

COORDINATION AND CONVENTION IN HANS REICHENBACH'S PHILOSOPHY OF SPACE

The concept of coordination ("Zuordnung") was central to the writings of some of the early followers of Logical Empiricism. In his *Allgemeine Erkenntnislehre* (1918), Moritz Schlick characterized the process of cognition as a coordination of concepts with objects and of judgements with facts, while defining truth as uniqueness of coordination. Whereas Schlick's conception was realistic in spirit, Hans Reichenbach used in his *Relativitätstheorie und Erkenntnis apriori* (1920) the concept of coordination in a framework that was still influenced by Neo-Kantianism. He emphasized the role of coordination with respect to the constitution of objects and introduced the idea of coordinative principles ("Zuordnungsprinzipien") which are *apriori* in a relativized sense.¹ Later, he abandoned the Kantian approach and moved on to a conventionalist epistemology, trying to separate factual and conventional kinds of coordination and calling the latter coordinative definitions ("Zuordnungsdefinitionen").

I would like to take a closer look at the concept of coordinative definition as it is employed in Reichenbach's *Philosophy of Space and Time* (1928).² I will argue that he employed two quite different concepts of coordinative definition here without distinguishing properly between them. The first one bears a strong similarity to the conception of definitional coordinations that can be found in Schlick's *Allgemeine Erkenntnislehre*, regarding them as interpretation rules for the concepts of an axiomatic system. But without proper differentiation, Reichenbach used a different type of 'coordinative definition' in the broader sense of conventional elements of our world descriptions, despite their not being coordinations in a proper sense. I will try to show that the most prominent example of a so-called 'coordinative definition' in Reichenbach's philosophy of space, the definition of congruence, is of such a kind.

In his *Philosophy of Space and Time*, Reichenbach introduced the concept of coordination within the context of his distinction between mathematical and physical geometries. He took the idea that the application of a mathematical system to reality can be interpreted as a coordination of implicitly defined concepts with real objects from Moritz Schlick's book *General Theory of Knowledge* (*Allgemeine Erkenntnislehre*, 1918).³ This way, a mathematical geometry is turned into an empirical theory. But not all coordinations can have a factual content and, hence, be true or false. Rather, there must be *some* coordinations that are definitional in nature, called *coordinative definitions*.⁴

Reichenbach explains the idea of coordinative definitions by presenting a simple example. If a distance is to be measured, the unit of length has to be determined beforehand by definition. But that cannot be done by an ordinary conceptual definition, since such a definition does not say anything about the size of the unit. This can only be done by “reference to a physically given length”⁵, i.e. by a coordinative definition. Before such “metrical coordinative definitions” are given, statements about distances do not have factual meaning. In this sense, Reichenbach calls them “logical presuppositions concerning measurements”.⁶ It is possible to express this insight in a different way: the adoption of a unit of measurement is not determined by facts, but is rather a matter of stipulation. Thus, coordinative definitions are examples of conventional elements in our world-description.

In the given example, the coordinative definition is ostensive in nature, it can only be achieved by reference to a physical object: “‘that thing there’ is to correspond to such and such a concept”.⁷ According to Reichenbach, there is no difference in principle when there is an “insertion of some further concepts” between the concept to be defined and the real object. His example is the coordinative definition “a meter is the forty-millionth part of the circumference of the earth”. Here too we refer to a “physical length”, the circumference of the earth, even if the reference here is “rather remote” by means of the interposition of conceptual relations.⁸ And the situation is the same when we define the unit of length by reference to a certain wavelength. It is true that not the wavelength itself is observable but only certain phenomena like interference patterns, which are theoretically related to it. Nevertheless, the wavelength is “a piece of reality”, and thus it can play its part in a coordinative definition.⁹

That the unit of length must be defined before measurements are possible is not a very profound insight. But Reichenbach gives us this rather trivial example only in order to clarify the main characteristics of coordinative definitions. After this is done, he turns to the far more interesting case of the relation of congruence.¹⁰ But it will turn out that, contrary to Reichenbach, the definition of congruence is very different in nature compared to the definition of the unit of length.

To determine whether two distances at different locations in space are congruent, we have to measure their respective lengths. The standard procedure is to carry a measuring rod from one place to the other and read off the respective numbers. By taking up insights of Hermann von Helmholtz, Reichenbach saw that the measuring procedure just described is subject to a hidden premise – namely, the presupposition that the length of the measuring rod did not change while transported. That this is by no means a matter of course becomes clear once we consider the question of determining such changes of length: it seems obvious that this can only be done by comparison with a different measuring rod. Now imagine a force that has the same effect on all objects regardless of their composition, and let this effect be of such a kind that the lengths of these objects change by the same factor while in transit from one point to another. It is easy to

see that such a "universal force" could not be detected, since all *relations* of length would remain the same, and it is only such relations that can be measured.¹¹ Therefore, the assumption that such an effect does not arise cannot not be derived from observable facts.¹² Reichenbach concludes:

The problem does not concern a matter of *cognition* but of definition. There is no way of knowing whether a measuring rod retains its length when it is transported to another place; a statement of this kind can only be introduced by a definition.¹³

Thus the relation of congruence that holds between objects that are divided spatially is undetermined unless the concept of congruence has been fixed by definition. In this sense, the definition may again be called a "logical presupposition concerning measurements". And since it is achieved by a coordination of the concept of congruence with "a real object", here again we have a case of a coordinative definition.¹⁴ At least that is what Reichenbach tells us. But is this really a tenable point of view?

When Reichenbach says that it is the function of coordinative definitions to give such statements that express the results of measurements an objective meaning, he seems to have a certain semantic model in mind. Coordinative definitions are regarded as semantic designation rules that determine the reference of geometrical concepts. And after their reference is fixed, they can be used in the context of a physical geometry to make assertions about the real world. This way of looking at coordinative definitions obviously follows the model of defining the unit of length: before the concept of a unit is given a reference, it cannot be used to make statements about the lengths of physical objects. But it would be a mistake to over-emphasize the similarity between this simple case and the definition of congruence. With respect to the coordination between concept and object, there is a principal difference between these two cases. It is plausible to consider the definition of the unit of length to be an ostensive definition. There is a physical object, the standard meter in Paris, that can be identified by an ostensive gesture as reference for the concept in question. And an interposition of other concepts does not change the way in which the coordination works. It does not matter whether one has a measuring rod or a pattern of interference: there is always an observable object that can be identified by an ostensive gesture, even if in the latter case the object of reference is not the observable pattern itself but the non-observable wavelength, which is connected to the observed phenomena by a simple conceptual relation.

The case of the definition of congruence is completely different. Since it is a two-place-predicate, the coordinated entity can only be a relation, i.e. the relation which obtains between two spatially separated physical objects if their lengths turn out to be equal when measured by a transported rod. The extension of the congruence-predicate, then, is the class of pairs of congruent objects. This reading is supported by Reichenbach's formulation that the concept 'equality of length' is coordinated to a "physical structure".¹⁵ At first sight, this seems to be an acceptable view – why should we not regard relations as being real in the

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