

The weight of Wittgenstein's standard metre

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Abstract

Paragraph 50 of Wittgenstein's *Philosophical Investigations* famously says that there is one thing of which one can neither state that it is 1 m long nor that it isn't: the standard metre in Paris. Consensus appears to be that (1) exegetically speaking, Wittgenstein affirms this claim, and (2) systematically, whether or not one agrees with it, the practice of using a material artefact as a measurement standard has important philosophical consequences. In this paper, in contrast, we show that (1') Wittgenstein does not affirm the standard metre claim and (2') historical facts about material length standards do not warrant deeper philosophical conclusions. References to material measurement standards in the literature gravely distort the actual metrological practices of developing and using such standards.

I | INTRODUCTION

Measurement standards are the subject of metrology, a high-precision discipline at the interface between engineering and fundamental physics. But they also lead a double life in philosophy: a number of points about metaphysics and philosophy of language have been backed by reference to measurement standards and the alleged practices of their employment. The common historical point of reference for these philosophical claims is a sentence from §50 of Wittgenstein's *Philosophical Investigations*¹:

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.

Konstanzer Online-Publikations-System (KOPS) (§50)
URL: <http://nbn-resolving.de/urn:nbn:de:bsz:352-2-8scpugx9ohkw5>

¹Wittgenstein's (1953) text is quoted from the revised 4th edition by P. M. S. Hacker and Joachim Schulte, Oxford 2009, which sensibly uses 'state' rather than 'say' (as in the Anscombe translation) for 'aussagen'. In the following, references of the form '*n*' refer to remark number *n* in that work. In all quotations in this article, italics are as in the quoted source.

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We follow the literature in not focussing on the uniqueness claim ('There is *one* thing ...'), but on what can or cannot be stated of the standard metre. The statement in question we will call the Standard Metre Claim (SMC):

Of the standard metre one can state neither that it is 1 metre long,
nor that it is not 1 metre long.

(SMC)

This claim certainly sounds paradoxical: If length is defined by reference to a certain object, the standard metre, how could that object not be 1 m long? Here, it is important to see that the SMC only claims that the length of 1 m *cannot be attributed* to the standard metre, nor any other length: one *cannot state* that the standard metre is, or is not, 1 m long. The SMC is not a thesis about the length of the standard metre, but about length attributions. This is somewhat easier to make sense of: If one adopts the implicit, underlying claim that any attribution of a length contains a reference to the (unique) material artefact that serves as the length standard, the standard metre, then an assertion of the form 'This is x metres long' means (is defined as) 'This is x times as long as *that*', where '*that*' directly refers to the standard metre.² Let us call this the Length Attribution Claim (LAC):

"This is x metres long" means "This is x times as long as *that*",
where "*that*" directly refers to the standard metre.

(LAC)

Given the LAC, to claim that the standard metre is 1 m long is to assert that 'This is as long as *that*', where both 'this' and '*that*' point to the same thing, which comes down to '*This is as long as this*'. That is surely a useless assertion.³ And there is perhaps some good sense of 'one cannot state' according to which one can then indeed conclude the SMC from the LAC.⁴ At least, one cannot state this and thereby state something informative. And even if one denies that the SMC follows from the LAC, one may try to draw interesting conclusions from the LAC itself.

²Wittgenstein does not explicitly consider such a definition of the metre in the *Philosophical Investigations*, but he discusses it in the earlier manuscript MS 113, known as *Philosophische Grammatik* (1931–32), page 23r; the passage is repeated in MS 115 (*Philosophische Bemerkungen*; 1933 and 1936), page 58: 'If the definition of the metre is the length of the Paris standard metre, then the sentence "this room is 4 m long" say the same thing as "this room is 4 m long and 1 m = the length of the Paris standard metre"'. Author's translation from the German original; text and dates from Wittgenstein (2016).

³See §279 for the similar example of someone who knows his own height in units of his own height.

⁴For instance, Wittgenstein's earlier idea of bipolarity as a precondition for contentfulness, which he arguably affirms in the *Tractatus* and certainly in the 1913 *Notes on Logic*, would supply such as sense (see Hanks, 2014).

