

Introduction

Mario Bunge's Project

François Maurice

Sommaire

- 1 The Project of a Lifetime
- 2 Reading Bunge
- 3 Contributions
- 4 Bibliographies
 - 4.1 Texts by Mario Bunge in French
 - 4.2 Texts in French devoted to Mario Bunge's thought
 - 4.3 Works on or around Mario Bunge

This first issue of *Metascience* pays tribute to Mario Bunge on the occasion of his 100th birthday. This is not the first time, and certainly not the last, that thinkers pay tribute to Mario Bunge or that his work is the subject of a study, and rightly so, because the man is a humanist and the work is worthy heir to the Enlightenment. Mario Bunge has made significant contributions to a wide range of disciplines: physics, philosophy, sociology, psychology, cognitive sciences. This issue is also a way to make Bunge's thinking known to a French readership¹.

¹ For the English reader, please note that the final version of this issue is published in French by Éditions Matériologiques. This means that all the articles in English have been translated into French, but none of the articles in French have been translated into English, with the exception of François Maurice's article, *Metascience: for a Scientific General Discourse*, which serves as the founding text of the journal, as well as this introduction to this special issue, *Introduction: Mario Bunge's Project*, and the presentation of the journal, *Presentation: Metascience and the Bunge alternative*. Those last texts and the six articles received in English are freely available on the website of *Metascience*: <https://metascience-en.sopromet.org/sections/1-issues/number-1/>.

1 THE PROJECT OF A LIFETIME²

On New Year's Eve of 1937, at the age of 18, Mario Bunge resolved to study only serious intellectual subjects. He moves up a gear. He chooses to study physics at university and philosophy on his own. He is thus a physicist by training and a philosopher by vocation.

He had just spent a few relatively difficult years in high school. However, the last two years of primary school went well. The teachers of the progressive primary school *Escuela Argentina Modelo* were competent and motivating: "I flourished at that school, where I was put in charge of the classroom library, was elected senator of our miniature parliament, made some friends, and earned some medals. I looked forward to doing even better in high school. How utterly mistaken I turned out to be!"

The *Colegio Nacional* High School in Buenos Aires did not make a good impression on the young man. He had just left a progressive elementary school and enjoyed some freedom at home. The *Colegio* offered only discipline, and merit was assessed only by exam scores. For Bunge, the school was more like a correctional facility than a place of learning. He rebelled. He published a short-lived *Magazine against the Professors*, one of whose professors, caricatured as a chimpanzee, made the headlines. He got away with a fourteen days' suspension: "Even I was surprised at my irreverence, because I had behaved well in my elementary schools."

The *Colegio* "frees" the student at the end of 1936 because he does not do well in most subjects: "I was a mediocre student because I was neither motivated nor fond of most of my teachers." In the same year, Bunge completed all subjects as a "free student" at the *Colegio Nacional Sarmiento*, with the exception of trigonometry, a subject in which he failed twice. He studied *Plane Trigonometry* by Isaac Todhunter, published in 1859, and then easily passed the trigonometry exam. He fell in love with mathematics, so he began to study *Calculus Made Easy* by Silvanus P. Thompson, published in 1910, a work which appealed to the notion of infinitesimal rather than the formal notion of limits. He received his high school diploma in 1937 and then enrolled in the Faculty of Physicomathematical Sciences at the National University of La Plata, an ideal place for a

² We freely draw inspiration from Mario Bunge's autobiography, *Between Two Worlds*, 2016, to introduce you to this scholar of contemporary Enlightenment. All quotes in this section come from this autobiography.

theoretical mind: “The young La Plata University was perhaps the most advanced in Latin America, because it assigned priority to the basic sciences [...] instead of being a factory for producing lawyers, physicians and bookish engineers [...]”.

