FRENCH STUDIES IN THE PHILOSOPHY OF SCIENCE

Contemporary Research in France

Edited by

ANASTASIOS BRENNER
Université Paul Valéry - Montpellier III, France

and

JEAN GAYON
Université Paris I - Panthéon Sorbonne, Paris, France

Springer
Editors

Anastasios Brenner
Département de philosophie
Université Paul Valéry-Montpellier III
route de Mende
34199 Montpellier cedex 5, France
anastasios.brenner@wanadoo.fr

Jean Gayon
Institut d’histoire et de philosophie
des sciences et des techniques
Université Paris I-Panthéon Sorbonne
13 rue du Four
75006 Paris, France
gayon@noos.fr
## Contents

**Introduction**  
Anastasios Brenner and Jean Gayon ............................................. 01

**Part I: Styles in Philosophy of Science and Technology**

1 Anne Fagot-Largeault: The Legend of Philosophy’s Striptease: Trends in Philosophy of Science ......................... 25

2 Daniel Parrochia: French Philosophy of Technology ................. 51

**Part II: General Philosophy of Science**

3 Anastasios Brenner: A Problem in General Philosophy of Science: The Rational Criteria of Choice ...................... 73

4 Sandra Laugier: Science and Realism: The Legacy of Duhem and Meyerson in Contemporary American Philosophy of Science .......... 91

**Part III: Physical and Chemical Sciences**

5 Gilles Cohen-Tannoudji: Philosophy and 20th Century Physics ........ 115

6 Hervé Zwirn: Foundations of Physics: The Empirical Blindness ........ 141

7 Bernadette Bensaude-Vincent: Philosophy of Chemistry .............. 165

**Part IV: Life Sciences**

8 François Dagognet: Pharmacology as a Philosophical Object .......... 189

9 Jean Gayon: Philosophy of Biology: An Historico-critical Characterization .................................................. 201

10 Claude Debru: Philosophy and Contemporary Biological Research .... 213
Part V: Philosophy of the Behavioral and Cognitive Sciences

11 Joëlle Proust: What Is a Mental Function? ........................................ 227

12 Daniel Andler: Philosophy of Cognitive Science ............................. 255

Part VI: Philosophy of Economics

13 Philippe Mongin: Duhemian Themes in Expected Utility Theory ........ 303

Notes on the Authors ........................................................................... 359

Name Index ......................................................................................... 367
The first two sections of this introduction provide an overview of the history of philosophy of science in France. The last section comments on the specific content and structure of the present book.

1 An Attempt at Periodization

For those who first encounter French philosophy of science the prominence of Gaston Bachelard (1884–1962) comes as somewhat of a surprise. His thought does not fit in easily with the familiar currents: neo-Kantianism, pragmatism, logical positivism. His own labels – applied rationalism and technical materialism – are perplexing. The reception of his works in English-speaking countries was belated, and his influence there has been slight. Yet Bachelard was a prolific and an inventive author. Trained in mathematics, physics and chemistry, he was quick to turn philosophical reflection toward the new theories of his day: atomism, relativity and quanta. His relentless efforts yielded some 20 books. From philosophy of science Bachelard was led further to the study of imagination and poetry. He did not fail to conceptualize his experience as a science teacher and later a professor of philosophy, providing incentive remarks that could inspire pedagogical reform. His
observations on the role of science in society could even be called upon in the context of political thought. Georges Canguilhem (1904–1995), claiming to pursue his legacy in the philosophy of medicine, initiated what can be termed a Bachelardian school. In turn Michel Foucault (1926–1984) brought this school to the attention of an international audience. Bridging at least three generations, Bachelard’s thought continues to be felt in the works of several authors in this volume.

Yet when Bachelard came on stage, philosophy of science was already a well-established discipline in France. His two thesis supervisors, Léon Brunschvicg (1869–1944) and Abel Rey (1873–1940), had provided him with methods of inquiry as well as an institutional setting. The former had initiated him to an original brand of neo-Kantianism and convinced him of the decisive character of mathematical reasoning in the sciences. Abel Rey had shown him how to elaborate a precise philosophical reflection with respect to earlier changes in science: thermodynamics, electromagnetism and atomic theory. There are also those important figures of the past generation whose ideas at first inspired Bachelard and then to which he reacted: Henri Poincaré (1854–1912) and Pierre Duhem (1861–1916). Finally, one should not forget the importance of Émile Meyerson (1859–1933) with whom Bachelard was to constantly measure himself.

To reach the inception of philosophy of science, we must go back still further. Auguste Comte (1798–1857) is certainly to be counted as one of its founding fathers.\(^1\) His *Cours de philosophy positive* provided an impressive picture of the complete spectrum of the sciences and initiated several major topics of this new field of studies.\(^2\) The 50-year period that begins with the publication of the first volume of this work in 1830 and ends in 1870 we may take as the founding years. Various historical factors can be invoked to explain the emergence of philosophy of science. The chemical revolution, the impact of industrial developments showed the need to reconsider the synthesis provided by Diderot and d’Alembert in their *Encyclopédie*. The French revolution carried with it projects of social reorganization and educational reform. Comte’s initiative runs parallel to attempts occurring in Europe at the same time, provoked by similar causes but carried out in different manners: for example Bolzano’s *Wissenschaftslehre* (1837) and Whewell’s *Philosophy of the Inductive Sciences* (1840).\(^3\)

Comte set the agenda in several respects for philosophy of science in France. Positivism, in one form or another, dominated here the philosophical scene until World War One, and even later thinkers who had relinquished positivism continued to pay tribute to him, most notably Canguilhem and Michel Serres.\(^4\) First and foremost there is Comte’s decision to favor a historical approach over a logical one. Philosophy of science, he continually asserts, must be grounded on history of science. This trend was to characterize in the main French philosophy of science. As an attempt to direct philosophical reflection toward science and to make scientific knowledge a model, positivism, in its various forms, has been intimately bound up with a large portion of philosophy of science either as a source inspiration or as a target for criticism: from Comtian positivism to logical positivism and even to post-positivism. It is thus important to come to grips with the significance and role of this doctrine. The Vienna Circle acknowledged a debt toward Comte, and one finds in the latter at times some astonishing anticipations: Comte formulates an empirical
criterion of meaning in order to exclude metaphysics and adopts with respect to the development of science a resolutely sociological approach. Some of the questions considered essential by Comte however lost their importance or disappeared altogether. He went to great pains to draw up a classification of the sciences and delimit the fundamental disciplines. By the end of the 19th century science had given rise to much interdisciplinary research, and readers of Comte could ironize on the limitations he imposed. On the other hand, topics to become central such as measurement or theory confirmation did not receive much attention in his works.

