Philosophy of Science // Fall 2015

Handout 4

Conventionalism in geometry: Einstein

Mathematical applicability. Einstein begins with this question: how can mathematics be applied to reality? Depending on what your views of mathematics are, this can mean a familiar epistemological question: how does our thought represent reality? Or it can mean: how can statements about abstract mathematical objects be used in empirical predictions? Einstein's beautiful response: 'As far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality.'

We think of axiomatic (pure) geometry as based on arbitrary axioms. This view of the axioms dispels all previous worries about the necessity of mathematical axioms. For there is no sense left for us to say that this or another system of axioms describes how the physical space (or the visual space) is. For us to be able to make any pronouncements about the geometry of the world, we should first be able to apply mathematical geometry to the physical world. And to do this we should introduce a correlation between axiomatic geometry and practical (applied) geometry.

The solids postulate. Geometry treats of rigid bodies. Lines, triangles, spheres do not change their geometrical properties when transported to a new position in space. Trivially, their positions with regard to each other would change, as would their coordinates (if a coordinate system is determined). This concern with rigid bodies is not inexplicable, since geometry owes its origin to the need to describe motion of natural bodies relative to the immobile Earth.

We further observe that solid bodies of ordinary experience can undergo changes of position without a change of state (of quality). We can also say, with Poincaré, that changes in the position of solid bodies can be reversed by the voluntary motions of the observers. We can then coordinate pure geometry with physical geometry by means of the postulate: 'Solid bodies are related, with respect to their possible dispositions, as are bodies in Euclidean geometry of three dimensions.' These bodies that are so related Einstein calls 'practically rigid'.

Are there such bodies in nature? This question can only mean: Which bodies in nature can *play the role* of practically rigid bodies? The assumption we make is that measuring rods act as practically rigid bodies. That is, measuring rods are unaltered under transport.

Geometry as an empirical science. According to Einstein, Poincaré made a key mistake when he claimed epistemic priority for the Euclidean geometry. He could only have talked about the *pure* Euclidean geometry. But experience favours no pure geometry. With the solids postulate, however, we can come to the conclusion, as in GTR, that the practically rigid bodies do not obey the laws of the Euclidean geometry.

This evidently being Einstein's conclusions, it is still rather unclear how exactly he proposes to respond to Poincaré's conventionalism. He admits that, strictly speaking (*sub specie aeternitatis*), Poincaré is right. Certainly, the naive empiricist assumptions of the existence of rigid rods can no longer be accepted. At different points in the article Einstein seems to claim that the success of GTR would not have been possible, have we accepted conventionalism. This claim, if true at all, would not involve us in serious complications. For a clearer statement, and effectively an elaboration of Einstein's position, we have to turn to Reichenbach's text.

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