The year of resolution was a defining year: “That year of 1937, so critical for me, I read more than at any other time in my life.” While reading Bertrand Russell’s *Problems of Philosophy*, published in 1912, immediately convinced him that psychoanalysis was “pure fantasy”, it took him ten years to realize that the “Hegelian verbiage” of dialectical materialism concealed two doctrines interesting in the embryonic state: epistemological realism and ontological materialism. He was impressed by the pre-Socratic, Spinoza and French Enlightenment philosophers. He also realizes that most philosophers have never practiced science. In order to do better than them, he studied physics for fourteen years and received his doctorate in 1952 from the University of La Plata. From 1943 to 1951, he worked under the direction of Guido Beck (1903-1988) on problems of nuclear and atomic physics. Bunge only considered himself a professional philosopher after two decades of philosophizing and only after he had published a few books and a dozen articles. The demands Bunge had placed on himself made him go a long way in order to reach his goal: “to join philosophy with science.”

After returning from a postdoctoral stay with David Bohm in Sao Paulo in 1953, Bunge embarked on two long-term research projects: the study of the philosophy of physics and its foundations, and the study of categories of determination, including causality and chance. These projects occupied him from 1954 to 1970 and led to the publication of *Causality* and *Metascientific Queries*, both in 1959, then to that of *Foundations of Physics* and *Scientific Research*³, both in 1967. The *Treatise on Basic Philosophy* was born a few years later, in 1974, the culmination of this search for a link between philosophy and science.

2 READING BUNGE

Mario Bunge’s project has led him to write more than 150 books and 540 articles or chapters, including translations into several languages. The

³ *Scientific Research* was republished as *Philosophy of Science* in 1998.

work covers all branches of philosophy, from ontology to ethics, including semantics, epistemology, methodology, praxeology and axiology, as well as a wide range of scientific disciplines, from physics to sociology, including chemistry, biology and psychology. Undoubtedly, Bunge's magnum opus is the *Treatise on Basic Philosophy*. The first volume of the *Treatise* was released in 1974, the last in 1989. There is a before and an after the *Treatise*.

There was also a before and an after *Foundations of Physics* and *Scientific Research*. The year is 1967. For Bunge, the situation is clear. In his preface to *Foundations of Physics*, he invites us to roll up our sleeves since in any case the analytical tools for metascientific research are available:

There is little excuse for failing to attempt it, as all physical theories teem with logical and semantical difficulties, and the great majority of them are in their infancy as regards logical organization and physical interpretation. The prime matter—supplied by the physicist—and the tools—wrought by the mathematician, the logician and the philosopher of science—are there.

This work of axiomatization of theories of physics was undertaken to combat operationalism and to remove from the field of physical theories any concept pertaining to psychology. For Bunge, without this double axiomatization, formal or logical, and factual or semantic, to discuss the interpretation of a theory is only tantamount to “hand-waving, when not magic-wand-waving.”

With *Scientific Research*, Bunge offers us a manual of “methodology”, each section of which ends with a set of 10 problems, which makes a total of 930 problems to be solved. Many of these problems could be the subject of a master or doctoral thesis, and some of them would occupy a lifelong researcher. Answers to problems are not provided! Fortunately, each chapter ends with a detailed and commented bibliography. Let us understand that this is a manual of methodology in the Bungean sense, and not a manual of method, that is to say a manual which explains the methods specific to a discipline, the methodology here being the study of methods, the normative branch of epistemology. *Scientific Research* is an opportunity not only to deal with the methodology of science, but also the methodology of philosophy and metascience. The successes of formal logic and semantics “suggest adopting a clear methodology, more precisely one that

draws on that of science.” A significant part of the work is also devoted to the semantics of the factual sciences, a theory necessary for the dual axiomatization of *Foundations of Physics*.

