

# On Science and Philosophy

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**Abstract:** The paper is a plea for bringing together the history and philosophy of science in a unitary perspective. It starts from thoughts developed by the German philosopher Ernst Cassirer in his posthumous, last volume of the *Problem of Knowledge*, and it continues with outlining a comparable position of the French philosopher and historian of science Gaston Bachelard. The last section is devoted to the author's own view of a historical epistemology of experimentation.

**Keywords:** Bachelard, Cassirer, epistemology, experimentation, science, philosophy

With this aperçu, I would like to sketch a few thoughts with respect to the relation between philosophy and contemporary science, philosophy of science and contemporary science more precisely, that do not have any systematic aspiration. They are, on the contrary, the conclusions of someone who started his academic career as a philosopher of science, then retooled as a natural scientist, more concretely as an experimental molecular biologist, and ended up as a historian of science, or perhaps more to the point, a historical epistemologist. But in order not to completely leave these deliberations in the realm of the personal, I will embed them in a brief discussion of the respective thoughts of two philosophers of science who paved the way to historical epistemology around the middle of the twentieth century: one of them brought up in Germany, the other in France. I have attempted to determine their place in the broader trend of historicizing epistemology from the *fin de siècle* throughout the twentieth century elsewhere.<sup>1</sup> Both of them did not inform my early education. But both of them became firm reference points for my further intellectual development.

### “The Era of the Great Constructive Programs Is Past and Gone”

Ernst Cassirer concludes his introduction to the fourth and last volume of *The Problem of Knowledge*, devoted to *Philosophy, Science, and History Since Hegel*, with the following words: “The era of the great constructive programs, in which philosophy might hope to systematize and organize all knowledge, is past and gone. But the demand for synthesis and synopsis, for survey and comprehensive view, continues as before, and only by this sort of systematic review can a true historical understanding of the indi-

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1 Rheinberger 2010.

vidual developments of knowledge be obtained.”<sup>2</sup> These sentences stand at the end of a lifelong occupation with the relation between science and philosophy. They imply two remarkable consequences. First, there was a time in the history of the development of the sciences in which such encompassing philosophical programs were possible and even beneficial, according to Cassirer. He saw Kant as the culmination point of this era and, at the same time, as the messenger of its decline. It was the development of the sciences themselves that since then has made such an approach impossible. And second, what needs to come to replace them is “a true historical understanding of the individual developments of knowledge.” Systematicity has to be replaced by historicity. Metaphysics has to give way to epistemology. Such is then the double task of what consequently can be called historical epistemology, the philosophy of science of our era: On the one hand, it has to conceive of itself as a historically changeable enterprise, an enterprise that is entangled with, and cannot be separated from, the dynamics of the sciences. And on the other hand, it has to develop a historical understanding of the diversification of scientific knowledge production.

Cassirer concluded that such a reorientation “requires a persistent, patient steeping of oneself in the work of the separate sciences, which must not only be investigated in respect to principles but explained concretely, that is, in the way they conceive and handle their primary and fundamental problems.”<sup>3</sup> And this is what he himself did, during his years of exile in Gothenburg between 1935 and 1941, with this last, posthumously translated volume of his knowledge tetralogy, steeping into the problems of what he called the exact sciences (non-Euclidean geometries and theoretical physics), biology, and the historical sciences of the second half of the nineteenth and the first half of the twentieth century. In addition, he made clear that even in the loftiest heights of theory, what was of foremost importance was its empirical grounding, commenting with a quotation from Werner Heisenberg: “The modern theories have not originated from revolutionary ideas brought into the exact sciences from without, so to speak; rather they are naturally forced upon science as it attempts to carry out logically the program of classical physics ... It is manifest that experimental investigation is always the necessary pre-condition of theoretical knowledge, and that significant progress is made only under

