Lecture 17

Helmholtz

1. Geometry and the tabula rasa

   "... in testing rigid bodies for the invariance of their form ... we must use the very same geometrical propositions we sought to prove." (p 47)

   "... all original spatial measurement depends on asserting congruence, and that, therefore, the system of spatial measurement must presuppose the same conditions on which alone it is meaningful to assert congruence." (p 49)

2. Physical presuppositions for the applicability of geometry [or "are there rigid bodies?"]

   "Thus all our geometric measurements depend on our instruments [rods] being really, as we consider them, invariable in form." (p 63)

   "Every comparative estimate of magnitudes or measurement of their spatial relations proceeds therefore upon a supposition as to the behaviour of certain physical things, either the human body or other instruments [rods] employed." (pp 63–64)

3. Geometry doesn't mean anything by itself [it needs mechanics]

   "We cannot however decide by pure geometry (G) and without mechanical considerations (P) whether the coinciding bodies may not both have varied in the same sense." (p 67)

   "A soon as certain principles of mechanics (P) are conjoined with the axioms of geometry (G) we obtain a system of propositions which has real import, and which can be verified or overturned by empirical observations." (p 68)

Poincaré and 20th century analytic philosophy

1. Hume's fork (analytic-synthetic distinction): if something is neither a relation of ideas nor a matter of fact, then it should be cast in the flames

2. Poincaré: the mathematics in empirical science is just relations of ideas (analytic sentences)

3. Logical positivism (Schlick, Reichenbach, Carnap): if something is neither a relation of ideas nor verifiable, then it should be cast in the flames

   (a) Reichenbach: the metric in GTR is conventional

4. W.v.O. Quine against logical positivism: the analytic-synthetic distinction is incoherent

5. Quine's children: all parts of a theory are on equal footing

(a) Example: Since GTR uses a manifold (M, g), it assumes that spacetime exists and has metric properties

Poincaré's conventionalism

1. Geometry is either synthetic apriori *or* experiential *or* conventional

   (a) If G were synthetic apriori, then there would be no non-euclidean geometry

   (b) Creatures who evolved in a different environment than ours might experience the world in a non-euclidean way

   (c) G does not look like experiential truths

      i. We don't experiment with geometrical objects but only with material objects

      ii. If experiential, then G would be subject to continual revision

      iii. G is based on a false presupposition of perfectly rigid bodies

2. What does it mean to say that G is conventional?

   (a) Choice of G is constrained only by consistency

   (b) Choices of G is guided by experimental facts

   (c) Choice of G is free

   (d) G consists of "disguised definitions" [analytic]

   (e) Choice of G is similar to choice of units (metric vs. imperial) or choice of coordinates (Cartesian vs. polar)

      i. HH: there are disanalogies between these cases

   (f) When choosing G, we aim for <u>convenience</u>, not for <u>truth</u>

3. Euclidean geometry is objectively more convenient

   (a) EG is simplest in the same way that a linear equation is simpler than a quadratic equation. (See the next essay)

   (b) EG agrees with the properties of natural solids

   (c) Everyone agrees that it would be more advantageous to give up the laws of optics than the laws of EG