There were other important figures from this period: André-Marie Ampère (1775–1836), Antoine-Augustin Cournot (1801–1877) and Claude Bernard (1813–1878). Ampère’s *Essai sur la philosophie des sciences* (1834) is among the early works to signal an autonomous reflection on science. Although it quickly fell into oblivion, it is part of the story, as a book with respect to which both Comte and Whewell could contrast their own conceptions. Ampère provides a link with the philosophizing that went on in the vigorous scientific movement of the 18th century as well as a close reworking of the conceptions of the encyclopedists. He is however best remembered for the controversial claim he made with respect to his major scientific contribution that his mathematical theory of electrodynamic phenomena was “entirely deduced from experience”. More subtle perhaps is the emphasis he places, in introducing his theory, on the descriptive task of science and its separation from metaphysical speculation. This prepared the ground for phenomenalist conceptions. It also showed the need to develop a discipline that would take up those questions left unanswered by science.

Cournot produced a series of noteworthy philosophical works, associating subtle philosophical analysis with careful historical study, among others *An Essay on the Foundations of Our Knowledge* (1851). In these works he breaks with the limits imposed on science by Kant and goes beyond Comte’s harnessing of science for social purposes. He does not shrink from addressing questions of origin, that of the universe or that of life. Cournot provides an attempt to follow up the metaphysical implications of science. Thus, in his view, science leads us to conceive our solar system like an island in a boundless, uncentered universe. Cournot also develops, in contradistinction to positivism and phenomenalism, a realist position in philosophy of science.

Bernard, who made a number of significant contributions to medicine, went on to reflect on his practice as a scientist. He explored the philosophical problems raised by the life sciences and brought attention to the precise features of experimental method. His *Introduction to the Study of Experimental Medicine* provided the background for discussions throughout the 19th century.

The Franco-Prussian War in 1870 not only signals a change of political system – the end of the Second Empire and the beginning of the Third Republic – but led a whole generation to reflect on French science and to seek to emulate the German university. We see here a second 50-year period running until the end of the First World War in 1918. Ushered in by Paul Tannery (1843–1904) and Émile Boutroux (1845–1921), this period is characterized by the institutionalization of the discipline. While Tannery called on Comte’s pioneering studies,
he sought to go beyond his very general and at times frankly superficial survey and give rise to genuine historical research, reading and editing manuscripts and correspondences. He thereby set the groundwork for the studies of Duhem and Gaston Milhaud (1858–1918) who were intent on bringing out the philosophical implications of scientific evolution. Boutroux, although primarily a historian of philosophy, directed attention to science. Along with Charles Renouvier (1815–1903), he brought the intricate conceptual system of Kant to bear on the scientific problems of the day. To this effect he resorted to Comte, producing a peculiar brand of rationalism and positivism.

It is telling of the attraction that philosophy of science exerted in those years to learn that Henri Bergson (1859–1941) was at first tempted to embrace this specialty. As he confides to William James in a backward glance on his formative years:

My intention was to devote myself to what was then called “philosophy of science” and, with this in mind, I set out to examine some fundamental scientific notions. It was the analysis of time as it occurs in mechanics or physics that overturned all my ideas.  

The elaboration of his metaphysics is thus preceded by a period of philosophical scrutiny of science. And his mature thought develops claims with respect to space, time, consciousness and life that have implications for philosophy of science. There were those who sought to follow up the consequences of his thought in this direction. But through the controversies he spurred and his insistence on questions avoided by scientific research, Bergson was a thinker philosophers of science had to contend with.

A succession of scientific revolutions was to provoke a reworking of the picture of knowledge: non-Euclidian geometry, the theory of evolution, thermodynamics and electromagnetism. One of the leading figures was Poincaré. His research in mathematics convinced him that non-Euclidian geometry was not a mere fiction but a fruitful conceptual construction. Meditating on the nature of geometrical hypotheses, Poincaré advanced the idea that they are conventions. Thereby he rejected both John Stuart Mill’s claim that they are empirical facts and Kant’s contention that they are synthetic a priori propositions.

Duhem formulated a similar idea with respect to physics. Hypotheses are not directly derived from experience; they are founded on the free choice of the theoretician. Indeed, Duhem condemns the Newtonian method of inductions and the procedure of crucial experiment. Experimental refutation is more complex than it was generally believed. This led to the holist thesis Quine was to formulate in the context of a logical analysis of science.

These striking results were taken up by several philosophers and scientists. Édouard Le Roy (1870–1954), a mathematician who had studied under Poincaré before embracing Bergson’s philosophical perspective, perceived here the rise of an intellectual movement that he labeled – it is worth noting – “a new positivism”. This reformulation of positivism captures in part what Duhem, Milhaud and Abel Rey were striving to do. It attracted the attention of young Austrian scholars who were to found the Vienna Circle and provides a connection between the philosophical traditions of France and Austria that deserves to be emphasized. However, the aim here was to moderate Comte’s strictures on theoretical speculation and metaphysics.
Le Roy emphasized the novelty of these reflections on science; he was one of the first to make use of the term épistémologie or epistemology, as we shall simply transpose it here. The term designates in French usage philosophy of science rather than theory of knowledge. What was being proposed was an investigation precisely centered on scientific activity. This carried an implicit criticism of earlier philosophy of science, as practiced by Comte and Ampère, and signaled a shift in the discipline.

In connection with these debates over the nature of scientific theories were early ventures to introduce philosophy of science into the university curriculum. One of the first seems to have been Arthur Hannequin (1856–1905), who around 1890 proposed courses under this heading at the Faculty of letters of Lyon. In 1892 a chair of “General history of science” was instituted at the College de France. Although historical in orientation, the generality aimed at expresses a philosophical concern. Shortly thereafter Milhaud set up a program of study in philosophy of science at Montpellier. His endeavor was crowned by success, and a chair of history of philosophy in its relation to science was created for him at the Sorbonne in 1909. This chair was to play a pivotal role in the future of the field, being held successively by Abel Rey, Bachelard and Canguilhem.

Although Meyerson belonged to the same generation as Poincaré and Duhem, he published his first book Identity and Reality in 1908, and his philosophy came to attract attention especially after World War One. The interwar years represent a turn in philosophical reflection on science. Several prominent figures had disappeared during the war, and the new scientific theories called for a reexamination of past views. Meyerson refused Poincaré’s recourse to induction and probability as a way of justifying hypotheses as well as Duhem’s deductive and holistic solution. He called on common reasoning and a psychological study of science. The hypotheses of science are plausible. The mind seeks identities, to which the real opposes resistance. Trained as a chemist under Bunsen and well-versed in German philosophy, Meyerson brought a different outlook as he became involved in discussions in France.