There was also a before and an after *Causality* and *Metascientific Queries*. The year is 1959. Several of the main Bungean themes are present: the dichotomy between formal and factual sciences, the notion of factual semantics, the unity of science, the nature of scientific laws, the different meanings of “law”, the notion of levels of organization, that of novelty and emergence, the different categories of determination, including causality and randomness, the lawfulness principle], scientific explanation and prediction, as well as a conception of metascience. Make no mistake, *Causality* is not just about causality; the work is sharp and wide, as evidenced by the subtitle: *The Place of the Causal Principle in Modern Science*. In the same way that *Scientific Research* is the companion of *Foundations of Physics*, *Metascientific Queries* is that of *Causality*: one is the general framework in which the research of the second takes place. We will find similar couples a few years later with *Philosophy of Psychology* and *The Mind-Body Problem*, then *Finding Philosophy in Social Science* and *Social Science under Debate*.

After the publication of *Foundations of Physics* and *Scientific Research* in 1967—and a few other texts in the same year and the following years!—during a trip to Spain, while staying with his family in a rented house near Marbella, Bunge recalls in his autobiography that “in the backyard there was a green lawn without trees and surrounded by a high wall, so there was nothing to do but think. There I had the idea of expanding my work to encompass all the main branches of philosophy.” It is an understatement! Not only will Bunge publish a treatise on philosophy which will cover all branches of philosophy, but he will also give himself the task of studying the main scientific disciplines in the light of his philosophical theories.

The *Treatise* is therefore the culmination of some twenty-five years of research and reflection on the nature of science, but also on the nature of philosophical or metascientific research. But to fully appreciate both the *Treatise* and the entire work, one must keep in mind the fiction/reality dichotomy and the distinction between reflection and theorization. From the dichotomy between fiction and reality follows other dichotomies:

between the formal and the factual, between a concept and the object to which it refers, between an attribute and the property it represents, etc. So the world should not be confused with our representation of it. This implies that there are no philosophical, metaphysical, logical or linguistic links between us and the world. But, instead of concluding that the world is then inaccessible, Bunge reflects on the situation, takes note of the success of science, adopts the same general postulates to which science subscribes, to finally develop general theories, a theorization that is not about the facts of the world but their scientific representation. To adopt the same general postulates as science is to say that Bunge does not problematize scientific facts in the same way as his fellow philosophers.

This state of mind is reflected in Bunge's work through the use of a singular expression: to take for granted. We find the expression everywhere in Bunge's work, and without an understanding of it, the expression will appear incomprehensible or trivial. Aren't we saying that nothing should be taken for granted? Isn't it peculiar to a philosopher to question everything? Bunge disagreed. He takes for granted an astonishing quantity of principles and postulates, the justification of which is found in a reflection on the world, on our relationship to it, and on the success of science. If science is successful, the majority of assumptions taken for granted by scientists must be the right ones. Why problematize them if they are the source of such success? Why not adopt them and thus build general theories, ontologies, epistemologies, methodologies and semantics, on a common basis with science? That's what he did. It must be understood that these general postulates are for Bunge a springboard for the development of his philosophical or metascientific theories; they are not the culmination of metascientific research but its beginning.

At the end of this introduction, we have grouped together a few books and journal numbers devoted to the thought of Mario Bunge. For the French readership, we have also grouped books, articles and chapters of Mario Bunge as well as texts devoted to his thinking available in French. This is not the first attempt to introduce Mario Bunge into the French-speaking world, but it seems to remain hermetic to his thinking. Note the effort of Éditions Vigdor to have published in the '90s three translations by Adam Herman of Mario Bunge's text as well as to have produced two

videos in which Mario Bunge explains his vision of quantum physics and democracy. Publishing Bunge in French is a militant gesture.

3 CONTRIBUTIONS

The thirteen contributions to this issue come from authors of different backgrounds, as it should be for a thought that covers as broad as that of Mario Bunge. Like Bunge's project, the following contributions are neither part of the analytic movement nor the continental movement in philosophy. Note, however, that the contributors to this first issue of *Metascience* do not necessarily endorse Sopromet's research program or the journal's editorial policy. We can reasonably think that they were willing to participate in the issue in order to pay tribute to a thinker dear to them. Nevertheless, we distinguish four types of contribution: 1) studies on the Bunge system; 2) applications or extensions of Bungean thought; 3) reflections and testimonies; 4) metascientific contributions.

