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A Meaningful Justification for the Representational Theory of Measurement

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Measurement, the means by which numbers enter science, is of fundamental importance to modern science. The relationship between its qualitative and quantitative aspects has generated many theories and much controversy. In Nineteenth Century geometry similar developments led the mathematician Felix Klein to devise a theory for unifying qualitative and quantitative approaches to geometry. Klein's theory, which today is called the "Erlanger Program," was based on transformation groups. In this article, the Erlanger Program is given a new foundation based on mathematical logic and is extended to science. The current dominant theory of measurement in the literature, the "representational theory," is then justified in terms of the new foundation for the Erlanger Program. Certain inferential techniques used in dimensional analysis and the related technique of "Possible Psychophysical Laws" are also given justifications in terms of the new foundation.