Taking up Poincaré’s ideas, Abel Rey was careful to emphasize the tendency toward realism. He was in particular struck by the recent discoveries of atomic theory. Philosophy of science was to be based on history of science, and Abel Rey was led to elaborate a historical approach based on techniques developed in the social sciences. He was fortunate enough to have his thesis Physical Theory according to Contemporary Physicists, a synthetic presentation of the turn-of-the-century debates, seized upon by the logical positivists. Abel Rey was furthermore included among Neurath’s collaborators to the Encyclopedia of Unified Science. However, this promising connection between French conventionalism and Austrian positivism was cut short. The First Congress of Scientific Philosophy was indeed held in Paris in 1935, but logical positivism presented at this early stage a radical program, and French philosophers by then were trying to shake off the long influence of positivism. Whereas the Vienna Circle and those associated with it were to have a strong impact in English-speaking countries, it is to be noted that French philosophy of science followed a very different pattern of development.
Abel Rey had taken up Milhaud’s chair at the Sorbonne, and he brought about the founding of the Institut d’histoire des sciences et des techniques. The aim of this institute was to encourage cooperation between the sciences and the humanities. Several prominent scientists were involved, and it gave rise to significant international collaboration. Thereby was achieved a strong institutional recognition of history of science and philosophy of science.

We may now return to Bachelard, who succeeded to Rey. He can be credited with having forcefully directed philosophical attention to the latest scientific theories. Along with Koyré, he was convinced that the succession of revolutions that had shaken science since the discovery of non-Euclidian geometry called for a “philosophical revolution”. Borrowing a phrase from Reichenbach, Bachelard spoke of a “conflict of generations”, and he was quickly led to spell out the inadequacies of the philosophical conceptions of his predecessors. In a typical passage of The New Scientific Spirit of 1934, Bachelard states:

One understands (…) the rejection of Poincaré’s opinion concerning the supreme convenience of Euclidian geometry. This opinion seems to us more than just partially erroneous, and, reflecting on it, one derives more than a lesson of prudence in forecasting the destiny of human reason. By correcting it, one is led to a genuine reversal of value in the rational realm and one recognizes the essential role of abstract knowledge in contemporary physics.

Although Bachelard emphasizes the component of action in knowledge, he refuses to let himself be drawn toward pragmatism. We know that Poincaré called on simplicity in order to defend the choice of Euclidian geometry as the language of physics. After the advent of the theory of general relativity, such a position could no longer be held. Bachelard not only invites us to take into account the global simplicity of the theoretical system; he suggests the importance of consistency. Science in its progress seeks to coordinate apparently divergent theories. This leads to a transformation of rationality itself. Bachelard developed his philosophy on broad lines. Following in this Duhem and Meyerson, he carried his philosophical inquiry into the field of chemistry – a science conspicuously neglected by the Vienna Circle.

Bachelard clearly marks a transition in philosophy of science. One perceives in his first book, Essai sur la connaissance approchée, how the idea of an “inductive power of mathematics” took shape. One also learns how Bachelard realized from the outset the meaning he sought to give to words like reality and realism:

Knowledge, if it is not to go against its principle of continual increase, cannot be tautological. It must therefore imply, willingly or not, an unknown element in the substantive that analysis claims to resolve into predicates. Thus one can turn down the realism of notions while accepting as constant a progressive reification. This constructive ontology never reaches its term, because it corresponds rather to an action than a finding. Should the object be at one moment assimilated and rationalized as it were, erased as an obstacle, reduced by analysis to its true nature as a notion; the same constructive process will then relate it to a new irrational. Generalization in mathematics tends to absorb the fields that border on the primitive field […]. This constructed realism will therefore set down a whole series of successive data. The elements will take on in these fields truly different existences, and it will be by an abuse of ontology that we shall forget the conditions that pertain only to these fields in order to transform them into properties truly belonging to the entities.
Let us emphasize the expressions of “constructive ontology” and “constructive realism”, which summarize the epistemological ontology developed in the later works.

Bachelard is not content to reformulate positivism; he opposes positivism altogether. Bachelard did not embrace logical analysis. He continued the historical approach, but affected a change in method. A continuist conception of scientific evolution had dominated up until then, this most prominently in Meyerson’s version: scientific knowledge evolved from common knowledge, and each stage of science was historically linked with the precedent. A different model underlies Bachelard’s view of progress, which is marked by a series of discontinuities, both at the historical and the cognitive levels. It is accompanied by the insistence on a “recurrent reading” of history: today’s science reveals the potentialities of past science.

It was after World War Two that Bachelard, who had been elected to the Sorbonne in 1940, gave full compass to the philosophical claims set out in the mid 30s and acquired his ascendancy over the field. Yet invasion, fascism and deportations had profound consequences on philosophy and justify our marking out a new period. The years from 1945 to 1970 can be characterized as those of a rather autonomous development: a deepening of this heritage in a direction leading away from idealism and an interaction with the intense debates over existentialism and political theories.

Canguilhem, who succeeded to Bachelard in 1955 at the Sorbonne (chair of history and philosophy of science), is often closely associated with the latter as a key figure of the “French style in philosophy of science”. Both authors indeed emphasized the necessary link between history and philosophy of science, and they were equally opposed to any kind of analytical approach to philosophy of science. Furthermore, Canguilhem had a strong personal relationship with Bachelard, and an impressive institutional and intellectual network developed around the two of them. Thus the “Bachelard-and-Canguilhem” style moulded the ethos of most of French philosophy of science in the second half of the 20th Century. Nevertheless Canguilhem’s approach to philosophy of science is sensibly different from Bachelard’s. The two philosophers differed first by their subject matter. Whereas Bachelard had a scientific background in mathematics, physics and chemistry, Canguilhem started on a medical curriculum shortly before World War Two, which led him to defend in 1943 a MD thesis on the concepts of the normal and the pathological. Under the title *Le normal et le pathologique*, this work remains today one of the most important in philosophy of medicine. It has been translated into English and in a number of other foreign languages. Though Canguilhem’s reflection on the life sciences extended far beyond medicine, it continued to be deeply influenced by his primary interest in medicine. A second important difference between Canguilhem and Bachelard is the former’s major interest and investment in history of science. For Canguilhem, the effective practice of history of science was immensely important for philosophy of science. Almost all of Canguilhem’s writings after 1943 closely combine the most rigorous approach to history of science (which earned him the prestigious Georges Sarton Medal) and a kind of philosophy of science based on the conviction that the genesis of concepts sheds irreplaceable light upon the problems
of philosophy of science.\textsuperscript{23} This doctrine and, probably more importantly Canguilhem’s vivid example, certainly contributed to shape the spirit and method of the vast majority of French philosophers of science in the past 50 years.\textsuperscript{24}

In the late sixties and early seventies two new directions emerged: on one hand, the application of philosophical reflection to a larger variety of objects and, on the other, an opening toward other traditions.

