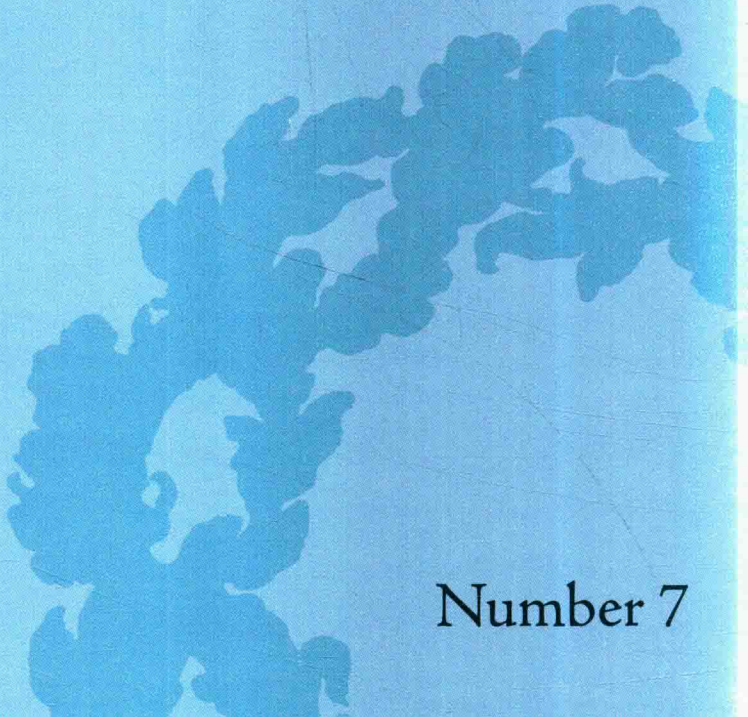
History and Philosophy of Technoscience

# Standardization in Measurement

*Edited by Oliver Schlaudt and Lara Huber*



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# STANDARDIZATION IN MEASUREMENT: PHILOSOPHICAL, HISTORICAL AND SOCIOLOGICAL ISSUES

EDITED BY

Oliver Schlaudt and Lara Huber



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# INTRODUCTION

Lara Huber and Oliver Schlaudt

This volume of fifteen essays offers the reader a multidisciplinary approach to standardization in measurement.[1] Measurement is crucial to modern civilization, and standardization is crucial to measurement. Standardization in measurement is also a challenge, for it is a multidimensional object in the study of which the epistemic and the social are intertwined and, in last analysis, cannot be separated. Over the last few decades research in the natural and life sciences has been marked by an unstable and often tense relationship between philosophical, historical and sociological approaches. The days of overt aggression (e.g., the 'science wars') seem to be over, but even if historians, sociologists and philosophers are interested in collaborating with one another, they usually do not know how, so there is a general tendency to withdraw into their own traditional domains. We think that standardization in measurement offers a quite natural opportunity to overcome disciplinary boundaries. This volume seeks to inform the reader about the fundamental relationship between measurement and standardization and to explore standardization in measurement in its various aspects: standardization of procedures, instruments and objects, of units of measurement and of vocabulary.

## Measurement and Standardization

### *Measurement*

Measurement is an old companion of mankind, dating back at least to ancient Mesopotamia. It is also intimately linked to science. Some have even argued that the development of quantitative methods is coextensive with science itself. '[In] any special doctrine of nature', Kant tells us in his *Metaphysical Foundations of Natural Science* from 1786, 'there can be only as much *proper* science as there is mathematics therein' – and thus measurement, if the mathematics is to be linked

to experience.[2] Viewed realistically, however, measurement is surely neither sufficient nor necessary for science; rather, it is key to widely differing scientific practices. As such it is strongly oriented towards the development of precision instruments and statistical analysis as much as data mining techniques. Not surprisingly, measurement attracted much attention in the early days of epistemology when physics was still the queen of the sciences – it is extremely prominent in Mach, Poincaré, the early Carnap and the Vienna Circle – and only ceased to do so when measurement theory, at intervals from the 1890s on but predominantly since the 1940s, tended to be treated in a purely formal way (axiomatic theories of measurement, theory of scales). The formal approach to measurement – conceived as the representation of objects by numbers – studied the construction of mappings between a given 'empirical relational structure' and a numerical counterpart, neglecting thereby the intricate role of laboratory work involved in accessing the 'empirical relational structure' in such a way that numbers can be mapped onto it. This work is often of a local nature, not stabilized once and for all, and rests on material artefacts inherited from tradition and adapted to novel use. These contingent, 'history-laden' circumstances of measurement are mirrored in the full expression of a measurement result, consisting not only in a numeral – as supposed by the formal or 'representationalist' approach – but also in a unit and a margin of error. These aspects begin to attract attention from various perspectives: studies of error, historical epistemology, the practical turn. In this way, measurement re-enters the scene. Indeed, a recent review article observes a return of measurement to the forefront of philosophical research:

> A wave of scholarship has emerged in the past decade that views measurement from a novel perspective, bringing standards, artefacts, modelling practices, and the history of science and technology to bear on philosophical problems concerning measurement. This recent work departs from the foundationalist and axiomatic approaches that characterized the philosophy of measurement during much of the 20th century. Inspired by developments in the philosophy of scientific modelling and experimentation, contemporary authors draw attention to scientific methodology and especially to metrology, the science of measurement and standardization.[3]