2 Cassirer 1950, p. 19.

3 Cassirer 1950, p. 18.

pressure from the results of experiment, never through speculation.”<sup>4</sup>

In this book, Cassirer developed what he called a “functional” perspective on knowledge. For such a view, the object does not count as “a given fact but as a problem; it serves as the goal of knowledge, not as its starting point.” And he continues: “No matter whether we are concerned with the ideal or the real, the mathematical or the empirical, with nonsensuous or sensuous objects, the first question is always not what they are in their absolute nature or essence, but by what medium they are conveyed to us; through what instrumentality of knowledge the knowing of them is made possible and achieved.”<sup>5</sup>

What this means is that scientific practice in its diversification is coming to be seen as the driving force of the sciences, and that this not only conditions theories, but also the forms in which one can fruitfully reflect upon them. The turn to scientific practice that underlies such a deeply historically tainted epistemology is therefore crucial. In fact, it implies a turn of the attention from the corpus of knowledge to the scientific research process. Philosophically reflecting upon the sciences then becomes equivalent to reflecting upon how they produce their results and how they manage to permanently transgress their own actual boundaries at a given time.<sup>6</sup>

### “Every Hypothesis, Every Problem, Every Experiment, Every Equation Would Demand Its Philosophy”

Gaston Bachelard, the ten years younger French contemporary of Cassirer, who is generally credited as being the father of historical epistemology *à la française*, developed his ideas about the contemporary sciences along similar lines. In the opening of his *Philosophy of No*, we read the following sentences: “Every hypothesis, every problem, every experiment, every equation would demand its philosophy. A philosophy of epistemological detail needs to be founded, a differential, scientific philosophy which would constitute a counterpart to the integral philosophy of philosophers. This differential philosophy would be responsible for measuring the development of a thought.”<sup>7</sup> What Bachelard calls a differential, or “distributed” philosophy departs from the premise that “the mind at

4 Cassirer 1950, p. 83, quoting Heisenberg 1935, pp. 5-26, on pp. 7 & 16sq.

5 Cassirer 1950, p. 62.

6 See Rheinberger 2012, pp. 105-111.

7 Bachelard 1968, p. 12. Translation amended.

work is a factor of evolution.”<sup>8</sup> Scientific rationality is not something given *a priori*, but a product of the scientific activity itself and thus deeply marked with a historical index. A philosophy that seeks to do justice to the sciences must itself be and remain a philosophy at work, a “tentative philosophy of science.”<sup>9</sup> The dynamics of scientific development calls for a kind of philosophical reflection that is able to emulate its transgressive character. The coherence of such a reflection can no longer be a systematic one, where everything revolves around a center. It can only be a genealogical coherence, a coherence of historical diversification. In his *Le Rationalisme appliqué*, Bachelard finds the following words for this movement: “One cannot achieve such a deep-going renewal without a disposability of the scientific spirit, a disposability that is in need of a more or less explicit poly-philosophism.”<sup>10</sup> The “coherent pluralism”<sup>11</sup> of the sciences is in need of a coherently pluralistic philosophy. And Bachelard continues: “The history of the sciences abounds in events of reason, facts that have forced the rational organization of experience to reorganize itself.”<sup>12</sup> *Events of reason* is the catchword here. An event is an event only if it cannot be anticipated, if it cannot be deduced from first principles. To conceive the development of the sciences not as a deployment of an originary reason, but as a series of events that can touch on the character of reason itself, is thus a profoundly discontinuous, yet recursively coherent process in need of a philosophy of science that shows the same character of openness, ready to risk its own presuppositions at any time if required.

It is clear that we have here an asymmetric relation. “Science in effect creates philosophy,”<sup>13</sup> as Bachelard put it in his *New Scientific Spirit*. Philosophical reflection on the sciences is kindled by the moves that scientific reason undergoes in its development. According to Bachelard, it is science as a materially mediated and collectively organized process of transgressing the boundaries of a given state of knowledge (the process of research) that poses the biggest challenge to philosophical reasoning. It is therefore a key for understanding the human forms of knowledge more generally. As Marx once put it: “In the anatomy of man there is a

8 Bachelard 1968, p. 14.

9 Pravica 2015.

10 Bachelard 1949, p. 43.

11 Bachelard 1932.

12 Bachelard 1949, p. 44.

13 Bachelard 1984, p. 3.

key to the anatomy of the ape.”<sup>14</sup> It is only by taking up this challenge that philosophical reasoning can live up to its calling: to understand the human mind. The human mind is a mind that can risk itself.