Foucault acknowledged his debt toward Canguilhem,\textsuperscript{25} who reversely considered that Foucault had more radically accomplished his own program. He developed Bachelard’s and Canguilhem’s “historical epistemology”,\textsuperscript{26} giving it a broader and more systematic orientation. Foucault did not indeed limit himself to philosophy of science proper, but sought to track down the interrelation of our elements of knowledge. He contested traditional separations, emphasizing the relation between knowledge and power. This led to his archeology of knowledge and his historical ontology. Whereas Bachelard was interested in revolutionary science, Foucault turned toward the reorganization of systems of knowledge over the long term. He sought to map out the trajectory of concepts and practices, that is the precise conditions of their historical constitution.

There is also a close connection between Canguilhem and François Dagognet (see the chapter by this author in the present volume). After training both in philosophy and medicine (psychiatry), Dagognet (born in 1924) who was also Bachelard’s \textit{protégé}, first devoted himself to history of biology and medicine (resulting in a major book on Pasteur),\textsuperscript{27} and to philosophy of medicine (his book on “remedy”).\textsuperscript{28} Although Dagognet came to occupy the same chair of history and philosophy of science as Bachelard and Canguilhem, and played an institutional role quite similar to Canguilhem, his writings (numbering more than 60 books) extend to many more subjects than his mentors. Not only did he write on a huge array of scientific and technological topics going far beyond biology and medicine), but also on almost all possible subjects in philosophy, including morals, politics, religion, and art. The most distinctive trait of his thinking is to have attempted systematically to reevaluate a number of traditional philosophical problems in the light of present scientific knowledge. We know of no other contemporary philosopher who could more vividly illustrate Canguilhem’s dictum: “Philosophy is a reflection for which any foreign matter is good – and we hasten to add – for which any good matter should be foreign”. As Bachelard, Canguilhem, and Foucault, Dagognet always felt alien to logical empirism and analytic philosophy.

On the other hand, Jules Vuillemin, Gilles-Gaston Granger and Jacques Bouveresse attracted attention to logical empiricism and analytic philosophy, leading to an attentive examination of these currents. Vuillemin (1920–2001) came from the school of historians of philosophy that had formed around Martial Gueroult. He had followed the teaching of Bachelard and Cavaillès. In his early works on Descartes and Kant he endeavored to bring out the connection between their metaphysical ideas and the scientific method which inspired them; he was intent on revealing the axiomatic organization underlying their philosophical systems. Vuillemin was thereby drawn to analytic philosophy, which he helped to propagate in France.\textsuperscript{29} However he did not hesitate to express his reluctance to give up historical inquiry:
Making my way (…) a difference between me and the majority of Anglo-Saxon analysts emerged. There were those who, singlemindedly interested in chasing down grammatical errors in the talk of philosophers, forgot the existence of scientific languages. But even those who applied the method of “rational reconstruction” to these latter more often imposed on them principles of their own choice. I resisted this violence done to history, and trusted in the sciences such as they are, and not such as they should be. Moreover, it is presumptuous to neglect the philosophical tradition.\textsuperscript{30}

As for Granger (born in 1920), he had explicitly assigned himself from the very beginning the task of bringing together the threads of rational inquiry that had separated into two antagonist currents at the beginning of the 20th century: Anglo-American schools of thought resorting to logical and linguistic analysis as opposed to Continental ones devoted to conceptual and historical study.\textsuperscript{31} Bouveresse (born in 1940), in turn, devoted much energy to exploring Wittgenstein and the Austrian tradition, which he brought forcefully to the attention of the French philosophical community. Going beyond this source of inspiration he has produced an abundant series of original and vigorous studies on knowledge and science.\textsuperscript{32}

Yet when logical empiricism came to receive sustained attention in France, it was no longer a dominant movement. It had come under severe criticism both by philosophers using logical methods but rejecting its dogmas as well as by philosophers calling on history. Analytic philosophy had likewise undergone changes; logic had been in some quarters replaced by ordinary language. Thus Carnap, Reichenbach and Russell were studied along with the second Wittgenstein, Quine, Popper and Kuhn. Logical empiricism had by then become the object of critical scrutiny and historical examination. This would eventually lead to a series of studies that could be seen to converge with a program of research in the origins of logical empiricism and the sources of analytic philosophy.

\section{Methods and Objects}

In the course of its development philosophy of science changed considerably. Various manners of characterizing reflections on science were proposed. Although Comte was concerned with general issues, he was careful to distinguish the sciences with respect to method and object. Philosophy was thus applied in turn to each fundamental science, and Comte most often used the term philosophy with a defining adjective: “mathematical philosophy, astronomical philosophy, physical philosophy, chemical philosophy and biological philosophy”.\textsuperscript{33} This gave rise to what has been named regional epistemologies; philosophical considerations are to be formulated with respect to specific scientific context. There is however a certain ambiguity here: is such reflection part of the sciences considered or something autonomous? In earlier usage philosophy could designate simply the essentials of a scientific field, its principles and methods. Later Ernest Renan was to coin the generic expression “scientific philosophy”.\textsuperscript{34} He thereby referred to a particular tradition in French thought devoted to be sure to science but also naturalistic in orientation. In addition he was intent to promote a rigorous philosophy based on the model of science,
which could be seen to lead to a form of positivism better called scientism. The expression scientific philosophy was to remain in use alongside philosophy of science. But philosophical reflection came to mark its difference with respect to the sciences that constitute its subject matter – a metadiscourse.

What characterizes a large portion of French philosophy of science is the importance allotted to history. This is apparent in the early formulation of the discipline by Comte as well as its later institutional establishment. Of course, a historical approach can be pursued in many ways, and in the context we are examining, it indeed gives rise to a variety of styles of research. One direction consists in grounding philosophy of science upon the history of science. In the absence of empirical testing, history of science provides a means of assessing philosophical conceptions of science. This is particularly clear in Duhem. His *Aim and Structure of Physical Theory* furnished an analysis of the stages involved in the construction of a scientific theory. But this “logical analysis”, as he termed it, was to be followed by a historical study, and the numerous volumes he devoted to the evolution of science since Antiquity bear witness to this preoccupation. Such a method was followed by many of his contemporaries, for example Meyerson and Brunschvicg. Post-positivists were later to call on this tradition in their effort to reassert the importance of history, and this was one of the trends of the French tradition that received the most sustained interest abroad. Yet if it is reasonable to require that philosophical conceptions be justified in some sense by the historical record, it is not obvious that philosophy should be modeled solely on the scientific method of empirical testing.

Another significant line of research is directed toward the history of philosophy in its relation to the sciences. It was encouraged by scientifically inclined historians of philosophy, such as Boutroux. Milhaud in introducing philosophy of science within the university curriculum was careful to link this specialty with the history of philosophy, which has always played an important role in France. The study of the scientific background provided a promising way to renew the interpretation of the great systems of the past. Koyré, in turn, formulated a philosophically oriented history of science. He revealed the philosophical motivations underlying the works of Galileo and Newton among others. The early writings of Vuillemin and Granger further scrutinized the connection of science and metaphysics in Aristotle, Descartes and Kant.

