dimensions statistiques et probabilistes. Il incombe à l'épistémologie de rendre compte de cette tendance et de procéder pour ce faire à une clarification des concepts scientifiques exprimant les différentes modalités de l'*à-peu-près* et les coefficients de corrélation de la subjectivité à l'œuvre par rapport au domaine qu'elle construit.

Je propose d'évaluer la pertinence et les limites de ce parallèle entre le projet de Bachelard et de Husserl, en examiner quelques notions clés : typologie des formes d'induction, formation des concepts probabilistes et statistiques (intervalle de confiance, principe d'incertitude de Fourier, fonction d'erreur, mesure d'erreur, loi normal des erreurs, etc.), statut du possible probabiliste, sens et conditions de validité de leur application à des contextes expérimentaux et d'observation.

[1] Bachelard, G. *Essai sur la connaissance approchée*, Alcan, 1927, p. 297.
[2] Weyl, H. *Raum, Zeit, Materie*, 4e éd., Springer, 1921, p. 147.
[3] Lobo, C. "Le résidu philosophique du problème de l'espace chez Weyl et Husserl », in *Weyl and the Problem of Space*, Springer, 2019
[4] Husserl, H., *Die Krisis der europäischen Wissenschaften un, die transzendentale Phänomenologie, Eine Einleitung in die phanomenologische Philosophie* (ed.) Walter Biemel, Husserliana, Vol. VI. La Haye, Martinus Nijhoff, 1950. P. 382-383

## COGNITIVE EMOTIONS AND THE PERSONAL CHARACTER OF INQUIRY

Zachary MABEE
University of Reading, UK

Work over the past few decades in the philosophy and sociology of science has helped to highlight the human dimension in theoretical inquiry and its significance at various junctures of the scientific endeavor. There are various ways to characterize this impact, for instance in terms of inquiry's being more *subjective* than we had traditionally conceived. As Mary Joe Nye and others have recently highlighted, Michael Polanyi anticipated, in certain key ways, this heightened awareness to the human dimension in theoretical inquiry, particularly in the sciences. His most central, noteworthy, and enduring contribution on this front is probably his theory of tacit knowledge or, more precisely, his contention that all knowing has a crucial tacit component to it. Another key, and sometimes overshadowed, aspect of his project, though, is the central methodological place that he affords the "intellectual passions" or cognitive emotions. Indeed, one of the key ways in which he takes knowledge to be decidedly *personal* is the way in which it is typically arrived at *not* dispassionately, but rather through a process in which epistemic agents exercise great care and emotional solicitude in grappling with a problem.

In this paper, I aim to take stock of Polanyi's account of the "intellectual passions," noting their place within his broader theoretical framework, but also specifically highlighting the manner in which, for him, their active role serves to make knowledge more *personal*. In doing so, I shall highlight certain key ways in which I find a personal account of inquiry to be more satisfactory or *complete* than an "impersonal" one (as we shall see typified in, e.g., the Popperian analysis of Alan Musgrave). I will also highlight the prescient character of Polanyi's analysis, on this front, by appeal to recent work by Paul Thagard on the role of the emotions in scientific thinking, analysis, and theory development. I shall strive also to highlight at least a few ways in which such a "personal" account of theoretical activity and knowing is in fact more contiguous with various other important, but sometimes theoretically neglected, kinds of human knowing. Furthermore, I shall offer some suggestions as to how a distinctly personal approach to human knowing and epistemic states can help to mitigate the perennial tension between the objective and the subjective, as typically construed.

Nye, Mary Jo. Michael Polanyi and His Generation: Origins of the Social Construction of Science. Chicago: University of Chicago Press, 2011.
Polanyi, Michael. Personal Knowledge. London: Routledge, [2012] 1958.

## OPENNESS AS THE GOAL AND THE LIMIT OF INQUIRY: FEYERABEND'S METAPHILOSOPHY AND ITS CONSEQUENCES

Dorian MĄCZKA
Institute of Philosophy, Jagiellonian University, Krakow, Poland

One of the most debated questions regarding Paul Feyerabend's philosophy is the apparent shift in his views on scientific inquiry – in the Sixties Feyerabend seemingly turned from a Popperian theoretical pluralist to a radical, anti-Popperian epistemological anarchist. In this paper I discuss this change and show that such a shift was necessary, given Feyerabend's distinctive metaphilosophical idea – his unending and ultimately impossible quest for openness.

In the first part of the paper I analyze Feyerabend's epistemological proposals and show that they should be conceived as a call for maximally open epistemology and philosophy – openness, according to Feyerabend, should be the goal of inquiry. I discuss four Feyerabendian ideas that may be presented as arguments for openness: (1) in the face of similarities between myth and theory we are bound to make the ethical choice between closed-minded dogmatism and open-minded criticism; (2) descriptive or analytical epistemology perpetuates status quo; (3) normative epistemology forces external and unfruitful rules on science; (4) pluralism provides a framework of epistemic, ontological and, last but not least, ethical openness..