**“If, in any experiment, one does not risk one’s reason ...”**

In his short paper on “Surrationalism” Bachelard states accordingly: “There should be no hesitation: one should choose the side where one thinks the most, where one experiments the most artificially, where ideas are the least viscous, where reason loves to be in danger. *If, in any experiment, one does not risk one’s reason, that experiment is not worthwhile attempting.*”<sup>15</sup> This quotation gives me the keyword for a few remarks in conclusion. Experimentation is the form that the modern sciences have developed in order both to allow for and to contain the risk of reason. A historical epistemology that aims at doing justice to the dynamics of the modern sciences must therefore have a close look at the practices of experimentation.

However, experimentation is not the only legitimate object in an analysis of scientific practice. Scientific practice comes in many different guises that have aptly been described as “ways of knowing.”<sup>16</sup> In the last instance, however, it is experimentation that has the power for, and is the driving force of, reorienting the research process. Consequently, my own work as a philosopher and historian of science has concentrated on an analysis of contemporary experimentation. In *Toward a History of Epistemic Things*, I have developed the notions of “experimental system” and “epistemic thing” in an effort to create an alternative to the traditional vision of experimentation as *ancilla theoriae*.<sup>17</sup> Epistemic things take shape in systems of experimentation composed of instruments, apparatus and procedures that stabilize them sufficiently but at the same time allow them to play out their ambiguity. At the core of science as a process, of science in the making, there is ambiguity. It is ambiguity that incites science to get away from the actual state of the art toward an open future. “Without ambiguity, no change, ever,” as Paul Feyerabend put it aptly in his autobiography.<sup>18</sup> Determining the particular shapes in which the sci-

14 Marx 1953, p. 26.

15 Bachelard 1936, pp. 186-189, here p. 186.

16 Pickstone 2000.

17 Rheinberger 1997.

18 Feyerabend 1995, p. 179.

entific enterprise plays this game is a worthy focus of any philosophical and historical effort to learn about our human faculties of knowing.

### Postscriptum

Almost forty years ago, I was invited to participate in a survey on “Why Philosophy, or What For?” published in the German annual publication *Dialektik*.<sup>19</sup> I add it here in a translation as a postscript; it appears to me that it still has not lost its actuality.

“The natural sciences are and continue to be about empirically investigating forms of movement and evolution of matter and conceptualizing them analytically. From a certain stage of their development, the empirical sciences realize a self-regulatory dynamic of experiment and theory formation, in the sense of an open system for which, as is generally known, the so-called ‘boundary conditions’ are constitutive in respect to its maintenance as well as its development. I would like to claim that philosophy is a moment of these boundary conditions, therefore co-constitutive for the maintenance and development of the sciences. It has, however, as a knowledge form *sui generis*, no place at the level of the empirical acquisition of scientific knowledge and its conceptualization. It leads into blind alleys if philosophical categories are substituted for scientific concepts. I would therefore also answer in the negative the question whether in the research process of the empirical sciences problems are being set free that need the means of philosophy for their solution. What, then, could co-constitutivity of philosophy for the sciences possibly mean? In philosophical thinking – it is perhaps better to speak of philosophical thinking instead of *the* philosophy – scientific knowledge and explanation of the world is being digested. This digestion confronts the sciences with different interpretations of scientific knowledge and explanations of the world: as positivistic, critical-rationalist, or materialist philosophies of science. And these interpretations clearly belong to the theoretical ‘boundary conditions’ of the maintenance and development of the sciences. On the part of the sciences, they are usually represented as spontaneous philosophy of the scientists. A form of philosophical thinking that presents itself as *accessible* to such spontaneous philosophy could, in a reversal of the question denied above, set free, in the research process of the empirical sciences, *new* problems of a sort that require the *means of the sciences* in their solution.”

19 Rheinberger (1980), „Orientierungen der Philosophie,“ pp. 147-171, on pp. 164-165.

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