It is therefore understandable that the SMC is subject to philosophical debate. In fact, that debate is quite extensive, both with respect to the role of the SMC within the argumentation of Wittgenstein's *Investigations*⁵ and, outside the Wittgenstein literature proper, with respect to its tenability and possible metaphysical consequences.⁶ As far as we can see, despite some disagreement about the status of the passage in the context of the *Investigations* and its overall tenability, the following two theses about the SMC are commonly held:

1. In §50, Wittgenstein affirms the SMC and uses the standard metre to illustrate a thesis about the role of paradigms in language-games.⁷
2. The actual details of the historical practice of using the standard metre are not important and need not be looked into. The LAC gives a perhaps somewhat idealised, but philosophically useful picture of our real practice of length measurement.⁸

Given these two theses, it is clear why Wittgenstein's §50 is philosophically interesting: Either there is a sense in which the SMC is true,⁹ or critique of the SMC points towards other interesting metaphysical consequences of the LAC.¹⁰ In this paper, we will argue against this general consensus, in two steps. First, we defend a dissenting interpretation of the status of the SMC in §50¹¹:

- 1'. Wittgenstein does not affirm the Standard Metre Claim in §50. That claim only serves as an illustration. Its tenability is not discussed, and certainly not assumed, in the *Investigations*—nor, in fact, in the rest of the Wittgenstein corpus.

Second, and more importantly, we discuss in some historical detail the actual role of material artefacts in length measurement. These details show that a practice of which the LAC is true would be useless from the point of view of

⁵For recent literature on §50, see, e. g., Gert (2002, 2010), Pollock (2004), Dolev (2007), Jacquette (2010) and Jolley (2010).

⁶A classical and influential discussion of the passage is given by Kripke (1980, 54–57).

⁷See, e. g., Salmon (1988), Kripke (1980), Pollock (2004) and Dolev (2007). For a dissenting opinion, see Gert (2002), who in turn is contradicted by Jacquette (2010) and Jolley (2010). See also Gert (2010).

⁸The secondary literature generally contains no relevant references. And even von Savigny (1994, 99, 107), who in his careful commentary does refer to some historical details, contains a factual error, claiming that after the introduction of the Ångström in 1927, no physical standard metre was in official use any more. See note 20 below for more details of the history.

⁹See, for example, Pollock (2004) and Dolev (2007).

¹⁰This is the line of Kripke (1980) and of many works discussing Kripke's points afterwards.

¹¹We thus agree, in this respect, with the position taken by Gert (2002, 2010).

metrology, and can therefore not be part of our scientific measurement practice. Thus, we claim:

- 2'. The historical facts about our length measurement practices matter. By considering these details, we learn something important about the role of material artefacts in science and technology. Their role could not be fulfilled if they were embedded in a practice of which the LAC was true. Thus, a practice of which the LAC is true could not be a practice of science and engineering as a universal human endeavour.

We will thus argue that philosophical discussions of the SMC are ill-motivated. Wittgenstein is right not to affirm the SMC, since it is untenable, even given a generous bit of idealisation. And given the untenability of the underlying image of the role of artefacts in our measurement practice, the actual establishment of a material length standard cannot be used to back metaphysical claims, either.

We begin by arguing for our claim (1') in Section II. Section III presents historical details on which we base our defence of claim (2') in Section IV.

II | THE ROLE OF THE STANDARD METRE IN §50

Investigations §50, whose three paragraphs (§50a–c) we quote in full below, stands in the context of a discussion of the idea of ‘ultimate elements’. The larger context is the question of whether one can mark a fundamental distinction between names, which should refer to such ultimate elements, and descriptions. Both (the early) Wittgenstein and Russell had held such an atomistic view of language, with Russell claiming that, ultimately, only the demonstrative ‘this’ fulfils the logical role of a name. The reference of such a name, it is assumed, exists of necessity. In the *Investigations*, Wittgenstein explicitly criticises his earlier *Tractatus* doctrine of *Gegenstände* that were to form ‘the substance of the world’ (TLP 2.021). In §46, Wittgenstein quotes a passage from Plato’s *Theaetetus*, thereby marking the philosophical problem of necessarily existing ‘ur-elements’ as a perennial philosophical problem in need of treatment. In §48, Wittgenstein introduces in detail a language-game ‘for which this account [of the necessary existence of ur-elements] is really valid’, thereby following his method (introduced in §2) of studying simple, artificial language-games as a means of treating philosophical confusions. At the beginning of §50, he voices one possible interpretation of the claim that of the elements, one can neither say that they are, nor that they are not:

What does it mean to say that we can attribute neither being nor non-being to the elements?—One might say: if everything that we call “being” and “non-being” consists in the obtaining and

non-obtaining of connections between elements, it makes no sense to speak of the being (non-being) of an element; just as it makes no sense to speak of the destruction of an element, if everything that we call “destruction” lies in the separation of elements.