In the second part I show that Feyerabend's philosophical pursuit leads to the conclusion that openness is ultimately the limit of inquiry. In case of Feyerabend's pluralism, there is an inherent tension between the principle of proliferation and the principle of tenacity. According to the latter, in order to successfully conduct research one has to at least temporarily limit his openness to possible alternatives. Nevertheless, Feyerabend's methodology does not suggest where this boundary should be set. His epistemological anarchism faces similar problem: true anarchist has to become an anti-anarchist. Feyerabend embraces this ambiguity and suggests that anarchism should be perceived as reductio ad absurdum of critical philosophical inquiry in general.

In the third and final part of the paper I argue that this conclusion need not imply an end of philosophy of science. Rather, it may indicate a shift in our understanding of its very idea. According to late Feyerabend, philosophy should be relegated to telling "stories" about different modes of life. In a similar fashion philosophers of science and epistemologists can develop alternative models of method, knowledge or science and present them neither as norms nor as descriptions, but rather as metascientific conceptual experiments.

## THE OPEN/REGIONAL EPISTEMOLOGY OF PSYCHIATRY

Ivana S. MARKOVÁ
University of Hull, UK

The concept of 'open epistemology' is multivocal. The 'openness' may refer to: 1) the nature of the objects of knowledge (ontological referent), 2) the ways in which they are known (epistemological or methodological referent); 3) the inclusive / exclusive manner in which science presents as a 'truth-maker' to social users; and 4) the fact that for the legitimation of their knowledge different sciences may require different epistemologies. Each of these interpretations may generate different and fruitful definitions of 'open epistemology'.

Soon after its construction during the early 19th century, psychiatry (previously called 'Alienism') demanded scientific status on the basis that it: a) possessed specific objects of study (mental symptoms, diseases); and b) generated legitimate knowledge (descriptions, explanations and prescriptions). Although brought under the aegis of medicine, it soon became clear that the traditional epistemology of medicine was unable to deal adequately with problems specific to psychiatry.

Alienism was constructed during a crucial moment of the post-Enlightenment reorganization of the sciences, particularly after the appearance of the social / human sciences. It found itself in the awkward situation of having to medicalize 'madness' a complex cultural object that until then had been shared by several disciplines. In the end, alienists needed to borrow concepts from both the natural and social sciences and this forced them to construct a language which was structurally and semantically hybrid and which eventually led them also to offer hybrid definitions of madness.

These vicissitudes explain the conceptual instability of psychiatry. Unable to find ways to combine the heterogeneous concepts in use, psychiatrists have oscillated between two extremes (neurosciences versus the hermeneutic disciplines). Little effort has been made to blend the two approaches.

One way forward may be to accept that hybridism is a legitimate ontological state of affairs. In this case, it becomes necessary to develop a proprietary and regional form of epistemology that is generated by the internal needs of psychiatry. It is likely that this will be of the open variety in the sense that it might include a plurality of knowledge-making devices. The internal needs of psychiatry, determined by the hybrid nature of its objects of study, require that attention is given to: 1) the configurators of 'meaning' (socio-cultural, personal, interactional factors), 2) neurobiology, and 3) their contextual setting.

## THE "TURN TO PRACTICE" AND PHILOSOPHICAL ACCOUNTS OF "SCIENTIFIC UNDERSTANDING"

Mark NEWMAN
Rhodes College, Memphis, TN., USA.

Explanatory understanding is a primary epistemic aim of science, but there is significant variation across scientist-philosophers about what explanatory understanding really requires. Indeed there are several conflicting philosophical models of explanatory understanding, each claiming to capture core components of the concept, yet most ignore "the turn to practice" as advocated by philosophers like Feyerabend, Kuhn, Hanson, Lakatos, Laudan, etc.

In this paper I consider the 'Contextual Theory of Scientific Understanding', (Dieks 2001, Dieks 2009, deRegt and Dieks 2005, deRegt 2009, deRegt and Gijbers 2017, deRegt 2017) which explicitly does appeal to historical case studies and the way scientists have conceived and argued over the notion of explanatory understanding (e.g. Classical Gravitational Theories; Mechanical Models of the 19$^{th}$Century; Early Quantum Theory). Advocates of the theory observe that standards of intelligibility and understanding very dramatically across scientific episodes, and hence conclude that a set of universally applicable and timeless criteria for scientific understanding are inappropriate.

