Thursday, June 24 1:30-4:30PM, rm. 148

Symposium:

Hans Reichenbach and the Axiomatization of Relativity Theory: Historical and Theoretical Perspectives

Flavia Padovani, "On the Development of Reichenbach's Axiom of Connection/Axiom of Coordination Distinction"

Thomas A. Ryckman, "The Absence of an Affinity in Reichenbach's Logical Analysis of General Relativity"

Robert Rynasiewicz, "From "Bericht" to "Axiomatik". The Development of Reichenbach's Formulation of the Foundations of Relativity"

The symposium focuses on the evolution of Hans Reichenbach's views on space, time and motion and the development of his underlying epistemology, with particular attention to his attempt to axiomatize relativity theory. Reichenbach's approach to the problems related to the theory of space and time radically changes between his first book, *Relativitätstheorie und Erkenntnis apriori* (1920), and its most famous and definitive expression in *Philosophie der Raum-Zeit-Lehre* (1928). His *Axiomatik der relativistischen Raum-Zeit-Lehre* (1924), that appears between these two works, systematically represents a new procedure, named "constructive axiomatization", which is rooted in the philosophical method of analysis of science sketched out in 1920 and which marks nonetheless a relevant modification in his conceptions. The papers composing this symposium each seek to elucidate an aspect of this period in Reichenbach's intellectual path, especially where it intersects the paths of other significant thinkers of the period.

Flavia Padovani, Université de Genève
(fl.padovani@bluewin.ch)

On the Development of Reichenbach's Axiom of Connection/Axiom of Coordination Distinction

According to autobiographical notes that Reichenbach composed in 1927, *Relativitätstheorie und Erkenntnis apriori* (1920) was written in only ten days. The declared aim is a revision of the Kantian doctrine of the *a priori* in the light of the theory of relativity; his solution is to retain its fundamental aspect as constituting the concept of object whilst considering cognition as coordination. Thus an axiomatic conception of physic is sketched, depending on a distinction between axioms of coordination and axioms of connection. However, his *Axiomatik der relativistischen Raum-Zeit-Lehre* (1924) signals a definitive surrender of a relativized *a priori*, the (constitutive) principles of coordination becoming (conventional) coordinative definitions..

Reichenbach's use of the term "Verknüpfungaxiome", originating in Hilbert's *Grundlagen der Geometrie*, stems from an article by Arthur Haas, *Die Axiomatik in der modernen Physik* (1919). The original manuscript of *Relativitätstheorie und Erkenntnis apriori* shows that the distinction between axioms of connection/coordination was introduced only as a revision. Indeed, among Reichenbach's manuscripts and various drafts for the *Axiomatik*, there is evidence of a later attempt to clarify the question in an unpublished paper entitled *Der Begriff des Apriori und seine Wandlung durch die Relativitätstheorie*. Interestingly, there Reichenbach partly returns to Hilbert's formulation and distinguishes three different kinds of axioms: beside the previous

two, he also adds several "Axiome der Ordnung". In my paper I will delineate the origin and development of this distinction and I will propose an interpretation of Reichenbach's shift towards conventionalism in the early Twenties.

T.A. Ryckman, Clare Hall, Cambridge, and University of California, Berkeley
(thomas.ryckman@sbcglobal.net)

The Absence of an Affinity in Reichenbach's Logical Analysis of General Relativity

The cornerstone of Reichenbach's "logical analysis" of relativity is the thesis of "the relativity of geometry", that an arbitrary geometry may be ascribed to spacetime if physical laws are correspondingly modified through the introduction of "universal forces". But this is only half the story. Metrical properties are deemed less fundamental than "topological" ones, ultimately reducible to the causal order of events. In this way, the whole edifice of geometrical structure of spacetime is regarded epistemologically derivative, resting upon ultimately basic empirical facts about causal order and a prohibition against action-at-a-distance. Accordingly, the most secure expressions about the order of space and time are those regarding the order of coincidences of point-events; such statements are "objective", reporting "ultimate facts of nature". But the analysis presupposes the affine structure of the metrical field to be as conventional as its metric, whose determination relies upon stipulations about rods and clocks. I will show how the argument for metric conventionalism from the existence of "universal forces" cannot be sustained once affine structure is given its actual significance in general relativity. This blocks any reductive move from geometrical properties of the metrical field to ultimate facts about causal order, facts that anyway are later regarded as supervening upon "causal anomalies … inherent in the nature of the physical world". I conclude with a speculation about logical empiricist philosophy of science had an affine connection been central to Reichenbach's analysis of relativity theory.

Robert Rynasiewicz, Department of Philosophy, Johns Hopkins University, Baltimore
(ryno@lorentz.phl.jhu.edu)

From "Bericht" to "Axiomatik". The Development of Reichenbach's Formulation of the Foundations of Relativity

Reichenbach sketched proposed formulation of the empirical and conceptual foundations of relativity in his "Bericht ueber eine Axiomatik der einsteinschen Raum-Zeit-Lehre", presented at a conference in Jena in 1921. The "Bericht" reports only the axioms and definitions to be adopted and claims without proof that the representation theorems follow, promising that the details will appear in a later publication. That later publication is presumably the monograph, *Axiomatik der relativistischen Raum-Zeit-Lehre*, which appeared in 1924. The system of axioms and definitions of the *Axiomatik*, though, is considerably more extensive and complex than that of the "Bericht". The question naturally arises, what happened in the interim. Among the hypotheses are the following. (1) Reichenbach discovered deficiencies in the original formulation. (2) The claims to adequacy of the "Bericht" were merely bluff, and, when forced to fill in the details, Reichenbach found it necessary to reformulate in order to get "fixed points" along the way. (3) The differences reflect primarily a striving for greater generality in order to more perspicuously display the extent conventional components of the theory, in particular that of simultaneity. (4) The "Bericht" uses only the "Einstein definition." The Axiomatik introduces the so-called "epsilon definition." (5) The

revisions were meant to placate criticisms and objections encountered early on from others. After briefly summarizing the formal relation between the two systems, I propose to sketch the principle motivations, drawing on the surviving drafts of various stages of the *Axiomatik* as well as on extant correspondence, including that with von Neumann and Weyl.