(§50a)

This interpretation is, however, dismissed immediately, and another option is brought forward, marked as the preferred reading. (Note that all the time Wittgenstein is discussing an idea that he held in the *Tractatus*, but which he now rejects.) The SMC occurs in this context:

One would like to say, however, that being cannot be attributed to an element, for if it did not *exist*, one could not even name it, and so one could state nothing at all about it.—But let us consider an analogous case. 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.—But this is, of course, not to ascribe any remarkable property to it, but only to mark its peculiar role in the game of measuring with a metre-rule.—Suppose that samples of colour were preserved in Paris like the standard metre. So we can explain that “sepia” means the colour of the standard sepia which is kept there hermetically sealed. Then it will make no sense to state of this sample either that it is of this colour or that it is not.

(§50b)

The last paragraph of §50 comments on the idea of the ‘sepia’ colour standard, which is presented in parallel with the SMC, and then reverts to the discussion of §48:

We can put it like this: This sample is an instrument of the language, by means of which we make colour statements. In this game, it is not something that is represented, but is a means of representation.—And the same applies to an element in language-game (48) when we give it a name by uttering the word “R”—in so doing we have given that object a role in our language-game; it is now a *means* of representation. And to say “If it did not exist, it could have no name” is to say as much and as little as: if this thing did not exist, we could not use it in our language-game.—What looks as if it *had* to exist is part of the language. It is a paradigm in our game; something with which comparisons are made. And this may be an important observation; but it is none the less an observation about our language-game—our mode of representation.

(§50c)

Thus, the main point of §50 is to comment on what it means to say that neither existence nor non-existence can be attributed to the elements of language-game §48. That particular language-game, which is described in detail and even illustrated in colour, is the topic of §49 and of the remarks following §50. The larger context thus shows that the statements about the standard metre and about standard sepia are not part of the ongoing discussion, but just function as illustrations for a point Wittgenstein is making about the language-game of §48 that he is really discussing. The statements are put forward for illustration but not affirmed.¹² The important message, taken up into the discussion of §48 ('And just this goes ...'), is not what can or cannot be stated about the standards for '1 metre' or 'sepia', but the *diagnosis* that follows: 'this is, of course, not to ascribe any extraordinary property to it, but only to mark its peculiar role in the language-game'; 'This sample [...] is not something that is represented, but is a means of representation'. This is what Wittgenstein picks up in reverting to his ongoing discussion of the language-game of §48; the reference to the Paris archive is only used to illustrate the analysis of the simple artificial language-game of §48. The tenability of the illustrations does not matter.

The larger context of the *Investigations* supports this reading of the SMC, and the parallel example of the standard sepia, as mere illustrations. Wittgenstein never returns to discuss them. The colour sepia is used once before, in §30, in a remark on ostensive definition; the metre is not mentioned outside §50 at all. The image of the Paris archive never returns. Apart from the singular nature of the illustrations, one should note an even stronger exegetical point: To read Wittgenstein as placing any weight on the SMC, or even to represent the SMC as a part of Wittgensteinian doctrine, would be to contradict the important maxim of the immediately following remark §51, which Wittgenstein adheres to in his discussion of §48: 'In order to see more clearly, here as in countless similar cases, we must focus on the details of what goes on; must look at them *from close to*' (§51). He exerts so much effort to analyse the simple language-game of §48; much more effort would be required to come to grips with the actual practice of using the standard metre. Wittgenstein does not expend this effort, and this is a clear indication that he does not present any verdict on what is and what is not the case with respect to that practice.

Our diagnosis is also confirmed by a consideration of the *Nachlass*. Wittgenstein mentions the Paris standard metre, or the Greenwich foot, in a number of places, but in none of these does he affirm the SMC or an

¹²In the *Investigations*, we often find different voices arguing about a point in question, but Wittgenstein does not consistently mark passages as being in his or an interlocutor's voice. The dialectical setting of §50, however, makes it clear that we cannot attribute the SMC to Wittgenstein himself, since a decisive rebuttal is provided here and in the two parallel cases discussed in §50.

analogue.¹³ One should also take into account the fact that Wittgenstein had a background in engineering. It does not seem far-fetched to assume that he knew actual practices of length measurement and their relation to material artefacts, or at least some important aspects of that relation. Minimally, he would have known where to look, and been able to understand the relevant literature, had he considered a detailed study of the actual practice important for his aims.¹⁴

We can conclude that in the *Investigations*, Wittgenstein cannot be read as affirming the Standard Metre Claim.