This approach does however face "the dilemma of case studies": the philosopher who uses case studies is either guilty of "cherry-picking" from a very large and diverse repository in our history books, or is guilty of overgeneralization by moving from a few select cases to a universal generalization about the scientific concepts at issue. (deRegt 2017)

The Contextual Theory supposedly avoids this dilemma by using an "integrated model of HPS" (deRegt 2017, p. 8). I will explain this claim, but argue that taken this way, the Contextual Theory is unable to answer at least one very important question which any theory of understanding should provide: According to the theory, achieving scientific understanding is a subjective and relative issue because it requires the use of values and judgment, and these differ from context to context. This contradicts the generally accepted claim that science is objective and value-free. deRegt claims this problem can be answered by differentiating between macro, micro, and meso-levels at which understanding is achieved. I disagree, arguing that deRegt's account commits the fallacy of equivocation on what he calls the 'methods of theory-use'—those methods that scientists use to generate objective and trustworthy explanations. The equivocation is that the methods which provide objectively good explanations, "epistemic understanding", are truth-tracking, but confused with alternative methods, those that provide "pragmatic understanding", which are not necessarily truth-tracking.

## EXPLORERS OF KNOWLEDGE AND SEXUALITY: THE OPEN EPISTEMOLOGY OF BRONISLAW MALINOWSKI AND WILHELM REICH

Håvard Friis NILSEN
Ostfold University College, Norway

In the literature on the history of modern anthropology, Bronislaw Malinowski is usually portrayed as the first scholar who broke effectively with any influence from psychoanalysis, as well as rejecting any psychological basis for anthropology as a science. The standard narrative hails Malinowski as a truly scientific mind, securing a firm empirical basis for the young science of anthropology.

Malinowski's continued interest in psychoanalysis has received little attention, however, and particularly surprising is his long-term friendship with, and support of, the controversial psychoanalyst Wilhelm Reich. Malinowski gave Wilhelm Reich public credit as a scientist and liked his psychoanalytic forays into anthropology, as well as expressing interest in Reich's biological laboratory experiments on the origin of life and exploration of spontaneous generation.

The coming together of these two strong personalities with widely different backgrounds and from widely different disciplines shows a surprising mutual respect and an example of a genuinely open epistemology.

Based on previously unpublished correspondence between Bronislaw Malinowski and Wilhelm Reich found in Reich's private archives recently opened to researchers, Friis Nilsen argues that the story of Malinowski's ideas of science is much more complex than hitherto assumed, and we are for the first time able to reconstruct the story of a surprising and fascinating intellectual friendship, which throws new light on one of the founders of modern anthropology.

## WHAT SCIENTIFIC REALISTS (STILL) HAVE TO LEARN FROM FEYERABEND

Miguel OHNESORGE
University of Cambridge

I argue that Paul Feyerabend's criticisms of monism and scientific rationality offer insights into the flaws of two currently wide-spread versions of scientific realism, namely (i) Standard Realism based on inference-to-best-explanation (IBE) arguments and (ii) Structural Realism (SR).

For that, I first show that IBE arguments rely on a notion of "explanation" that situates itself outside of scientific practice and thus appeals to a chimera of rationality that Feyerabend proved to be flawed. The underlying demand to explain the "success" of research programs does simply not arise from the perspective of scientific practice. It makes no sense to "defend" sciences by offering "explanations" that are themselves irrelevant and grammatically alien to the business of scientists. The typical conditions to establish the ontological or metaphysical relevance of IBE arguments such as "maturity" and "success" are likewise confused, as they suggest rational measures of scientific enterprises that can somehow be established tradition-independently and without reliance on what Feyerabend called the "natural interpretations" of the research program in question.

Secondly, I appeal to Feyerabend's arguments for normative pluralism to oppose advances by proponents of SR, especially its ontic version, to (a) set aside historicist arguments against scientific realism and (b) make positive metaphysical claim about Science per se. Structural realists use so called structural theoretical continuity as a motivation for a "naturalistic" metaphysical unification based on set-theoretical or computational formalisms. Taking James Ladyman and Don Ross' formulation as an example, I show how their approach leads to an enforcing of grammars from meta-mathematics and theoretical physics onto other branches of current and possible future science. I show (a) that local structural continuities fall short of offering credible evidence for the global modal *and* logically-transitive closure of Science they defend. Furthermore, I point out that no de facto structural consistency of scientific theories on a supposed fundamental level could motivate modal restrictions of theories on individual scientific research programs.

Finally, I sketch how a post-Feyerabend scientific realism might look like. Ultimately, such a variant of realism must be based on a minimal notion of pragmatic coherency. It further has to include a normative commitment to theoretical and ontological pluralism. Right now, such a position is approximated most closely by Hasok Changs's Active Realism (AR).