Bachelard had misgivings over antecedent conceptions of scientific growth as a continuous process, exemplified in particular by Meyerson. He set about to elaborate what has been named a “historical epistemology”. Study of past science still retained to be sure its importance. But it was to be placed within a clearly discontinuist conception, inspired by the recent discoveries in science. Scientific revolutions are accompanied by breaks between common knowledge and scientific knowledge. Bachelard made explicit the position from which the philosopher observes the past: a reading is accomplished with respect to current science and must be continually renewed. This perspective set the agenda for the intricate and subtle historical studies pursued by Canguilhem and Foucault.

Recently has emerged a conscious effort to understand the history of philosophy of science. French studies in this area are not unrelated to an ongoing program of
research at the international level. One of the aims of this program is to explore the origins of logical empiricism and the sources of analytic philosophy. Different motivations may underline this historical perspective: one may wish to encourage a reappraisal of these movements, after the diverse criticisms leveled at them by their antagonists or hope to bridge the divide between Anglo-American and Continental traditions. This program has taken a particular turn in France leading also to a study of phenomenology, a current whose influence was strong. Husserl’s connection with Austrian thought has been emphasized. In addition French philosophy of science prior to Bachelard has become the object of a more thorough and systematic investigation.

Philosophy of science, which during its early development had concentrated on theory, gradually expanded its compass to include the concrete aspects of scientific activity. The advent of a philosophy of action, Bergson’s claim that humankind is best described as *homo faber* and turn-of-the-century debates over experimental method initiated a shift. Each scientific instrument has its own theory, whose purpose is to explain how it works and how it is to be applied. In turn the theorist must take into account the approximate nature of observations. Observatories and laboratories are vast networks of instruments. A sharp boundary between theory and practice is brought into question. Instrumentation reacts on the theoretical construction.

Nevertheless Bachelard’s move away from the idealism that had dominated until then opened up a new path. The “applied rationalism” and “instructed materialism” of his later thought made it possible to truly take into consideration other aspects of science. His “phenomenotechnics” was seen as a call for a precise description and careful analysis of the material aspects of science. This led to an interest in machines and technology that his followers were to take up: Canguilhem, Gilbert Simondon (1924–1989) as well as François Dagognet and Bruno Latour (born in 1947). Philosophical reflection was applied to numerous unusual objects: factories, automata, computers, airplanes, spaceships. Along similar lines Dominique Lecourt (born in 1944) has explored the interaction between humankind and science, the fears provoked by technology and the myths surrounding progress.

Although there was some resistance on the part of French philosophers – and also mathematicians – to the development of mathematical logic, it would be wrong to think that there was no interest in applying formal methods in philosophical reasoning. Poincaré, who was preoccupied by the foundations of geometry and arithmetic, provided an examination of the construction of our notion of space, which calls resolutely on mathematical reasoning. Duhem, who was in the process of developing a highly deductive presentation of thermodynamics, formulated a precise analysis of the structure of physical theories. He came close to what has been called the standard view of scientific theories. If modern logic makes it possible to reach a more precise formulation, the main outline was nevertheless in place: theories are axiomatic systems in which the theoretical concepts receive meaning in terms of observables with the help of correspondence rules. One understands how logical positivists could find inspiration in the work of these philosopher-scientists. During the first half of the 20th century there were indeed several significant attempts in applying logic or mathematical methods to philosophical problems by Louis Coutu-
rat (1868–1914), Jean Nicod (1893–1924), Jean Cavaillès (1903–1944), Jacques Herbrand (1908–1931), Albert Lautman (1908–1944), all tragically cut off short—
that the loss was not easily compensated may point to the difficulty of forming specialists in this field within the French educational system.\textsuperscript{44} It was as if everything had to be started over again after World War Two.

Following this interruption, there were several meritorious attempts to reestablish philosophically inclined work in logic.\textsuperscript{45} Robert Blanché (1898–1975), although somewhat isolated, published many books on logic, its history and the foundations of mathematics, providing an account of new developments in many-valued systems and modalities. Roger Martin was instrumental in setting up a program of study in logic within the philosophical curriculum at the Sorbonne. The reception and diffusion of research in this area however was somewhat belated in France. Scholars interested in the analytic tradition, such as Maurice Boudot, Maurice Clavelin and Jean-Claude Pariente, still had to push in the 1970s and 1980s for a better knowledge of logic.\textsuperscript{46} More recently there has been the work of Philippe de Rouilhan and Jacques Dubucs, who have established a noteworthy program in logic within the Institut d’histoire et de philosophie des sciences et des techniques. One may also signal a line of development in deontic logic, initiated by the Polish logician, Georges Kalinowski, who settled in France, followed up by Jean-Louis Gardies and more recently by Patrice Bailhache.

There has been a slow but steady increase of interest in logic in France, which has accompanied the advent of analytic philosophy. However as philosophy of mind has now come to replace philosophy of language, it is to be feared that this interest may slacken.\textsuperscript{47}

3 Philosophy of Science in France Today

In the two previous sections, we sought to present the origins, the development and the major tendencies of French philosophy of science on the long run. We shall now characterize the intentions and scope of the present volume.

The origin and purpose of the book deserves being explicated. Although the two editors are known to have dwelt on several figures and aspects of “French epistemology” (i.e. philosophy of science),\textsuperscript{48} they did not want to produce another historical book. What we proposed to Springer was to publish in the Boston series of Philosophy of Science a collection of essays by significant contemporary French figures in philosophy of science. For several decades, the publisher had been willing to provide such a volume, but all attempts seem to have failed because of the rivalry between schools of thought and networks, and of the sometimes highly conflictual character of the relationships between individuals. The absence of a society of philosophy of science was probably both a sign of the difficulty and an obstacle to the realization of a volume of the present sort. Whatever the causes, the fact is that the project of the present volume emerged in 2004, shortly after the creation of the Société de philosophie des sciences in 2002.\textsuperscript{49} The Society was not involved
in any way in the elaboration of the volume, but the context it gave rise to certainly favored the feasibility of the project through a tight cooperation between the two of us and Springer.