III | THE HISTORY OF THE STANDARD METRE

The above discussion was solely focussed on the role of the SMC for Wittgenstein's argumentation in the *Investigations*. But what about the claim itself? Is it true, or at least true when read *cum grano salis*? What about the underlying image of the use of a unique material standard: Is the LAC an adequate description of an established practice, so that the LAC can be used to back up philosophical claims? Before we can tackle this question in Section IV, we need to describe in some detail the historical practices in which a material standard metre artefact was actually involved.

Most current philosophical discussions of the standard metre issue acknowledge that the definitorial position of a material artefact as the standard metre is a thing of the past. In fact, the present official definition of the SI unit of 1 m, effective since 1983, does not refer to *any* individual artefact any more: the metre is defined as the distance light travels during $1/299,792,458$ s in vacuum, where the SI unit of 1 s is in turn defined as the time of a specific number of certain atomic transitions.¹⁵ Thus, the present official metre definition only refers to natural kinds and conventionally chosen numbers. The

¹³See note 2 above for early discussions in the 1930s, which cannot be read as Wittgenstein affirming the SMC either. Wittgenstein also discusses the *Greenwich foot*, thus referring to somewhat different length measurement practices in historical succession. *Urmeter* passages in the *Nachlass* are MS 109 (*Bemerkungen*, 1930/31), 243; MS 113 (*Philosophische Grammatik*, 1931/32), 23r, 23v; MS 115 (*Philosophische Bemerkungen*, 1933 and 1936), 58; MS 121 (*Philosophische Bemerkungen*, 1938/39), 55r; MS 122 (*Philosophische Bemerkungen*, 1939/40), 64v; TS 211 (1931/32?), 405, 569, 570; TS 212 (1932/33?), VII-57-1–3; TS 213 (*Big Typescript*, 1933), 241r; and then several preliminary versions of the *Philosophische Untersuchungen*: MS 142 (1936/37), 45; TS 220 (1937), 38, 49; TS 227a (1944–46), 44f.; TS 227b (1944–46) 44f.; TS 239 (1937), 39. For text and dates, see Wittgenstein (2016). We found one place at which Wittgenstein appears to affirm something like the SMC (see Diamond, 1976, 159), but that passage is from a lecture transcript, not from Wittgenstein himself.

¹⁴Note that the *Investigations* do contain a few remarks that directly reflect Wittgenstein's knowledge of actual scientific or engineering practices (e.g. §79, §194).

¹⁵To be precise, since 1983 the frequency of the ground state hyperfine transition of caesium-133 (the element used in modern atomic clocks) is fixed to be $9,192,631,770\text{ s}^{-1}$. There are official recommendations for using laser-based length standards, making for an even simpler determination of the metre as a number of wavelengths of certain types of monochromatic (laser-)light, but the official definition is in terms of the speed of light only. From 1960 until 1983, an atomic length scale was adopted as the official length standard.

SMC is of course untenable, given that definition (no matter what ‘the standard metre’ refers to), as the underlying LAC is simply false. Thus, philosophical discussions based on the LAC have to consider a *historical* or a *counterfactual* setting in which the metre definition refers to an individual artefact. When Wittgenstein wrote the *Philosophical Investigations*, the metre definition did refer to an artefact, but that practice was changed in 1960. Prior to 2019, the discussion could have switched to the SI unit of 1 kg, which until then was defined by reference to an artefact, but that last official role of an artefact has also been abandoned.¹⁶ Since 2019, all measurement units of the SI system are defined in terms of natural kinds and conventionally chosen numbers.

Following the literature, we will stick to the length standard example from the *Investigations*. We will, however, mention some parallels with the mass standard along the way. The practices involved are similar in all relevant respects.