## THREE KEYS AND OPEN EPISTEMOLOGIES IN FEYERABEND'S PLURALISM

Deivide Garcia da Silva OLIVEIRA
Universidade Federal do Recôncavo da Bahia (CCAAB/professor)
York University (Post-Doctorate)

This paper aims to clarify and analyze the notion of pluralism in Feyerabend's philosophy and its implications for scientific knowledge regarding the idea of open epistemology. As a result, we will argue that such a position is not only compatible with scientific research, but also it is epistemically desirable. For instance, the use of experience, as fundamental part of discovery and justification of scientific knowledge is still controversial. In an inverse proportion, it has been assumed that metaphysical knowledge has no legitimate role to play in the justification of scientific knowledge. Since scientific justification is assumed to be empirical, "experience can be regarded as a true source and foundation of knowledge" (Feyerabend, 1969, p. 132), and metaphysical knowledge unable to provide any base for our knowledge, at least from Uniformist grounds. It entails severe limitations to open epistemologies due to restrictions and reductions running out before any scientific problem arise, putting "the cart before the horses" (1993, pp. 20-21).

From a Feyerabendian view about what could be described as open epistemology, there will be not only a rejection of a Uniform fashion of scientific knowledge. Also, open epistemology is a part of the fundament and consequence of his notion of Pluralism, redesigning elements that are overvalued (e.g., experience) or undervalued (e.g., metaphysics), from a traditional Uniformist view. For instance, according to Feyerabend (1969, 1993, [1963]1999), and this is a position that remained through his whole work, metaphysics is an indispensable part of modern science. If we had followed Uniformism, the progress of knowledge would be compromised, all possibilities of investigations prematurely and definitely closed because our observations do not match with our theories. This subject raises some questions, like what Feyerabend meant by pluralism (according to us it is based on three key notions: experience, proliferation, incommensurability), and most importantly to this talk, how his approach could be considered open, and what advantages it brings to science and to philosophy of science.

Feyerabend, P. (1969). Science without experience. *The Journal of Philosophy, 66*, 791-794.
Feyerabend, P. (1993). *Against method* (3rd ed.). New York: Verso.
Feyerabend, P. ([1963]1999). How to be a Good Empiricist; A Plea for Tolerance in Matters Epistemological. In J. Preston (Ed.), *Philosophical Papers - Knowledge, science, and relativism* (Vol. 3, pp. 78-103). Cambridge, New York: Cambridge University Press.

## NIELS BOHR AND THE CONSTITUTION OF KNOWLEDGE

Ana PATO
Centro de Filosofia das Ciências da Universidade de Lisboa

In this communication, I intend to discuss some of the most important Bohr's epistemological considerations which he intended to raise to epistemological principles. What will be under analysis is the constitution of knowledge and the value of scientific theory in Bohr's thought. For Bohr, the role a scientific theory is to give order to the observed phenomena, it is the coordination of regularities. Bohr argued in favour of the existence of definitive limits to knowledge. These limits, in his framework, are grounded in the inseparability between the quantum object and the measuring devices. This is a problem triggered by quantum mechanics. But, in fact, quantum mechanics would only be unveiling a more general epistemological position, he considered.

We can find in philosophical thought (of philosophers or of scientists, may it be more or less structured) two different lines regarding the constitution of knowledge: to some objective reality is at the basis of scientific knowledge, to others we cannot go beyond sensations or other subject-dependent instance.

This problem may be found related to the two different answers to the question of whether it is possible to know the natural object as independent of the subject of knowledge, or, in different terms, if there is an objective content in the human representations of the world.

While exposing and developing a dialectical materialist theory of knowledge, Lenin developed an extensive critic, in his work *Materialism and Empiriocriticism*, against the position that goes from the sensations to the world. He criticized the empiriocriticism of Mach and Avenarius and unveiled the implicit idealist premisses of some trends in the philosophy and science of his time, namely in physics.

Departing from the major guidelines of Lenin's critic to empiriocriticism, I will contrast them with Bohr's epistemological positions, namely on the problem of the constitution of knowledge, exploring similarities, differences and consequences concerning the value of the scientific theory

## ON THE PROBLEM OF THE PLACE OF ERROR IN THE PHILOSOPHY OF SCIENCE: ADVANCES AND LIMITS OF THE THEME WITH EPISTEMOLOGY OF BACHELARD

Lilia Ferreira Souza QUEIROZ
Federal University of Bahia – UFBA

When we talk about scientific errors in Bachelard's epistemology, that is relativity new compared to his general image of rationalist in scientific research. This recognition is due to, first, philosophies with positive understandings about science whereas it omitted scientific errors or perceived them as transitory elements in the construction of knowledge (Allchin, 2015). Nonetheless, we will argue for the inclusion of errors of a necessary and non-transitional element and present it inside Bachelard's philosophy. In his view, a systematization of errors as something positive in scientific research because "psychologically there is no truth without rectified error" (Bachelard, 1996, 293). However, we can see in the analysis of his epistemology three phases of development: concrete; concrete-abstract and abstract. The presence of errors occurs only in the concrete phase of the formation of the scientific mind. Thus Bachelard's abstraction can assure greater certainty to scientific truth knowledge only after the scientific spirit had moved away from all errors raised with sensitive knowledge and overcoming its obstacles.