Here is the method that we applied. We first made a confidential list of 16 possible authors, which was raised to nineteen, the directors of the Boston series, Jürgen Renn and Kostas Gavroglu, expressing the wish that “all ideas and themes of French Philosophy of Science be represented”. Throughout the process we kept several concerns in mind. First, the length of the chapters should be reasonable enough so that the authors could develop their subject and provide a reliable image of their style of thought. Correlatively, the volume should not exceed the limits allowed by Springer. Beyond these material constraints, we wanted the authors to be representative both in terms of national and international recognition. We wanted the texts to be genuinely original, and provided in English. We did not want the papers to be comments on “French philosophy of science”, but rather a sample of significant contributions reflecting what philosophy of science is today in France. We also took seriously the publisher’s concern that the book be thematically coherent and representative, and truly constructed, rather than a series of free contributions. With this in mind, we elaborated a provisional outline of the volume that was sent to all prospective authors, with the names of contributors, and a relatively precise definition of the topics that we proposed to them, in function of their own work. This method excluded the possibility that several papers dealt with the same topic. But it raised a serious difficulty, because it resulted in not inviting several colleagues for whom we had high esteem. Out of the 19 authors contacted, one did not answer because of illness, two declined because they did not want to be labeled as “philosophers of science” (although major international figures in that respect), and three renounced because they were not able to provide their paper in time. We decided not to contact new authors, first because we did not want to modify the list of contributors that had been sent to the invited authors, and, secondly because the overall result fitted well with the general outline of the volume, except for philosophy of logic and mathematics, which constitutes an obvious gap of this book.

The book is divided into six parts. The first two parts deal with general issues in philosophy of science. Part I treats of styles in philosophy of science. Anne Fagot-Largeault offers a classification of methodological styles in philosophy of science at an international level. Daniel Parrochia presents a classification of styles in philosophy of technology with particular emphasis on the French case. In Part II, entitled “General philosophy of science”, Anastasios Brenner and Sandra Laugier examine two major traditional problems, theory choice and realism, and analyze the interactions, analogies and differences between important American and French philosophers on these subjects (Duhem, Meyerson, Bachelard, Quine, Kuhn).

The four other parts of the book bear upon subjects related to special scientific areas. Part III contains two essays in philosophy of physics, and one in philosophy of chemistry. Cohen-Tannoudji and Zwirn, both physicists and philosophers, characterize modern physical theory, with a different approach: Cohen-Tannoudji offers a rational reconstruction of the intellectual itinerary of 20th physics; Zwirn favors a discussion of the issue of realism in the physics of today. The third chapter
of Part III is devoted to chemistry, a scientific discipline that inspired important contributions by French or French-speaking philosophers of science in the 20th century (especially Duhem, Meyerson, Metzger, Bachelard, Stengers). Bensaude-Vincent relies on these authors, and on more recent authors worldwide, to contend that chemistry requires “a philosophy of its own”, based upon the recognition of the irreducibly technical aspect of chemistry (“knowing through making”), and the subsequent necessity for philosophers of taking history of science seriously.

Part IV deals with the philosophy of life sciences. François Dagognet, known for his important work in the history and philosophy of medicine, claims that pharmacy and pharmacology should be more seriously considered by philosophers, because of the inextricable mixture of science, technology and moral problems exhibited by its history. Claude Debru summarizes his own philosophical work on the physiological sciences (especially paradoxical sleep and the classification of leukemia), and defends “the idea of philosophy as an interpretative, reflective and speculative activity which can be practiced within science as well as about science”. Jean Gayon offers a characterization of “philosophy of biology” as it has developed in the past 30 years approximately at an international level.

Parts V and VI bear upon human sciences, or at least, sciences for which humans are central: behavioral sciences, cognitive sciences and economics. Joëlle Proust, who was until recently the only French philosopher to engage in the modern debate on function, a debate that has raged in philosophy of biology and philosophy of psychology since the early 1980s, supports a theory of function alternative to the two traditional “systemic” and “etiological” theories of function, and applies it to the notion of “mental function”. Daniel Andler offers a broad picture of the origins, scope and structure of cognitive science. Andler denies that philosophy of science should aim only at solving foundational and methodological issues, or particular conceptual puzzles: “there is also the more general concern of providing a perspective on the structure and dynamics of a field, its relations to other areas of inquiry, its purported limitations or misconceptions, its future directions”. Part VI is entirely devoted to economics, with an essay by Philippe Mongin, who convincingly shows that Duhem’s methodological holism (rather than the radical version of epistemological holism defended by Quine) provides a fascinating tool for examining the testability (or rather untestability) of expected utility theory.

How far do these contributions illuminate the question of whether contemporary French philosophy of science has a distinctive character? As we already said, the purpose of this book is not to give a direct answer to this question. We did not ask the authors to confront it, but rather to write an essay on a topic of their own, and one most able to illustrate the character of their style of thinking for an international audience. Most of our contributors asked us whether they should offer a review of French literature on the question. Our response was that they were free to do so if they thought it necessary, but that this was not a requirement: they were free to treat their subject with the method and with the help of the literature they felt appropriate.

Nevertheless, the present introduction is an exception to the rule of the book. The first two sections endeavor to describe the particular paths taken by French
philosophy of science in the 19th and 20th centuries, and offer a few conjectures about the possible coherence of this history. In this third section, we cannot avoid drawing some lessons from the contemporary contributions that we have received. Of course, we are aware that our sample is quite restricted, and probably biased, although we have attempted to be as open to various schools and networks as possible. But precisely because we did not ask the authors to make a statement on “French philosophy of science” and to defend it, we can the more freely venture to extract from our sample several tendencies that were not predictable from the onset, given the rules we had proposed to our authors. Readers, especially non-French readers will be free, of course, to draw their conclusions from their own perspective, and we do expect that this kind of dialogue will arise. As far as we are concerned, four general tendencies can be seen in the material that we have gathered.

First, one may ask how many authors felt the necessity of explaining what philosophy of science in general is or should be. Eight authors have explicitly faced this issue, and clearly considered it a decisive issue, intimately related to their way of practicing philosophy of science. This is not a surprise in the case of the first chapters, dealing with “Styles in Philosophy of Science and Technology”. But a similar concern, with one exception, appears in all the other parts of the book: Brenner in Part II, “General Philosophy of Science”, Bensaude-Vincent in Part III, “Physical and Chemical Sciences”, Dagognet, Debru and Gayon in Part IV, “Life Sciences”, and Andler in Part V, “Philosophy of the Behavioral and Cognitive Sciences”. All agree that history (history of science and technology, but also history of philosophy and social history) matters to philosophy of science. All of them seem also to be of the opinion that, with or without history, there is more to philosophy of science than just foundational, methodological or particular conceptual puzzles in this or that area of scientific investigation. Andler (already quoted), summarizes nicely a rather general feeling among these authors, a feeling that reminds us of Auguste Comte: one of the legitimate ends of philosophy of science is to provide “a perspective on the structure and dynamics of a field”, either from within the chosen field or by reflecting on its relations with technology, society and history by and large.

Of course, there is nothing extraordinary in such positions. Other national traditions in philosophy of science would most certainly include spontaneous assertions about the issue of what philosophy of science may or should be. Once again, this was not explicitly requested of the authors. More than half of them did it, and not only those committed to general philosophy of science. This may be related to rather deep doubts and conflicts concerning the nature and limits of philosophy of science in France today. Furthermore, all these authors insist on the importance of history – something that would probably not be expected in the case of many other countries, especially those that significantly contribute to the international literature in the field of philosophy of science.