1) Studies on Bunge's System

François Maurice, in his contribution “**Metascience: for a Scientific General Discourse**”, defends a non-philosophical interpretation of Bunge's work by revisiting the problem of the nature of philosophy, including the way it has to problematize reality and the knowledge of it, as well as that of the nature of human reflection, which does not present itself as the prerogative of philosophy, but as “the most fairly distributed thing in the world.” In order to take into account the particular nature of philosophy and the universal nature of reflection, Maurice advances the notion of general discourse. Philosophy then appears as a general discourse among others. Since Mario Bunge neither problematizes reality nor knowledge of it in the same way as philosophers, he cannot be considered as a philosopher, but rather as a metascientific. By separating the faculty of reflection from the philosophical discourse, it is then possible to envisage the development of a general scientific discourse, a metascience, the objects of study of which are the products of science, i.e. concepts, propositions and scientific theories, and whose main task is the development of metascientific theories, as found in Mario Bunge's *Treatise on Basic Philosophy*.

Jean Robillard, in his contribution “**Le monde selon Bunge : de la méthode au modèle à la réalité**” (*The World according to Bunge: from Method to Model to Reality*), emphasizes this important aspect of Bunge’s approach, namely the construction of philosophical theories. He examines in particular “the axiomatic method as a method of theoretical construction and proof” of Bunge’s scientific ontology, and this “axiomatic method essentially makes it possible to construct hypothetico-deductive systems—which is in Bunge synonymous with scientific theory.” Robillard also demonstrates that the Bungean method excludes any notion of boundary between the outside world and the knowing subject, which amounts to saying that Bunge adopts, from the start, a method that does not problematize our relationship to the world in the same way as philosophers problematize it.

2) Applications or Extensions of Bungean Thought

Luis Marone, in his contribution “**On the Kinds of Problems Tackled by Science, Technology, and Professions: Building Foundations of Science Policy**”, proposes to distinguish the components of the system of human knowledge, namely the science, technology and professions, based on an analysis of the types of problems encountered in each of them. He puts forward a typology of problems and solutions to these problems where the notions of direct problems and inverse problems, dear to Bunge, play an essential role. From this typology, it is then possible to classify activities within science, technology or professions. This understanding of the distinct nature of the activities of the system of human knowledge is essential for the formulation of a science policy for integral development.

Eduardo Scarano, in his contribution “**The Inverse Approach to Technologies**”, offers us a study of the components of technology, especially the non-scientific components, through an approach complementary to that of Bunge. Scarano’s analyses reveal no less than a dozen components of the technology. Although aware of the existence of non-scientific components of technology, Bunge was primarily interested in the link between science and technology. The study of the components of the technology, what Scarano calls the inverse approach (not to be confused with an inverse problem), allows a tidy classification of technologies. In fact, Scarano postulates the existence of a continuum of technologies that “at

one extreme, come close to being almost confused with science and, at the other extreme, tenuously fulfill some requirement of science.”

Ivan Maffezzini, in his contribution “**Génie logiciel et ontologies**” (*Software Engineering and Ontologies*), offers us a characterization of the link between the notion of ontology in software engineering and that of ontology in philosophy. Bunge’s scientific ontology is used for this task, notably the physical object/conceptual object dichotomy, to which Maffezzini adds the natural language/programming language dichotomy. This last dichotomy “could be the missing link which would allow Bunge’s theory to cover the development process from the expression of the initial needs to the code installed in the machine.” The use of ontologies in software engineering is justified after examining three machine relationships: machine-human, machine-machine, machine-nature. The machine-human relationship is not problematic insofar as the individual can always interpret his relationship with the machine, but once we have to make machines interact with nature, it is no longer possible to confuse the concept with its object. In the latter case, a scientific ontology *à la Bunge* is then necessary in software engineering.