According to Bachelard phases, the position of marginal errors is mainly linked to the initial stage of knowledge, and that it loses its function along with a supposed evolution of scientific thought, that is, analyze. Thus, if on the one hand, his epistemology of error opens new possibilities, on the other it inheritance over the view of error continued to predominate, since the Bachelardian view was not radical enough to break through the problem of importance of reduction or omission of errors in the process of discovery and justification of scientific knowledge. Therefore, we emphasize the necessity of reevaluating errors as the first condition for scientific knowledge in all stages of knowledge and then acknowledge that if on the one hand, Bachelard did not take the topic of errors far enough, on the other hand, he opened a path to contemporary researches.

## OPENING THE SCIENTIFIC RATIONALITY: TRANSFORMATIONS OF REASON IN THE HISTORY OF SIENCE, FROM KHUN TO POPPER AND FEYERABEND

Carlos Bellino SACADURA
University of Cape Verde; Faculty of Human and Social Sciences

The positivist approach to scientific rationality conceives an unidimensional reason that progresses along history once the positive stage is achieved, after the theological and metaphysical ones. Thomas Khun did break with this view, stating that science evolves not through an increasement of knowledge, but due to changes in the way science views the world. So, there is no permanent and closed view in science, but a change in the models of scientific rationality, or paradigms shift, that became more open and dynamic. But while Khun says that this shift happens only in some extraordinary moments of crisis or scientific revolutions, Karl Popper says that this revolution is permanent, scientific rationality is in itself revolutionary and open, not only in periodical times of crisis, but every time, reshaping the structures of reason along its history.

With Paul Feyerabend occurs a radicalization of this process, questioning reason in itself, and the scientific method. He says goodbye to reason and stays against method, proposing that there are multiple ways of rationality and methodology. This pluralism changes our views of science, opening our mind and challenging our thinking about knowledge. The path that those philosophers cross is one of wider opening and pluralizing the ways of building scientific knowledge. They invite us to go further, through the ways they did open, as we can see in some philosophers like Gerald Holton, that did receive their heritage, and did open new paths in philosophy of science research.

## BACHELARD ET LES OBJETS SCIENTIFIQUES

Isabel Serra
Centro de Filosofia das Ciências da Universidade de Lisboa

Les objets de la science n'ont pas de lieu fixe et permanent : ils se situent entre le monde et nos connaissances scientifiques dans une sorte de construction souple constamment défaite et refaite au cours de l'activité et de la réflexion propres à la science. C'est Gaston Bachelard qui a mis en évidence l'activité de construction propre à la démarche scientifique. La science, dit-il, « réalise ses objets sans jamais les trouver tout à fait, elle ne correspond pas à un monde à décrire, mais à un monde à construire »[1].

Cette conception d'objet scientifique justifie, dans *Le Nouvel Esprit Scientifique* [2], des énoncés très caractéristiques de la philosophie de Bachelard, tels que la thèse selon laquelle « l'esprit scientifique doit se former *contre* la Nature » ou que « les idées simples ne sont point la base définitive de la connaissance ». Pour Bachelard « il n'y a pas de phénomènes simples ; le phénomène est un tissu de relations. Il n'y a pas de *nature* simple, de substance simple ; la substance est une contexture d'attributs ». Cette dialectique du « simple et du complexe » est développée dans *Le Nouvel Esprit Scientifique* aussi à travers des problèmes scientifiques concrets, tels que celui des spectres atomiques où l'on trouve « une mine quasi inépuisable de paradoxes épistémologiques ». Ces exemples concrets sont fondamentaux pour donner du relief aux idées de Bachelard sur les objets scientifiques.

Un autre point qui mérite d'être souligné est la manière dont Bachelard envisage la relation des objets scientifiques avec sa représentation mathématique. Dans *La Formation de l'Esprit Scientifique*, il énonce très clairement la force de cette relation lorsqu'il discute du rôle de la représentation géométrique : « la science de la réalité ne se contente plus du *comment* phénoménologique ; elle cherche le pourquoi mathématique ». Mais plus que cela, il considère que « la tâche première où s'affirme l'esprit scientifique » est celle de « rendre géométrique la représentation, c'est-à-dire dessiner les phénomènes et ordonner en série les événements décisifs d'une expérience »

Dans cette communication nous discuterons la pensée de Bachelard autour des objets scientifiques dans une perspective d'épistémologie ouverte en essayant de montrer les raisons et le sens de telle perspective. On aura recours surtout aux deux œuvres citées mais aussi, ponctuellement, à d'autres travaux de Bachelard, ainsi qu'à ceux de quelques de ses commentateurs.

