Why Immaterial Standards Matter

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In a well-known passage in the *Investigations*, Wittgenstein makes the following claim: "There is *one* thing of which one can state neither that it is 1 metre long, nor that it is not 1 metre long, and that is the standard metre in Paris." (2009, p. 29e) [original emphasis]. The standard meter, Wittgenstein reasons, is an 'instrument' of our language. Qua an instrument, it provides a means through which length can be represented, though it is not itself representable. It is thus illegitimate, he claims, to ask whether the standard meter is a meter long. I begin this talk by showing how Wittgenstein's concerns become immaterial in the face of modern measurement theory. That's because standards nowadays are set by definitions, not samples. I then proceed to explore several advantages of the definitional approach, focusing, among other things, on the stability it offers over the old sample-centric approach.

Let's travel back in time to the 1950s. How would one find out whether something was a meter long back then? By laying it against some sample meter like a ruler. And how were these sample meters constructed to ensure they were a meter long? By machines whose operation was calibrated against so called 'working standards', i.e. some meter-long sample used for industrial purposes. These were in turn checked against so called 'secondary standards', themselves presumably adjusted to match the standard meter in Paris. But what about the standard meter itself? Surely, the standard meter cannot be laid against itself. Thus, it seemed right back then to claim, like Wittgenstein did, that we cannot ask whether the standard meter is a meter long. Commenting on this point, Beaney (2006) concurs with this assessment. Indeed, he goes on to generalise: "it is illegitimate to say of any sample that it either possesses or lacks that property of which it is a sample" (ibid.).

Fast forward to today. Luckily for us, standards are not material anymore. Instead of a sample meter, we rely on a definition that makes reference to a fundamental physical constant: "The meter is the length of the path travelled by light in vacuum during a time interval of 1/299 792 458 of a second" (NIST). Such definitions are now commonplace and they include the standards for the units of time and of temperature.[1] Thus, the issue of comparing a sample to itself that so puzzled Wittgenstein and Beaney doesn't even arise. But beyond this rather minor point, notice that the main advantage of the definitional approach is that it overcomes a problem that plagues all physical samples, namely mutability. It does so by making reference to fundamental physical *constants* in the said definitions.

It might be objected that the problem of mutability does not vanish if, as some physicists have speculated, the values of the parameters we identify as fundamental constants do indeed vary over time. One redeeming feature of the aforementioned definitions is that they do not only make reference to such parameters but also to relations between them.[2] This means that even in the case where the parameters turn out not to be constant, unless the related parameters co-vary, any non-negligible change in their values would be reflected in our measurements. This would in turn force us to opt for definitions that cite parameters that are either truly worthy of the fundamental constant label or at the very least those that cite parameters that come as close to being worthy of it as possible.

References:

Beaney, M. (2006) 'Wittgenstein on Language: From Simples to Samples', in E. Lepore and B. Smith (eds.), *The Oxford Handbook of Philosophy of Language*, Oxford: Oxford University Press, pp. 40-59.

National Institute of Standards and Technology (NIST), Reference on Constants, Units and Uncertainty, http://physics.nist.gov/cuu/Units/current.html

Wittgenstein, L. (2009) *Philosophical Investigations*, transl. by G.E.M Anscombe et al., 4th edition, Oxford: Wiley-Blackwell.

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[1] Indeed, the last remaining bastion of sample-centric standards is the standard kilogram, a platinum-iridium cylinder kept at the International Bureau of Weights and Measures in Sèrves, France. Even this however is about to be replaced by a definition, with proposals to such effect having already been made.

[2] In the case at hand, the speed of light in a vacuum (a fundamental constant) is related to a fraction of a second (a basic unit of time).