III.1 | Methodology

As no material artefact plays a definitorial role in measurement any longer, we are forced to face a crucial decision, even though that is not usually made explicit. What kind of situation is it that we are envisaging when considering the SMC? Do we simply go back in time, placing ourselves in the actual historical setting of, say, 1815 or 1945? Or do we rather consider a counterfactual situation in which we *now* have a metre definition based on some specific artefact, ‘the standard metre’, of which we can stipulate that the LAC be true? In the literature, this is often taken to be a point of no importance. It is, however, crucial from a methodological point of view. For one, it is crucial given Wittgenstein’s approach. In the *Investigations*, Wittgenstein treats these two options completely differently. He establishes a method of working with explicitly defined language-games, such as in §48ff. Of these language-games, we know everything, since everything that holds of them is stipulated. By contrast, Wittgenstein looks at our actual practices and has a keen eye for their complexity—see, for example, §66ff. on the various things we call games. Wittgenstein expends much energy to show that, in philosophy, we are prone to distort our actual practices by likening them to hypothetical practices of which all-too-simple stipulations are true.

¹⁶The definition of the SI unit of 1 kg until 2019 referred to an artefact stored at the *International Bureau of Weights and Measures* (BIPM) in Sèvres, the standard kilogram. A long-planned revision was finally passed into EU law in the summer of 2019 (EU Commission Directive, 2019), following the Committee on Data for Science and Technology (CODATA) resolution of 20 May 2019. Since the matter is more recent, there is more published material on disputes about the actual mass of the kilogram prototype, directly showing that the mass analogue of the SMC, or the LAC, is also clearly false. For some relevant literature on the role of copies of the official kilogram prototype, see Girard (1994).

The methodological point about story vs. history, however, extends beyond Wittgenstein's own methodology. The LAC is also invoked by authors who do not necessarily share Wittgenstein's methodological outlook. What weight can the LAC be taken to bear? Well, this depends. If the situation in which the LAC holds is *just a story*, then we should treat it as such. We can certainly learn something from certain philosophical thought experiments, but in this case, we should not let the *faux* scientific setting push us towards metaphysical conclusions. To give an analogy: The fact that bosons (e.g. rubidium-87 atoms) can form a Bose-Einstein condensate in which, apparently, individual atoms become indiscernible, is a good motivation for rethinking some of our metaphysical ideas about individuals and indiscernibility.¹⁷ The fact that there is an episode of *Star Trek* in which a transporter malfunctions, producing two Captain Kirks,¹⁸ provides no such motivation. The fact of evolution is an interesting challenge to the Aristotelian notion of species; a story involving talking donkeys is not. To quote Davidson: 'Don't bother me with your stories'.¹⁹ So, is the LAC backed by historical scientific practice, or is it only a creative stipulation within some given story?

III.II | History

Let us look at the actual history. The first thing to remark upon is that there are two different historical settings that we might wish to consider. Wittgenstein, writing in the 1930s and 1940s, in the *Investigations* refers to the 'Urmeter in Paris', which was adopted as an international length standard from 1799. At the time Wittgenstein was writing, the Paris standard was already a mere museum piece, and a different artefact had been internationally adopted: in 1889, a standard metre kept in Sèvres, a place close to, but not within the city limits of Paris, became the official basis of all length measurements.²⁰ The actual practices of using these two different standard metres differed somewhat, but the main lines are similar. Anecdotally, it is

¹⁷We only say motivation for rethinking. The matter is complicated. The point here is just that the scientific findings are worthy of serious philosophical thought, not that they settle everything in a simple way. See French (2019) for an overview of the relevant scientific facts and the ensuing philosophical debate.

¹⁸Season 1, episode 5, 'The enemy within', stardate 1672.1.

¹⁹Attribution via Belnap et al. (2001, 50). See also Van Inwagen (1993).

²⁰In fact, for atomic length scales another length standard had also been adopted by the time in question: from 1927, there were in fact *two* different length standards, the Ångström for small distances (like spectroscopic wavelengths), and the metre for macroscopic distances, with no definitionally fixed conversion rate between them. Such a conversion rate was fixed in 1960, thereby effectively taking the atomic length scale to overrule the Sèvres artefact. The Ångström was not defined with reference to a specific artefact, but with reference to natural kinds and some rather complex technological constructions. We will not consider the atomic length scale in what follows. As mentioned, that standard was in turn superseded in 1983 by fixing the speed of light in vacuum and giving an atomic standard for the second. That situation was reaffirmed in the 2019 changes to the SI unit system that also got rid of the standard kilogram artefact.

perhaps interesting that only the 1799 metre was designed to be 1 m long, to be used as an end measure. That was soon seen to be a bad idea from an engineering point of view, since touching the ends means to subject them to wear—the standard metre actually shrank due to repeated use, and this was one of the reasons for revising the standard. So the 1889 metre (with an X-shaped rather than a rectangular profile to minimise the effect of various strains) was manufactured to be a bit longer than 1 m; the distance of 1 m is marked by two fine scratches on its surface.