[1] Bachelard, G., (1938), *La Formation de l'Esprit Scientifique*, Paris : Vrin.
[2] Bachelard, G., (1934), *Le Nouvel Esprit Scientifique*, Paris : Alcan

## OPEN EPISTEMOLOGY AND THE PROBLEM OF PSEUDOSCIENCE

Rui SAMPAIO da SILVA
University of the Azores

Feyerabend has famously argued, against rigid and abstract accounts of the scientific method, that for any supposedly universal methodological rule we can find examples in the history of science of successful violations of that rule. His methodological pluralism (a more fortunate expression than "epistemological anarchism") is an important contribution to the philosophy of science, and can be strengthened by considering the plurality of explanatory strategies across the sciences: nomological explanations; mechanism-based explanations (particularly in biology and psychology); inferences to the best explanation (which are crucial in the historical sciences); the use of qualitative and interpretive methods in the explanation of the human behaviour.

Considering the heterogeneity of scientific practices, it seems impossible to offer a definition of science in terms of necessary and sufficient conditions, and for this reason Laudan argued for the "demise" of the so-called demarcation problem, the attempt to distinguish between science and pseudoscience. According to his proposal, instead of classifying cognitive fields as scientific or pseudoscientific, we should instead adopt a piecemeal approach and confront specific claims with the available evidence.

However, there is something frustrating in Laudan's dissolution of the demarcation problem. Some cognitive fields are clearly unreliable, and the identification of such fields is useful at the level of public policies (regarding, e.g., education and healthcare). Furthermore, the impossibility to formulate clear definitions of science and pseudoscience does not entail a demise of the demarcation problem, because we can rely on a different, Wittgensteinian account of concepts as "family resemblances", which allows us to characterize science and pseudoscience in terms of "profiles" (a term used by Thagard in this context) constituted by typical features (as opposed to necessary and sufficient conditions). A profile of pseudoscience is even more useful for critical purposes than a profile of science, and philosophers like Bunge, Thagard and Hansson have developed lists of features of pseudoscience. Some of these features are sufficient to classify a cognitive field as pseudoscientific (like belief in authorities or the unwillingness to submit hypotheses to empirical tests), other ones are "warning signals" (like the neglect of alternative theories or the tendency to appeal to *ad hoc* hypotheses), but the distinction between these two types of features is not always clear and requires a close examination. At any rate, this "Wittgensteinian" approach has the merit of avoiding a rigid approach to science and fostering, simultaneously, a healthy skepticism towards putative scientific claims.

## TACIT KNOWLEDGE AND SCIENTIFIC EDUCATION: MICHAEL POLANYI'S EPISTEMOLOGY IN SCIENCE TEACHING

Thaís SOARES SILVA
Federal University of Bahia; Institute of Physics
Post-Graduation in Teaching, Philosophy and History of Sciences

The main focus of this research is to understand how Michael Polanyi's epistemology on tacit knowledge can contribute to scientific education and science teaching. This objective is due to the fact that scientific education has some problems due to naive images of science and of the scientist (Perez et al., 2001), contributing to the so-called crisis in science education, which results in students' avoidance of science courses and their lack of interest in these areas (Feyerabend, 1977; Fourez, 2003; Matthews, 1995). In this sense, it is possible to notice a common aspect playing a role in all that problem: the unawareness or misled approach of Tacit Knowledge as fundamental for the construction of scientific knowledge and also to its educational process. This knowledge could be considered built over lived experiences but does not mean that it is subjective. It is objective and also personal knowledge (Polanyi, 2013).

According to Polanyi (2013), we know more than we can express, and the exchange of knowledge that happens through different practices, examples observed by an apprentice - teacher to the learner - is also a dimension of the process of discovery and justification of science beliefs. This element emphasizes the notion of matrix supporting the notion of tacit knowledge in Polanyi. Since tacit knowledge is the source of all knowledge and matrix is a form of pin it down (localize it) and understand better the nature of tacit knowledge especially in science classrooms. So we can stimulate students with more meaningful learning. On this account, we argue that this proposal contributes to abundant intellectual life, education, and decision-making, also address the crisis in science teaching.

Feyerabend, P.K. (1977). *Against the method*. Translation of Octanny S. da Mata and Leonidas Hegenberg. Bookstore Francisco Alves Publisher S.A. Rio de Janeiro.

Fourez, Gérard. (2003). *Crisis in Science Teaching?* Investigations in Science Teaching, Porto Alegre.