Our second observation is about the relative importance of the human sciences. Mere counting of the number of pages devoted to the philosophy of human sciences tells us something. Of course, as editors, we tried to keep the authors of these sections (psychology, cognitive science, economics) within the assigned limits. We were surprised, however, by the density and the personal commitment of these
papers, and we finally decided not to authoritatively impose abridgement. These contributions testify to the importance of this domain in contemporary philosophy of science in general, and more especially in France. Let us note that the last three chapters of the book are totally alien to any kind of hermeneutics, historicism, relativism or social constructivism. The three authors concerned are more or less analytically inclined, and have nothing to do, for instance, with schools of thought inspired by philosophers such as Michel Foucault or Paul Ricoeur, not to speak of Pierre Bourdieu, Gilles Deleuze or Jean Baudrillard (we are aware here that we point towards very different styles of thought). Nevertheless, we may observe that their work arises in a national context where the status of the human and the social sciences have always been a major concern for the French intellectual community, and especially for French philosophers of science (again, the historical example of Auguste Comte remains here as a touchstone).

Our last two observations aim at locating the sample of papers that we have collected relative to general trends in philosophy of science today worldwide. It is often said that since the mid 1960s, philosophy of science has experienced two major shifts, the “historical turn” and the “regionalist turn”. These two shifts went in the same direction: they testified to a certain skepticism regarding the idea of a general and timeless theory of science. It is worth asking here how far this volume confirms or not these tendencies in the French case. As for the historical turn, we said earlier that more than half of the authors in this volume explicitly defend the claim that “history matters to philosophy of science” in one way or another. Thus, in a sense, contemporary French philosophy of science illustrates the general tendency. But two reservations should be made. First, for most of these authors, the dictum “history matters to philosophy of science” is not the result of a “shift”. Although Thomas Kuhn has been as popular in France as everywhere else (as reflected in this volume by Brenner’s and Laugier’s papers), the interest of philosophers of science for history is rooted in an earlier tradition, which in reality was so powerful in France throughout the 20th century that Kuhn was received more as a confirmation than as a revolution – even though this idea may rest on serious misconceptions about Kuhn’s thought. Secondly, the overall picture given by the present book is definitely that of a rather deep disagreement about the role of history in philosophy of science. Although they are a minority, the papers by Zwirn, Proust, Andler, Mongin, are not historically inclined. Furthermore, had we taken a larger sample of philosophers of science, especially including younger scholars, we would have observed in all likelihood a strong tendency toward non-historical work, both in the fields of general and special philosophy of science. We may also note a hardening of the rivalry (or divorce?) between the two schools of thought, the historically inclined and the analytically inclined. This conflict, of course, has nothing exceptional, but it is particularly harsh today in France, because of both the strength (and fertility, we should add) of the traditional historico-critical school and the vigor of the new analytically oriented one.

As for the regionalist turn, things are clearer. Out of the 13 chapters of this book, nine belong to special philosophy of science, which therefore seem to weigh more in our country than general philosophy of science. It could be objected that this was
the result of the editors’ choice. However, we think that our choice reflects honestly (though very partially) the best of philosophy of science in this country. It also echoes a long-term orientation of French philosophy of science underlined in the previous sections of this introduction. Since the French do not equate “epistemology” with the theory of knowledge, but with a critical reflection on the sciences as they historically existed or now exist, room for a purely general and normative philosophy of science has always been more restricted in France than elsewhere. This is not to say that few people are interested in general philosophy of science in this country. On the contrary, many of them are. But, with the significant exception of an increasing number of analytical philosophers, general philosophers of science tend to treat their subject with the spirit and methods of history of philosophy, a discipline which goes on occupying the most central role in academic training in philosophy in France. In a sense, the four papers in general philosophy of science included in this volume illustrate this tendency.

This being said, the common grid of the historical regionalist turn might well be a poor criterion for assessing the distinctiveness or non-distinctiveness of French contemporary philosophy of science. In the first chapter of this volume, Anne Fagot-Largeault suggests that three heterogeneous traditions have for a long time coexisted under the name of “philosophy of science”: “formal philosophy”, “historical epistemology”, and “philosophy of nature”. Formal philosophy is analytic philosophy applied to problems and methods belonging to science. Historical epistemology is based upon the principle that the genesis of problems, concepts, methods, and, possibly, the social structure of science, is key to a proper philosophical understanding of science. The expression “philosophy of nature” (or “natural philosophy”) is taken by Fagot-Largeault in a particular sense, defined as “speculative philosophy, grounded in scientific knowledge and data, going beyond just what those known data allow to assert, with a view to seizing a unity or rationale in the ways nature is constituted”. This involves both an attempt to synthesize the available scientific knowledge and, quite often, a more or less bold metaphysical reflection. According to Fagot-Largeault, this is the kind of philosophy of science that is most often developed by scientists, especially brilliant scientists (such as Whitehead, Waddington, or Schrödinger). But it is also the kind of “philosophy of science” found in general philosophers who explicitly try and develop a metaphysics inspired by positive science, and who most certainly would refuse the label “philosopher of science”. Bergson is a nice example.

Then, if we accept this original taxonomy, how does it apply to the present book, and, more generally, to French philosophy of science? On the whole, formal philosophy of science and historical epistemology are both represented in this book, although not equally (see above the paragraph on the “historical turn”). The balance, after all, could change, like in other countries, in one or another direction. As for the genre of “philosophy of nature”, it seems quite obvious that it constitutes an important horizon for a majority of authors in this volume. Most of them come to agree in the final analysis that the boundary between science and philosophy is uncertain. Some of them (e.g. Fagot-Largeault, Parrochia, Cohen-Tannoudji, Dagognet, Gayon, Debru) would most certainly concur with Andler that one of the
main tasks of philosophy of science, and not the least, is to provide comprehensive views of entire scientific areas and the possibility of an active dialogue with scientists in that perspective. Others (Brenner, Laugier, Bensaude-Vincent), come to the same conclusion on the basis of their more explicitly historical approach to philosophy of science.

This sympathy of French philosophers of science for “natural philosophy” (sensu Fagot Largeault) is probably shared with a lot of philosophers of science all over the world. But we believe that this is distinctively important in France because of the long lasting Comtian positivist tradition, which emphasizes so much the intrinsic value of science, that is to say the idea that the sciences – not a normative philosophy of science – pose their own norms of rationality. In such a historical context, one may expect that genuine scientists will play a major role on the theatre of philosophy of science. They won’t be conventionally identified as professional “philosophers of science”, but they will significantly contribute to the philosophical debate over science. For instance, to take just a few legendary examples, the mathematician René Thom, the physicists Louis de Broglie or Bernard d’Espagnat, the biologists Jacques Monod or François Jacob, have probably had a greater impact on the national and international scene of philosophy of science than most (and perhaps all) French philosophers of science of the second half of the 20th century. Again, this is not to say that similar figures do not play a similar role in other places. But we think that the French intellectual world is more inclined to produce such figures and to give them an important role in philosophy of science.