Martín Orensanz, in his contribution “**A Critique of Meillassoux’s Reflections on Mathematics from the Perspective of Bunge’s Philosophy**”, criticizes the main thesis defended by Meillassoux in his book *After Finitude* in light of Bunge’s philosophy of mathematics: “all those aspects of the object that can be formulated in mathematical terms can be meaningfully conceived as properties of the object in itself”, or as Orensanz reformulates it, “any property which can be mathematized can be construed as a primary quality”. Orensanz’s critique has as its starting point an ambiguity in Meillassoux’s conception of the nature of mathematics and that of objects in themselves and their primary qualities, which compromises Meillassoux’s very thesis. By appealing to the Bungean dichotomy between the factual and the formal, Orensanz refutes the Meillassian thesis while betting that Meillassoux’s philosophy can hold up if it benefited from Bunge’s mathematical philosophy.

Ricardo Gomez’s contribution, “**Mario Bunge : Epistemology is here to Stay**”, is a defense of the Enlightenment, of modernity, of epistemology, and of Mario Bunge, contemporary representative of modernity, and a destructive criticism of Latour’s notion of non-modernity. Two brief

comments by Gómez on Latour's conceptions say it all: "Enough is enough", and a little further, "Enough, again". Latour builds a straw man and then tells us that we have never been this straw man. It introduces ill-defined and ad hoc concepts, unrelated to scientific disciplines, such as "hybrids", "networks", "hybridization", "purification": for Gómez, it is a "creative paraphernalia of an alternative version of modernity and what it is to be modern." Before even tackling this notion of non-modernity, Gómez gives us a taste of Latour's argumentative method by criticizing a text by Latour on special relativity, "A Relativistic Account of Einstein's Relativity", whose conclusion is unequivocal: "All these statements show that Latour has not the slightest idea of what Einstein holds."

Laurent Jodoin's contribution, "**L'objectivité scientifique à l'heure de la post-vérité**" (*Scientific Objectivity in a Post-Truth Age*) takes the opposite of that of Gomez, as Jodoin attempts a delicate reconciliation operation between Mario Bunge and Bruno Latour, "if at all possible." This reconciliation is necessary in view of the political urgency in this post-truth era: "if there is an emergency, strategic alliances must be made." This reconciliation revolves around the notion of objectivity. Jodoin identifies three broad conceptions of objectivity: fidelity to facts, lack of normativity or axiological neutrality, and absence of personal bias. If it were possible to reconcile these three conceptions, through a reassessment of the notions of scientific representation, contexts of discovery and justification, and that of the fact-value distinction, in order to propose an "operational objectivity", then we might have found common ground with post-truth thinkers.

3) Reflections and Testimonies

Mario Bunge, in his contribution "**Criticism: Destructive and Constructive**", invites us to consider constructive criticism as more important than destructive criticism, although the latter proves necessary. Bunge calls upon his experience as a critic of sterile philosophical schools to deliver the message "the most effective criticism is the one accompanied by a suitable substitute", and for Bunge a solution often takes the form of a philosophical theory.

Roberto Miguelez, in his contribution "**Le métier de philosophe : sous le mode du témoignage**" (*The Profession of Philosopher: a Mode of*

Testimony), gives us a testimony of his disturbing experience as a student of Mario Bunge in Buenos Aires in Argentina in the sixties, at a troubled, violent and unstable time in the history of Argentina. Bunge's Socratic-inspired teaching method, that of "the privilege of questioning instead of ready-made answers", understood that the answers are to be *built by us* and not to be *found in us*, a teaching method that goes against the grain of pedagogical approaches of the time, is an opportunity for Miguelez to reflect on the profession of philosopher and the conditions of his exercise.

Jean-René Roy and Normand Baillargeon, in their contribution "**Les lumières de Mario Bunge: pour la méthode**" (*The Lights of Mario Bunge: for the Method*), defend the positive role of philosophy in science, more precisely the idea that "Bunge's works contribute in an extremely strong and positive manner to make healthier the life of the spirit, by enriching our intellect and by fighting against various disturbing forms of obscurantism which sometimes prevail." This text and that of Maurice respond to each other to the extent that the latter does not give any merit to philosophy with regard to the progress of science, although it also attaches great importance to Bunge's works, especially in the fight against obscurantism.