Matthews, M. R. (1995). *History, philosophy and science teaching: the current trend of rapprochement.* Department of Education, University of Auckland, New Zealand, Cat. Fís., V. 12, n. 3: p. 164-214, dez.

Perez, D. G. et al. (2001*). For an undistorted image of scientific work*. Science and Education, V.7. n.2, p.125-153.

Polanyi, M. (1958/2013). Personal Knowledge: a post-critical philosophy. Chicago: The University of Chicago Press.

## THE LEGACY OF GASTON BACHELARD'S PHENOMENOTECHNIQUE: *UN HÉRITAGE INVISIBLE*?

Massimiliano SIMONS[1] & Matteo VAGELLI[2]
[1] KU Leuven; [2] Université Paris 1 Panthéon-Sorbonne

One of the prominent concepts of Gaston Bachelard's oeuvre is that of phenomenotechnique, referring to how instruments create phenomena, rather than merely observe them, in science. It's legacy, however, is far more unclear. If discussed at all, the story around phenomenotechnique tells how in France this insight by Bachelard was soon forgotten or ignored, for instance in the oeuvre of Pierre Bourdieu or Louis Althusser, only to be taken up more recently in the oeuvre of recent scholars working on science, technology and experiment. The discussion then often centres around whether contemporary uses of phenomenotechnique, and their realist or constructivist ambitions, are legitimate readings of Bachelard.

In this paper, we want to argue that this story is problematic on at least two accounts. First of all, phenomenotechnique has never been forgotten in France, but was immediately picked up by a range of authors such as Georges Canguilhem, François Dagognet and Michel Serres. Moreover, recent authors who mobilized the notion of phenomenotechnique, such as Bruno Latour, Ian Hacking or Hans-Jörg Rheinberger, tend to mean something else with this notion. In fact, it will be argued that their point of view often risks to come closer to what an earlier generation of authors, such as Pierre Duhem or Ernst Mach, already claimed about the role of instruments. In contrast, this paper will argue that (a) there are clear differences between Bachelard's phenomenotechnique and contemporary uses of his work; and (b) that by returning to Bachelard's perspective one could correct certain biases present in the more recent perspectives.

## INFLUENCE OF THOMAS KUHN AND ERNST MAYR ON NATURAL SCIENCES AND ON SCIENCE EDUCATION

Cristina SOUSA
Faculdade de Ciências, Universidade do Porto

The first mention of the idea of ecological niche was as a "place in nature" by Charles Darwin (1859, p212), meaning a form of life or role in the ecosystem of a given species. Darwin described differences among finches' species of the Galapagos Islands and observed that each species has a preferential type of food and related this to speciation (Darwin 1859).

In 1917, Joseph Grinnell (1877-1939) was the first scientist to propose the concept of ecological niche in his study about a Californian bird, with the scientific name *Toxostoma redivivum.*

Grinnell (1917) described that each of the 3 subspecies, of *T. redivivum*, in his study, occupies its own niche leading to his conclusion that any two species cannot have the same niche. So, the concept of niche is inter-related with the concept of species and Ernst Mayr (2004) had an important role in proposing the biological concept of species. Thomas Kuhn (1993, p337) supported this idea of inter-relationship: "…a species and its niche are interdefined; neither component of either pair can be known without the other."

Ecological niche concept is highly relevant to understand several ecological phenomena, since it has been described by several authors that species coexistence occurs when there is stabilization of differences between niches and intraspecific competition rates (in Sousa, 2016). Therefore, it should be included in K-16 Science Education, in Biology (or Natural Sciences) classes.

Changing Nature of Science naive students' conceptions is one of the main goals of Science Education, in which one can find Kuhn's influence in the conceptual change theory, proposed by Posner et al. (1982).

Darwin, C. (1859). Darwin, C., (1859). The origin of Species by Means of Natural Selection, London, UK: Penguin Books. 477p.

Kuhn, T. S. (1993). Afterwords. In *World Changes: Thomas Kuhn and the Nature of Science*, edited by Paul Horwich, 311-341. Pittsburgh, USA: University of Pittsburgh Press.

Mayr, E. (2004). What Makes Biology Unique? Considerations on the Autonomy of a Scientific Discipline. Cambridge, UK: Cambridge University Press.

Grinnell, J. (1917). The niche-relationships of the California Thrasher. The Auk, 34, 427-433.

Posner, G., Strike, K., Hewson, P., & Gertzog, W. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. Science Education, 66, 211–227.

Sousa, C. (2016). Biodiversidade, nicho ecológico e seres humanos. [Biodiversity, ecological niche and human beings]. Bubok. ISBN 978-84-686-4392-2. 100p.