How did the standard work, and how did it come about? The standard metre is a brain-child of the French revolution. In the 18th century, almost every marketplace had its own system of weights and measures. Conversion was sometimes difficult and often a possibility for manipulation. Local units posed a difficulty for the expansion of long-distance trading as well as for the fairness and equality of exchanges or taxation. Thus, multiple factors were working towards a unified system. On the other hand, of course, it was politically difficult to force local authorities to give up their long-established conventions. The way around the political issues was to invent the metre from scratch and to couple it with something belonging to the whole of mankind: the earth itself. The design of a rational system of units was to base time measurement on the earth's revolution, length on its circumference, and mass on volume (cubic length), via the substance supporting all life on earth, viz., water.

These universalist ideals had to be implemented. Having settled for a definition of the metre as $1/40,000,000$ of the circumference of the earth measured across the poles (along the meridian passing through the Paris observatory), two expeditions in the 1790s set out to measure the part of that meridian between Barcelona and Dunkerque (both at sea level) by triangulation and the explicit measurement of two triangle bases as well as the latitudes of the two extremal cities. The convoluted history of these expeditions, taking place in a Europe in the grip of the French revolutionary wars, is told in engaging detail by Ken Alder.²¹ The expeditions led, eventually, to lots of data from which a length in terms of one of the old length units, the French *ligne*, was computed. A correction accounting for the oblateness of the earth at the poles was the subject of a heated controversy. In the end, a platinum bar and three platinum copies, as well as many copies from other materials, were made to represent the new length standard.²² On 22 June 1799, the stan-

²¹Alder (2002).

²²It turned out later that the metal used was not platinum, but an alloy containing several other elements (discovered only later on) in unspecified proportions, which accounts for controversies about the mechanical behaviour of 'platinum'. Even the metal used for the 1889 metre, an alloy of defined proportions of platinum and iridium, was later found to be thermodynamically unstable (Clusius, 1963, 173). Certainly, the 1799 choice of the metal was not dictated solely by engineering considerations, but to some extent also by the air of exclusivity and novelty that surrounded platinum at the time—a process for manufacturing things out of platinum had only very recently been invented.

ard metre was presented to the public in a grand ceremony—only to be taken back to the workshop to be polished and revised for another 9 months before it was finally deposited in the archive.²³ The history of the 1889 metre is somewhat less spectacular: After many political struggles, a new international treaty was signed and a few dozen platinum–iridium standards were made; one was officially designated the new standard, and the copies were distributed internationally.

For both of these standard metres, international treaties and national laws were established that did refer to one individual material artefact. For example, the 1889 metre convention, which was referred to by national law in France and in many other countries, reads:

The Conference [...] sanctions [...] the Prototype of the metre chosen by the CIPM. This prototype, at the temperature of melting ice, shall henceforth represent the metric unit of length.

(Conference Generale, 1889)

Isn't this clear evidence, then, that the LAC was literally true in the years from 1799 to 1889 (for the Paris artefact) and 1889 to 1960 (for the Sèvres prototype)? Doesn't that licence metaphysical conclusions to be drawn from the LAC (or from a parallel case about the kilogram, even until 2019)? We will now show that such an interpretation of historical (or recent) measurement practices is naïve, and that grand conclusions are unwarranted.

IV | ASSESSING THE LAC: A SPECIAL ROLE FOR ONE ARTEFACT?

Having laid down its history, what can we say about the philosophical import of the standard metre? What is the special role of the artefact mentioned in the law, really?

IV.1 | It's the law

It is a fact that the French law of 1805 (for example) explicitly refers to the standard metre as the sole standard of length. One must not forget, however, that laws need to be interpreted when it comes to application. The purpose of law is to further the society whose law it is: the laws were made for man, not the other way round, as the saying goes. And one needs to remember that metrology, the art and science of measurement standards, is at the service of both society as a whole and the sciences in particular.

²³Alder (2002, 253f.).

Let us put a literal reading of the LAC to the test, and let us assume that ‘object *A* is *x* metres long’ in fact means ‘object *A* is *x* times as long as *that*’, pointing to the material artefact, the standard metre. Now imagine that for some reason, the standard metre falls from the table and bends, thereby causing a 0.1% shrinking in the length standard—as *we* would say. But note that on a literal reading of the LAC, there simply cannot be any distortion in the standard, since the standard is exactly as long as it is!²⁴ Rather, the fall must have had other, strangely coordinated, effects on our universe. All of technology continues to work as usual, for sure, but weird things have happened. For example, the distance between London and New York has expanded—will your airline give you more miles for the flight? The speed of sound has increased. The wavelength of the yellow line in the sodium spectrum has shifted. A 2-m pipe at the hardware store has become longer than 2 m all of a sudden. (Luckily, it still fits exactly in your car, since the car has expanded as well).

