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Realism, functions, and the a priori: Ernst Cassirer's philosophy of science

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ABSTRACT

This paper presents the main ideas of Cassirer's general philosophy of science, focusing on the two aspects of his thought that—in addition to being the most central ideas in his philosophy of science—have received the most attention from contemporary philosophers of science: his theory of the a priori aspects of physical theory, and his relation to scientific realism.

Ernst Cassirer, the Neo-Kantian trained philosopher whose wide-ranging work spanned the first four decades of the twentieth century, was one of the most prominent and respected philosophers of science of his time. Easily the most subtle and mathematically well-informed of the Neo-Kantians, he was among the vanguard of early twentieth century philosophers seeking to understand the philosophical significance of the revolutionary advances made in logic, mathematics, and physics. Not only did Cassirer write some of the earliest philosophical works on general relativity and quantum mechanics,[1] but he was one of the first German academic philosophers to give serious attention to Russell's logicism and the new logic,[2] Dedekind's foundations of arithmetic, and to Hilbert's axiomatic foundation of geometry.[3] Cassirer also wrote extensively on some of the perennial issues in general philosophy of science: realism, confirmation, theory change, the nature of experimentation, the a priori elements in scientific theories, and the application of mathematics in physical science. Cassirer's commitment to a philosophy of science that engaged with cutting edge science ran deep and was widely known. For example, as a letter from Hans Reichenbach makes clear, Cassirer was the only philosopher to sign onto a petition, composed by Reichenbach in 1931 and co-signed by Hilbert and Einstein, petitioning the German government to create a chair in the philosophy of science.[4]

It is not surprising, then, that Cassirer's work has been studied extensively by historians of philosophy. But several prominent philosophers of science have also recently turned their attention to Cassirer, finding in his writings philosophical positions that only now many years later are receiving sustained philosophical interest. For example, many defenders of "structural realism" within the philosophy of science have explicitly pointed to Cassirer's writings as an historical anticipation of their own theories,[5] and Michael

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[1] Cassirer *Einstein's Theory of Relativity* [*ETR*] (1923 [1921]), *Determinism and Indeterminism in Modern Physics* (1954 [1936]). Throughout this paper, I will adopt the following practices. If there is a translation listed in the bibliography of a work not written in English, I will quote from the listed translation (except for occasional corrections that I make silently). Page citations are from the listed translations unless otherwise noted. Translations from works not in English for which there is no English translation in the bibliography are all my own.

[2] Cassirer (1907).

[3] Cassirer, *Substance and Function* [*SF*] (1923 [1910]), Chap. 2–3.

[4] Letter from Reichenbach to Cassirer, 5 June 1931, HR—025—11—04; 15 June 1931, HR—025—11— 03. These letters are reproduced in the CD-Rom accompanying Cassirer (2009).

[5] See French (2001), pp. 2–7, 14; French and Ladyman (2003), pp. 38–41; Gower (2000), pp. 87–95; Massimi (2010). Structural Realism is often split into "epistemic" and "ontic" versions. French and Ladyman see in Cassirer an anticipation of ontic structural realism; Gower and Massimi see in him an anticipation of epistemic structural realism.

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Friedman has identified Cassirer as an inspiration for the philosophy of science defended in his book *Dynamics of Reason* (2001, pp. 65–8; 2005).

Despite this attention, there is still disagreement among philosophers over the interpretation of many of the main ideas of Cassirer's philosophy of science. For example, one of the most striking and suggestive features of his philosophy is its conception of the a priori. Some interpreters (Richardson, 1998, chap. 5; Ryckman, 2005, chap. 2) have claimed that Cassirer's theory of the a priori is an anticipation (and, indeed, the historical source) of the theory of the relativized, but constitutive a priori later articulated by Reichenbach (who was, after all, Cassirer's student in Berlin). According to Michael Friedman, however, the a priori elements that Cassirer claims to find in science are absolute, but not relative, and are merely regulative, not constitutive (Friedman, 2000, 115ff). Alan Richardson, on the other hand, argues that Cassirer, in trying (unsuccessfully) to integrate a theory of the constitutive, relative a priori with a theory of the regulative, absolute a priori, succeeds only in presenting a "plurality of inconsistent accounts" (Richardson, 1998, p. 136). Last, Thomas Ryckman argues that for Cassirer (in his book *Einstein's Theory of Relativity*) the principle of general covariance is both constitutive and regulative (2005, p. 46)—thus agreeing with Richardson (against Friedman) that there are constitutive a priori principles in Cassirer's theory, while disagreeing with Richardson that this amounts to any kind of tension in Cassirer's thinking. Similar issues arise in discussions of Cassirer's relation to realism. As French, Ladyman, and Massimi all recognize,[6] there is a clear (though hard to articulate) tension between a reading of Cassirer's philosophy that brings him close to contemporary structural realism, and Cassirer's own rejection of realism in favor of idealism.