## *Standardization*

Crucial to this aspect of measurement is standardization. Standardization is a practice of regulation that extends into all spheres of human action. Standardization in nineteenth- and early twentieth-century industrial production can be seen as a major event in human cultural and social history. Accordingly, standardization cannot be reduced to exclusively scientific purposes such as measurement and its implications for related practices in everyday life. There are very different objects of regulation and topoi of standardization, including the stabilization

of material objects as much as the control of human interactions. It is for this reason that sociologist Lawrence Busch in his recent book speaks of standards as 'recipes for reality'.[4] Still, it is the domain of science where the genuine nature of standards is most apparent, given that they are both prerequisites for scientific practices and outcomes of scientific expertise. Standards formalize and regulate strategies of validation and therefore contribute significantly to the evolution of scientific practices as such. Standards, as for example clinical practice guidelines, provide trust in scientific methodology but also prioritize a given set of research practices.[5] Several studies in the history of science and technology have shown that practices of standardization arise predominantly on the basis of interactions with technical devices, notably measuring instruments. In his book *History of the Thermometer and its Uses in Meteorology* historian W. E. Knowles Middleton at least implicitly illustrates that any history of measurement simultaneously gives insight into a history of standardization.[6] This characteristic is not restricted to manufacturing technology or the calibration of measuring devices but includes quite varied approaches to formalization in science. It also responds to significant regulatory challenges, as explored, for example, by Geoffrey C. Bowker and Susan Leigh Star in their social study on the classification of disease.[7] Actually, it is the social sciences that have shown a steady and substantial interest in practices of regulation and the effects of standards on human action – or rather on human self-perception in the course of practices of normalization.[8] There is a huge literature on how standardization impacts on how individuals are viewed and judged, including, most famously, *Discipline & Punish: The Birth of the Prison* by Michel Foucault and *The Mismeasure of Man* by Stephen Jay Gould. As regards practices of standardization in laboratory science, the concept of 'standardized packages' introduced by sociologist Joan H. Fujimura could serve as a starting point for further research into the extent to which the standardization of technical devices serves a stabilization of facts and is effectively a means of regulating human action across divergent areas of application.[9]

Up until recently, the systematic challenges posed by standardization have not been addressed from the perspective of philosophy of science. Allan Franklin's book *Experiments in Particle Physics in the Twentieth Century* could be read as a systematic case study of how standards of measurement (here standard deviation) determine epistemic values such as significance or credibility. Due to technical innovation, standards remain objects of improvement or even displacement. This aspect could be classified as part of the history of scientific progress. Additionally, the case of 'shifting standards' could also be framed as a problem associated with an established scientific practice. As a consequence, epistemic values, such as significance or credibility, may be affected when a given standard is challenged due to its modified use.[10]

## Standardization in Measurement: A Multidisciplinary Approach

Standardization in measurement is thus a crucial and yet largely neglected component in the production of scientific knowledge. Furthermore, it is a multidimensional issue, which lays bare the entanglement of the scientific, technological and social issues that come into play in the development of knowledge in the natural and life sciences. As such, its study offers an excellent opportunity to rethink disciplinary boundaries. What we hope to gain from this new perspective on standardization in measurement is a much clearer picture of how scientific, technological and social issues not only coexist but indeed interrelate with and mutually influence one another in science.

Multidisciplinary approaches run counter to the commonplace distinction between facts and (epistemic) values, between a contingent context of discovery and a self-sufficient context of justification. This distinction is constitutive of epistemology as understood by many philosophers, and it is behind the endless quarrels between philosophers and sociologists which have taken place over the last forty years – and which, we think, have often enough paralysed efforts to understand how science works. The fact/value distinction has always had its doubters too, however. The 'heretical' movement of pragmatism, for example, challenged the fact/value dichotomy in a number of fundamental ways, while some early representatives of the sociology of science were also sceptical about it. Karl Mannheim, in his 1929 work *Utopia and Ideology*, regarded the fact/value dichotomy simply as an over-hasty, hypostatizing institutional strategy aimed at establishing epistemology as an independent discipline.[11]

This critical stance has reappeared more recently. In the wake of Nelson Goodman, Catherine Elgin proposed in 1989 'the Relativity of Fact and the Objectivity of Value', i.e., the thesis that fact and value 'are inextricably intertwined'.[12] Feminist philosopher Lynn Hankinson-Nelson and, in neo-pragmatist mode, Hilary Putnam both draw parallels between their attack on the fact/value distinction and Quine's critique of the synthetic/analytic dichotomy: the normative and the descriptive, just as the analytic and the synthetic, might well be aspects of our epistemic engagement with the world, but they are not mutually exclusive categories to which all the individual items of our knowledge can finally be allocated. The reason for this is that statements do not express bare facts but rather entangle facts and conventions – and so they do also with facts and values.[13] In her book *The Fate of Knowledge*[14] (2002) Helen Longino seeks to overcome the dichotomy between the (non-social) rational and the (non-rational) social by identifying the underlying values constitutive of scientific discourse and thus of the production of scientific knowledge. Far from being merely a disturbing factor (Francis Bacon's famous 'idols of the mind'), here the social *is* the rational – not only in the trivial sense of an instantiation of