It is clear that this way of interpreting the law is nonsensical. It would be economically disastrous, cause grand confusion in science, and be completely gratuitous. And the metrologists in fact catered for such accidents in advance (and lawmakers were clever enough to keep the law simple and flexible; see note 24). The copies of the standard were made for metrological reasons, not for fun²⁵: By having many different material artefacts, kept in different places and made from different materials (especially in 1799, when the chemical and material properties of platinum were not yet fully understood—see note 22), what was installed from the very start was, in fact, a network of different objects that could be, and were, minutiously compared against each other. The novel technologies invented for these comparisons, and the practices of employing them, were as much part of the deal as the individual artefacts.

In fact, for the improved 1889 metre, the official copies were planned to be, and actually were, compared with each other later on. This revealed a drift in the length of the official prototype, which was found to have shrunk by 0.5 μm (Clusius, 1963, 173). This statement, which on a literal reading of the LAC makes no sense, was in fact important in the move from a material to an atomic (natural kind-based) length standard. An exactly parallel story can be told for the kilogram prototype and its copies: the prototype’s drifting mass was one of the main arguments for moving to a natural kind-based mass standard in 2019. The metrological community openly discusses the problems involved, having to do

²⁴The usual *ceteris paribus* discussion can be started at this juncture. Add a clause, ‘The metre is the length of the standard *when straight*’. Reply: First, this clause simply is not in the law, so we are discussing a story rather than history. Second, other processes (both mechanical and chemical ones) may lead to shrinking without bending (this actually happened to the 1799 standard). Of course, additional clauses may be added to deal with that. But after a couple of rounds one will have to end with a clause that rules out length changes, which is inadmissible since if the artefact is the unique standard, there is simply no means to verify whether such a change has taken place.

²⁵Making them was extremely costly. Even acquiring enough platinum for the four bars was difficult (see Alder, 2002, 253).

with practical feasibility, reproducibility, and error margins. It is good to keep the official definitions simple and thereby flexible, but it is naïve to think that that is the whole story. The LAC is simply false.

This is not to say that there could not be practices for which something like the LAC could be literally true. Thus, taking up Wittgenstein's example of the standard sepia, there could be a cult whose followers are mandated to wear a bracelet the colour of sepia, where 'sepia' literally means 'the colour of *that* prototype'. If (as *we* would say) the colour of that prototype changes for any reason, we can imagine that all the followers will buy new bracelets, having found out, to their dismay, that the colour of their bracelet has changed all of a sudden (as *they* would say), since it deviates from the standard. Such a practice can be imagined; there may even be historical examples.²⁶ It is clear, however, that such practices go against the universalist aspirations of science and can have no place in metrology.

IV. II | Kripke on 'reference-fixing'

We finish by commenting on Kripke's famous discussion of the SMC in *Naming and Necessity*, in which he presents something like the LAC as an example of a contingent truth known *a priori*.²⁷ (Kripke treats the SMC as a piece of Wittgensteinian doctrine, which, as we have seen in Section II above, will not do, but this is of no consequence for what follows.) Kripke's discussion is, despite its brevity and lecture-transcript style, quite careful; he points out many pitfalls along the way. Still, he falls short of his aim of presenting an LAC-related example of a contingent *a priori* truth.

Kripke argues, first, that the claim that the standard metre is 1 m long, is not a necessary truth: the very thing, the standard metre, could have a different length 'if various stresses and strains had been applied to it'.²⁸ This agrees with our diagnosis of Section IV.I. Reading the LAC as a claim of meaning equivalence is thus ruled out. Kripke mentions the possibility of interpreting the metre standard in terms of a 'cluster concept',²⁹ which may point in the direction of our discussion of Section IV.I (though no details are given). The idea that is defended, however, is that 'stick *S* is one metre long at t_0 ' is used to '*fix the reference*' of the term 'one metre'. In giving such a definition, one is using 'an accidental property, namely that there is a stick of that length', to define the standard length.³⁰ Kripke goes on to discuss the epistemological status of the definition:

²⁶Think of the famous photo of a speech of Lenin's in Moscow on 5 May 1920, from which Trotsky and Kamenev were later edited out. An original (as *we* would say) would, by Soviet standards of the 1930s, officially have counted as a forgery, with enemy figures edited *in*.