4) Metascientific Contributions

Louis Marchildon, in his contribution "**La réalité face à la théorie quantique**" (*Reality and Quantum Theory*), presents some interpretations of quantum theory and the conceptions of reality that each of them gives rise to. We find the Copenhagen interpretation, the wave function collapse of von Neumann, the pilot wave of Bohm and de Broglie and the many-worlds interpretation of Everett. With the exception of the Copenhagen interpretation, these interpretations can be conceived in a realistic way, but each of them does not offer the same vision of reality. Any interpretation, however, will hardly escape the non-local nature of quantum reality. Marchildon reminds us that Bunge was one of the first in the 1950s to criticize the Copenhagen interpretation and to defend a realistic interpretation of quantum theory ever since.

Jean-Pierre Marquis, in his contribution "**Vérité partielle et réalisme scientifique: une approche bungeenne**" (*Partial Truth and Scientific Realism: a Bungean Approach*), set out the requirements to be

met for the development of a theory of partial truth in the factual sciences and thus proposes a research program to achieve this goal. Thus, the article's subtitle, "a Bungean Approach," can be read in two complementary ways. In a first reading, the Bungean approach is that of the thesis that the notion of factual truth is characterized by that of partial truth. In a second reading, the Bungean approach consists in developing a theory of partial truth, a hypothetico-deductive system. Thus, Marquis adopts the idea of partial truth and proposes a general plan for the development of a theory of partial truth.

These and other contributions, published in various languages, including English and Spanish, demonstrate the potential of a research program inspired by Mario Bunge's project. This project is part of the humanist and scientific tradition of the first Enlightenment in ancient Greece and the second Enlightenment in Europe. The researcher, unlike followers of the contemporary Counter-Enlightenment sects, does not conclude in the face of a difficult and complex problem that there is no solution or that all solutions are equal. No, he lifts up his sleeves, he works hard, he thinks, he analyzes, he synthesizes, he advances solutions, he tests them, he offers them for examination, in short, he confronts reality, at the risk of undermining his own beliefs.

4 BIBLIOGRAPHIES

4.1 TEXTS BY MARIO BUNGE IN FRENCH

- Bunge M., 1968, « La vérification des théories scientifiques », *Logique et Analyse*, 11 (41), p. 145.
- 1968, « Les concepts de modèle », *L'âge de la science I*, p. 165-80.
- 1968, « Physique et métaphysique du temps », *Proceedings of the XIVth International Congress of Philosophy II*, Herder, p. 623-29.
- 1971, « Conjonction, succession, détermination, causalité », in Piaget J. (éd.), *Les théories de la causalité*, Presses universitaires de France, p. 112-32.
- 1974, « Les présupposés et les produits métaphysiques de la science et de la technique contemporaines », *Dialogue*, 13 (3), p. 443-53.
- 1975 [1973], *Philosophie de la physique*, Seuil, traduit par F. Balibar, *Philosophy of physics*, Reidel.
- 1983, « De la neurologie sans âme et de la psychologie sans tête à la neuropsychologie », *Petite revue de philosophie*, 5, p. 1-45.