## TELLING STORIES IN SCIENCE: FEYERABEND AND THOUGHT EXPERIMENTS

Mike STUART
University of Geneva, Swiss National Science Foundation

Paul Feyerabend has been dismissed as a "clown," an "enfant terrible," and the "worst enemy of science," someone who defends voodoo and astrology, attacks strawpeople, misses the point, has no positive view at all and is a postmodernist. Others see him as one of the most exciting philosophers of science of this century, and many historians recognize the crucial role he played in the development of ideas we now take for granted in the philosophy of science, including pluralism, the disunity and value-ladenness of science, feminist philosophy of science and green philosophy.

Feyerabend tells stories, and claims to be a philosopher only in the sense in which a dog is. Nevertheless, there are many philosophical fruits to be harvested by combing through Feyerabend's work, especially his later publications. As areas that need attention, Brown and Kidd highlight the critical purposes Feyerabend sees for drama as well as his comments on metaphilosophy (2016, 7). This paper pursues both of these by locating Feyerabend's views on *thought experiments*. These are tools of the imagination that make epistemological progress in philosophy and science (making them relevant for metaphilosophy), and they typically have a narrative structure (making them relevant to the critical use of drama).

The first section of my paper argues that it is fair to discuss Feyerabend in the context of thought experiments. In the second, I reconstruct Feyerabend's views on thought experiments by considering his distinction between myth and story. A myth was a story that has congealed and become dogma. Thus, science and the superiority of capitalism (etc.) are mere stories. Forgetting that a myth is a story is a mistake. Nevertheless there are better and worse stories. A story is good insofar as it is interesting, appealing, and revelatory. Thought experiments, for Feyerabend, play an important role in the history of epistemic progress in the sense that they are special kinds of stories that exist only to break us out of our dogmatic slumber. They should not be evaluated as logical arguments, but as propagandistic jolts.

In the last section, I put Feyerabend's work in contrast with historical and current trends in the literature on thought experiments, to show that his contributions present live options for future research and telling criticisms of positions that are still held today.

Brown, M.J. & Kidd, I.J. 2016. "Introduction: Reappraising Paul Feyerabend", Studies in History and Philosophy of Science 57: 1–8.

# BACHELARD AND BOHM: HIDDEN VARIABLES, THE GHOST OF THE SCIENTIFIC SPIRIT?

Hannes VAN ENGELAND
KU Leuven

Gaston Bachelard famously complained that "Science does not get the philosophy it deserves." [1] In *La philosophie du non,* he stresses that (his) philosophy of science should be an *open* philosophy; for Bachelard "reason has to follow science." [2] To ensure this openness, Bachelard psychoanalyses the (new) scientific mind and formulates his theory of epistemological obstacles. An open philosophy of science should critically reflect upon itself and try to get rid of any epistemological obstacles: it must re-valuate, re-think and re-take everything. Openness is further ensured by the discursive process that science is, by the polemics waged in the scientific city.

An interesting question is to what extent Bachelard remains loyal to his own principles for an open philosophy. To examine this, I will confront the Bachelardian "dialectic philosophy of why not?" [3]with Bohmian mechanics. Bohmian mechanics is a deterministic interpretation of quantum mechanics in terms of so-called "hidden variables". If Bachelardian philosophy is the open philosophy it claims to be, then a Bachelardian philosophy for Bohmian mechanics must be possible. However, Bachelard ceased to publish epistemological books after he took note [4] of this interpretation of quantum mechanics.[5] To make sense of this, the following question should be answered: can Bachelard give Bohmian mechanics the philosophy it deserves?

To answer this question, I identify four metaphysical tensions between Bachelardian philosophy and Bohmian mechanics, to wit: determinism, realism, cartesianism, and continuity. The solution to the problem will consist in taking these tensions to signal epistemological obstacles in classical Bachelardian philosophy. The presented solution to resolve these tensions consists in being more Bachelardian than Bachelard, opening up Bachelardian philosophy to Bohmian mechanics.

From this perspective, it seems that Bohm's hidden variables theory was not the ghost of the old scientific spirit that has come to haunt the new scientific spirit, but that it can rather serve as an essential tool to re-animate Bachelardian epistemology.

[1] Gaston Bachelard, Le matérialisme rationnel. Paris : PUF, 1953, 20. (own tranlation)
[2] Gaston Bachelard, La philosophie du non : essai d'une philosophie du nouvel esprit scientifique, Paris : PUF, 2016, 145. (own translation)
[3] Gaston Bachelard, La philosophie du non, 36. (own translation)
[4] Bachelard presided the following lecture : De Broglie, Louis, "La Physique Quantique Restera-t-elle Indeterministe?" Bulletin de la Société française de Philosophie, T.XLVI, 25 Avril, (1953): 135-173.
[5] See also: Freiere Jr., Olival, "Gaston Bachelard et Louis de Broglie, ont-ils toujours été en syntonie?" Cahiers Gaston Bachelard 6, (2004): 160-166.