²⁷See Kripke (1980, 54ff.).

²⁸Kripke (1980, 55).

²⁹Kripke (1980, 55n).

³⁰Kripke (1980, 55).

What, then, is the *epistemological* status of the statement ‘Stick *S* is one metre long at t_0 ’, for someone who has fixed the metric system by reference to stick *S*? It would seem that he knows it *a priori*. For if he used stick *S* to fix the reference of the term ‘one metre’, then as a result of this kind of ‘definition’ (which is not an abbreviative or synonymous definition), he knows automatically, without further investigation, that *S* is one metre long.³¹

At this point, we should revert to our methodological discussion of Section III. *What* is an example of a contingent truth known *a priori*? Clearly, there is *some story* in which somebody knows the truth of ‘Stick *S* is one metre long at t_0 ’ *a priori*, even though it is not a necessary truth. Kripke points out that his discussion involves some idealisations, but he presents the establishment of the metric system as a real example of reference-fixing that establishes a contingent truth *a priori*.³² A mere story would certainly have much less metaphysical weight.

But who was it that fixed the metric system by reference to stick *S*, and when? Above, we pointed out that at the official ceremony on 22 June 1799, the stick presented to the audience was not, by its makers, assumed to be exactly 1 m long. That was an event of declaratory reference-fixing, if ever there was one—but the reference was the wrong one (even barring the problem of what ‘establishing a rigid designator that refers to a length’ comes down to; Kripke mentions an operational reading on p. 54). The date had been fixed in advance, the work had not progressed fast enough; an unfinished piece was shown. The people going through the motions of baptising knew that. Furthermore, it would have been the wrong reference even if the artefact had been finished, since the reference length was defined at the temperature of melting ice, 0°C, and it has not been reported that the stick was carried around in a bucket of ice on that June day.³³ And why should it? To please the metaphysicians? Well, maybe when Lenoir, the instrument maker in charge of producing the metric standards, put the finished piece back in the archive, there could have been a proper moment. (The present author does not know whether the artefact was cooled down to 0°C immediately before it was deposited; it seems unlikely.) But to imagine Lenoir uttering the words ‘This is one metre long’ at that moment is not to imagine a moment of baptising that puts the metric system in place. The system was established by a legal act, not by metrologists—they were just in charge of getting the instruments right.

As we mentioned, Kripke’s discussion is quite careful, and it is not unrelated to the facts. There was, of course, a practice in which a standard metre artefact

³¹Kripke (1980, 56).

³²See Kripke (1980, 57).

³³If you hope for a *List der Vernunft* through which wrong length and wrong temperature might just have cancelled out on that occasion, you will be disappointed: the errors do not cancel, they add.

played a special and substantial role—but that practice cannot be used to support Kripke’s claim about contingent *a priori* truth. That claim is rather based upon a story that is only loosely connected with actual measurement practices. The special role claimed for the standard metre is actually played by the whole network of metrological practices, not by a single artefact. The truth, as so often, is that the story is complicated, and that seems to be all.

V | CONCLUSION

We have seen that the actual practice of ‘measuring with the standard metre’ is complex and convoluted, and for good reasons. That practice plays its specific role in a larger human practice—science—that by its nature is meant to be as general as possible, and maximally independent of individual, local circumstances. Still, the use of individual, material artefacts can play an important role, since these may well be—for length measurement apparently were until well into the 20th century, and for mass measurement even into the 21st—the best means for achieving the required generality and accuracy. The standards for ‘best means’ here are set by technology, but also by political forces.

Meanwhile, since 2019, all material artefacts have been stripped of their roles as standards of length, mass or any other scientific unit. The only names occurring in the 2019 SI unit definitions (apart from the names of the units themselves and the names of conventionally chosen numbers) are light, vacuum, caesium 133, and the elementary charge (which is the negative charge of the electron and the positive charge of the proton). The universality of the system of units has thereby increased dramatically, from the 18th century reference to a material artefact modelled on the earth to the contemporary reference to basic building blocks of the world. If there is any metaphysical lesson to be read off from the historical development of measurement standards, it seems to be that metrologists—as well as scientists in general—have faith in the stability and universality of natural kinds.

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