This of course is a free conjecture of our own which would require extensive comparative work to be tested. As already said, the purpose of this volume is not to offer a collection of meta-philosophical studies, but rather to give a concrete sample of what philosophy of science looks like in France today. We hope that the sample offered here will fulfill this expectation, and foster the development of fertile interaction in philosophy of science worldwide.

Acknowledgment The project of a volume on French philosophy of science arose at a conference given by Robert S. Cohen in Vienna. Recalling his editorship of the Boston Studies in Philosophy of Science series he had launched, he pointed out the unfortunate absence, among the numerous volumes devoted to different national traditions, of one on French studies in the field. We express our thanks to Robert Cohen for his suggestion and his encouragements to follow it up. We also voice our indebtedness to Jürgen Renn and Kostas Gavroglu, for their acceptance of our project in the series and valuable help in bringing it to completion.

Endnotes

1 Prior to Comte’s explicit definition of the field, there were indeed endeavors that opened the path to philosophy of science, for example the Encyclopédie (1751–1780) of Diderot and d’Alembert or Laplace’s Essai philosophique sur les probabilités (1814).

2 In his advertisement, dated 1829, Comte writes: “I was careful not to choose the denomination of natural philosophy nor that of philosophy of science [philosophie des sciences], which would have been perhaps even more precise, because neither the one nor the other yet apply
to all orders of phenomena, whereas positive philosophy, by which I understand the study of social phenomena as well as all the others, designates a uniform way of reasoning applicable to all subject matters upon which the human mind can exert itself”, 1930–1942, vol. 1, p. VI. For a lexicological study of the expression “philosophy of science” in French, English and German, see H. Pulte, 2004.

3 Whewell responded to Comte’s endeavor, in particular in the second edition of his Philosophy of inductive sciences, IV, 6. We know that J.S. Mill engaged more directly with Comte in his System of logic shortly thereafter in 1843.

4 On Canguilhem’s relation to Comte, see his 1968. Serres is one of the editors of the current edition of Comte’s Cours de philosophie positive. Cf. Serres, 1972, 1974.


7 Letter to W. James of the 9th of May 1908, in Bergson, 1972, p. 776; 2002, p. 199. Bergson in all likelihood is thinking of the term épistémologie, which had gained currency and had lately been used with insistence by Meyerson.

8 Milhaud went so far as to speak of “positivisme logique” as early as 1905. He thereby refers to the conception of Renouvier and perhaps his own early attempt to reformulate it. Milhaud, 1927, p. 55, reproducing articles published in 1905.

9 Le Roy, speaking of determinism, writes “This belief assumes that science is an adequate knowledge of reality; whereas, for modern epistemology [épistémologie moderne], its aim is merely man’s action on nature”, in Actes du Premier congrès international de philosophie, Revue de métaphysique et de morale, 8, 1900, p. 540. In the same volume Russell takes epistemology as philosophy of knowledge, p. 562.

10 Despite the fact that the term had been coined earlier in English, French philosophers insisted on referring to science, resorting to gnoséologie eventually to designate the theory of knowledge.

11 Three years later, in 1895, a chair in philosophy of inductive sciences was established at the University of Vienna for Ernst Mach.


13 The official name of the chair becomes “History and philosophy of science”.

14 This institute continues to exist today. Now called “Institut d’histoire et de philosophie des sciences et des techniques”, it associates the Université de Paris I, the Centre national de la recherche scientifique and the École normale supérieure. For details on its founding, see Braunstein, 2006.


16 Bachelard, 1934, p. 178.

17 Bachelard, 1934, p. 40.

18 See Bachelard, 1932 and 1933.

19 Bachelard, 1928, pp. 185–191.

20 Canguilhem, 1943.

21 Canguilhem, 1966.

22 Canguilhem, 1989.

23 For an explicit argument in favor of this view of philosophy of science, see Canguilhem 1968.

24 This aspect of Canguilhem has been commented on again and again by a huge number of French philosophers of science. See however the external appraisal by Grene, 2000.


26 Neither Bachelard or Canguilhém coined the term “historical epistemology”, which was introduced by Dominique Lecourt (1969), with reference to Bachelard, in the context of a master’s thesis written under Georges Canguilhém. Today, many authors tend to think that the genre of historical epistemology, that is epistemology based upon careful historical work, is better illustrated by Canguilhém. On these issues, see Gayon in Gutting, 1989, Gayon 2003, Rheinberger 2005, Lecourt 2008.

28 Dagognet 1964.
33 See Comte, 1830–1842, Table of Contents.
34 Ernest Renan, 1890, chap. 16, p. 301.
36 See above n. 26.
38 For a study in English on Foucault, see Gary Gutting, 1989.
39 For example the activities of the International Society for the History of Philosophy of Science (HOPOS) and of the Vienna Circle Institute. See M. Heidelberger and F. Stadler, 2002.
43 Duhem, 1906, p. 199; translation, p. 133, modified.
44 On Nicod, Cavaillès and Hebrand, see Bitbol and Gayon, 2006.
45 This is not to mention the efforts of mathematicians: Paulette Destouche-Février did a lot to introduce to France research in logic after World War Two. Her own work dealt with non-classical logic in relation to quantum mechanics. Georg Kreisel, an Austrian logician trained in Cambridge, initiated a research program in combinatory logic during the 1960s in Paris, which was taken up by Jean-Louis Krivine and became a genuine school.
46 They were intent on providing a careful presentation of logical positivism and analytic philosophy, but did not dismiss history of science.
47 We wish to express warm thanks to Michel Bourdeau, director of research at the Centre national de la recherche scientifique (IHPST Paris), for providing us with helpful information concerning logic in France.
49 http://www.sps.ens.fr/

Bibliography

Bachelard Gaston (1951), L’activité rationaliste de la physique contemporaine, Paris, PUF.
Bachelard Gaston (1972), L’engagement rationaliste, Paris, PUF.
Bergson Henri (1972), Mélanges, Paris, PUF.
Bergson Henri (2002), Correspondances, Paris, PUF.


Dagognet François (1964), *La raison et les remèdes*, Paris, PUF.

Dagognet François (1967), *Méthodes et doctrine dans l’œuvre de Pasteur*, Paris, PUF.

Dagognet François (1970), *Le catalogue de la vie: étude méthodologique sur la taxinomie*, PUF.


Duhem Pierre (1913), *Notice sur les titres et travaux scientifiques*, Bordeaux, Gounouilhou.


Lecourt Dominique (2003), *Humain, posthumain: la technique et la vie*, Paris, PUF.
Lecourt Dominique (2008), *Georges Canguilhem*, Paris, PUF.