The goal of this paper is to present the main ideas of Cassirer's general philosophy of science. In particular, I will present the contours of the two aspects of his thought that—in addition to being among the most central ideas in his philosophy of science—have received the most attention from contemporary philosophers of science: his theory of the a priori, and his relation to scientific realism. I will argue (against Friedman) that Cassirer's theory assigns both constitutive and regulative, relative and absolute, roles for a priori representations. These a priori representations help explain the possibility of scientific objectivity and thus also objective reference. This theory of objectivity, and the need to secure it with a priori elements, flows out of the distinction between substance and function that is the main theme of Cassirer (1923 [1910]). In Section 1 of this paper I describe that distinction. In Section 2, I describe Cassirer's two part theory of the a priori and argue—contrary to Richardson—that Cassirer's second, absolute, part of the theory of the a priori is not inconsistent with the first, relativized, part, but *necessitated* by it.

The role of the theory of the a priori in Cassirer's philosophy of science is in explaining physical objectivity. In particular, objectivity is maintained in science even as physical theories change because the structure of science remains the same even as the fundamental ontologies of theories are replaced by successor theories. This naturally raises the philosophical question whether Cassirer was a "realist" at least about the structural features of physical theories, as are contemporary structural realists. In the last section of this paper, I critically evaluate this claim, distinguishing the senses in which Cassirer's philosophy of science is (and is not) a form of "realism."

Cassirer's philosophy of science was first presented in his 1910 *SF*. Starting with the publication of the first volume of the *Philosophy of Symbolic Forms* in 1923, these ideas were broadened in two ways. First, Cassirer came to appreciate that the various special sciences have their own distinct methodologies that need to be investigated individually, whereas the philosophy of science presented in *SF* is almost exclusively concerned with physics. In particular, in *The Logic of the Cultural Sciences* (2000 [1942]), Cassirer argues that cultural sciences such as history can attain objectivity despite not relying on the experimental and mathematical methods characteristic of physics. Second, Cassirer came to believe that the kind of human activities investigated by cultural sciences such as linguistics, anthropology, history, and comparative religion each make possible a distinct kind of objectivity. These various ways of constituting objectivity Cassirer calls "symbolic forms," and he argues that myth, art, and language are symbolic forms alongside the symbolic form of knowledge (which is the form exhibited most perfectly by science). The "functionalist" account of knowledge that I describe in Section 1 and the account of a priori elements that I describe in Section 2 are then carried over to these other symbolic forms, though of course in significantly modified ways. Unfortunately, given the confines of a paper, I cannot do any more than mention the wider vistas of Cassirer's philosophy of symbolic forms (though I believe that understanding Cassirer's philosophy of (mathematical and physical) science is an ideal way of working one's way into this larger system).

1. "Substanzbegriff" and "Funktionsbegriff"

The animating idea in Cassirer's philosophy of science—indeed, in his theoretical philosophy in general—is the contrast between substance-concept [Substanzbegriff] and function-concept [Funktionsbegriff], a contrast that provides the title for his first systematic book-length work in the philosophy of science.[7] Cassirer means this contrast to cover a number of different interrelated epistemic, logical, and metaphysical contrasts. Of these many uses, the most fundamental use that Cassirer makes of "Substanzbegriff" and "Funktionsbegriff" is *epistemological* and *Kantian*: it contrasts philosophical views that overlook the epistemic preconditions of various kinds of knowledge, with those that recognize the "functions" [or "preconditions"] that make certain kinds of knowledge possible.[8] To oppose the point of view of "Substanzbegriff," then, is to oppose various forms of epistemological atomism: the view that certain kinds of knowledge (be they scientific concepts, experiences, or measurements) could be acquired all by themselves, without any other epistemic conditions.

Cassirer's paradigm example of "Substanzbegriff," is an atomistic theory of concept acquisition (thus the phrase "substance-concept" to describe the approach he rejects). But the fundamental kind of atomism that he wants to oppose in the philosophy of physical science concerns measurement.[9] After analyzing a series of

[6] French and Ladyman (2003), p. 38. French (2001), p. 14. Massimi (2010).

[7] The interpretation in this section is defended and presented in greater detail in Heis (2014).

[8] Cassirer uses the term "function" ["*Funktion*"] in many ways, one of which is to refer to what mathematicians call "functions," especially when that function orders a series (*Reihe*), as the successor function orders the series of natural numbers. In §II of Heis (2014), I argue that the epistemic notion of function is primary, since it is only by recognizing the necessity of epistemic preconditions that the philosophical importance of mathematical functions becomes clear. As I will explain shortly, mathematical functions order contents into the kind of "unifed" whole that the functional theory of objectivity claims is a precondition of knowledge.

[9] See *SF*, 267: "If we take as given the whole of experience, as it is represented in any definite stage of knowledge, the whole is never a mere aggregate of perceptual data [Wahrnehmungsdaten], but is articulated and brought to unity according to definite theoretical points of view. It has already been shown from all sides that, without such points of view, no single assertion concerning facts, in particular no single concrete *measurement*, would be possible."