- 1983 [1977], *Épistémologie*, Maloine, traduit par H. Donadieu, *Epistemología*, Siglo XXI.
- 1986, « Culture et inculture », *Philosophiques*, 13 (2), p. 347-51.
- 1987, « Le problème corps-esprit », *Médecine psychosomatique*, 15, p. 85–94.
- 1989, « Des bons et des mauvais usages de la philosophie », *L'Enseignement philosophique*, 40 (3), p. 97–110.
- 1991, « La vérité », in Sinaceur A. (éd.), *Penser avec Aristote*, Erès, p. 453-57.
- 1991, « Le lieu et l'espace », in Sinaceur A. (éd.), *Penser avec Aristote*, Erès, p. 483-88.
- 1991, « Le système technique-science-philosophie : un ménage à trois fécond », *Revue internationale de systématique*, 5, p. 171–180.
- 1992, « La philosophie de Niels Bohr », *Horizons philosophiques*, 2 (2), traduit par Y. Robidoux, p. 27-50.
- 1994, *La science, sa méthode et sa philosophie*, Vigdor, traduit par A. Herman.
- 1994, « L'écart entre les mathématiques et le réel », in Porte M. (éd.), *Passion des formes : dynamique qualitative, sémiophysique et intelligibilité : à René Thom*, « Theoria », 1, Fontenay-aux-Roses, France, ENS éditions.
- 1996, *Intuition et raison*, Vigdor, traduit par A. Herman.
- 1998, « Une caricature de la science : la nouvelle sociologie de la science », *www.vigdor.com*, traduit par A. Herman.
- 2003, « Considérations d'un philosophe sur l'économie du néo-conservatisme (néo-libéralisme) », traduit par Services de traduction de l'Université McGill, Classiques des sciences sociales.
- 2004 [2001], *Matérialisme et humanisme : pour surmonter la crise de la pensée*, Liber, traduit par L.-M. Vacher, *Philosophy in Crisis : the Need for Reconstruction*, Prometheus Books.
- 2004, « Vers un nouveau matérialisme », in Dubessy J., Lecointre G. & Silberstein M. (éd.), *Les matérialismes et leurs détracteurs*, « Collection « Matériologiques » », Syllepse, p. 75-80.
- 2006, « La philosophie derrière la pseudoscience », *Science et pseudo-sciences*, n° 275.
- 2006, « Matérialisme et sciences », *Matière première (Syllepse)*, 1, p. 251-62.
- 2008 [1981], *Le matérialisme scientifique*, Syllepse, traduit par S. Ayache, P. Deleporte, É. Guinet & J. Rodriguez-Carvajal, *Scientific Materialism*, Reidel.
- 2008, « Préface », *Voir la société : le micro et le macro*, « Société et pensées », Hermann, p. 11-14.
- 2013, « La physique quantique réfute-t-elle le réalisme, le matérialisme et

- le déterminisme ? », in Silberstein M. (éd.), Cornuault N. (trad.), *Matériaux philosophiques et scientifiques pour un matérialisme contemporain*, Éd. Matériologiques, p. 417-34.
- 2016 [2016], *Entre deux mondes : mémoires d'un philosophe-scientifique*, Éd. Matériologiques, traduit par P. Deleporte, *Between Two Worlds : Memoirs of a Philosopher-Scientist*, Springer.
- 2019 [2013], *Philosophie de la médecine : concepts et méthode*, Éd. Matériologiques, traduit par P. Deleporte, *Medical Philosophy : Conceptual Issues in Medicine*, World Scientific.
- 2020 [2003], *Dictionnaire philosophique* (à paraître), Éd. Matériologiques, traduit par F. Maurice, *Philosophical Dictionary*, Prometheus Books.

4.2 TEXTS IN FRENCH DEVOTED TO MARIO BUNGE'S THOUGHT

- Belley P., 2001, *La technologie dans le système de Mario Bunge et son application à l'ingénierie sociale : le cas du développement durable*, Thèse, Université Laval.
- Chapoulie J.-M., 1969, « Un type d'explication en sociologie : les systèmes de variables en relations causales », *Revue Française de Sociologie*, 10 (3), p. 333.
- Deleporte P., 2013, « Le matérialisme scientifique de Mario Bunge », in Silberstein M. (éd.), *Matériaux philosophiques et scientifiques pour un matérialisme contemporain*, Éd. Matériologiques, p. 93-110.
- Espinoza M., 1992, « Les quatre causes : De Bunge à Aristote », *Revue Philosophique de la France et de l'Étranger*, 182 (3), p. 297-316.
- 1994, « Le réalisme scientifique : une métaphysique tronquée », *Archives de Philosophie*, 57 (2), p. 325-40.
- Jodoïn L., 2010, « L'héritage intellectuel de Mario Bunge : entre science et philosophie », *Philosophiques*, 37 (2), p. 439-55.
- 2013, « L'émergence et la réalité des états compatibles inobservables : le cas de l'entropie », in Silberstein M. (éd.), *Matériaux philosophiques et scientifiques pour un matérialisme contemporain*, Éd. Matériologiques.
- Landry C., 1989, « Entretien avec Mario Bunge », *Philosopher : revue pour tous*, 8, p. 25-33.
- Mahner M., 2013, « Le rôle du naturalisme métaphysique en science », in Silberstein M. (éd.), *Matériaux philosophiques et scientifiques pour un matérialisme contemporain*, Éd. Matériologiques.
- Maurice F., 2017, « Une triade scientifique ? », in Silberstein M. (éd.), *Qu'est-ce que la science... pour vous ?*, Éd. Matériologiques, p. 169-73.
- Russo F., 1973, « L'épistémologie de Mario Bunge », *Archives de Philosophie*, 36 (3), p. 373-93.

- Silberstein M., 2013, « La fonction architectonique du matérialisme », in Silberstein M. (éd.), *Matériaux philosophiques et scientifiques pour un matérialisme contemporain*, Éd. Matériologiques.
- 2013, « L'«unité plurielle» du matérialisme », in Silberstein M. (éd.), *Matériaux philosophiques et scientifiques pour un matérialisme contemporain*, Éd. Matériologiques.
- 2013, « Science(s) et matérialisme(s) : examen des conditions d'une synonymie », in Silberstein M. (éd.), *Matériaux philosophiques et scientifiques pour un matérialisme contemporain*, Éd. Matériologiques.
- Vacher L.-M., 1993, *Entretiens avec Mario Bunge : une philosophie pour l'âge de la science*, Montréal, Liber.

4.3 WORKS ON OR AROUND MARIO BUNGE

- 1990, *New Ideas in Psychology*, vol. 8, no 2 et 3.
- Agassi J. & Cohen R. (éd.), 1982, *Scientific Philosophy Today : Essays in Honor of Mario Bunge*, Reidel/Kluwer.
- Denegri G. & Martínez G., 2000, *Tópicos actuales en filosofía de la ciencia : Homenaje a Mario Bunge en su 80° aniversario*, Universidad Nacional de Mar del Plata-Editorial Martín.
- Denegri G., 2014, *Elogio de la sabiduría : ensayos en homenaje a Mario Bunge en su 95° aniversario*, Eudeba.
- Matthews M., 1996, « Editorial for a special issue on science and education in honor of Mario Bunge », *Science & Education*, vol. 5, no 2.
- Matthews M., 2003, « Mario Bunge : Physicist and Philosopher », *Science & Education*, vol. 12, no 5 et 6.
- Matthews M., 2012, « Mario Bunge, Systematic Philosophy and Science Education : An Introduction », *Science & Education*, volume 21 no 10.
- Matthews M., 2019, *Mario Bunge : a Centenary Festschrift*, Springer.
- Moessinger P., 1991, « Editorial », *New Ideas in Psychology*, vol. 9, no 2.
- Pickel A., 2004, « Systems and Mechanisms : A Symposium on Mario Bunge's Philosophy of Social Science », *Philosophy of the Social Sciences*, volume 34, no 2.
- Silberstein M. (éd.), 2013, *Matériaux philosophiques et scientifiques pour un matérialisme contemporain*, Éd. Matériologiques.
- Weingartner P. et Dorn G., 1990, *Studies on Mario Bunge's Treatise*, Rodopi.

References

- Bunge M., 2016, *Between Two Worlds : Memoirs of a Philosopher-Scientist*, Switzerland, Springer.

