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Evolving Planck Constant Measurements into the SI Kilogram Standard

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This is a very brief 100 year history of measuring $2e/h$ (pre-and post-Josephson), with a little on e^2/h (quantum Hall Effect, QHE), and then on to a direct measure of Planck constant h , where the watt balance technique combines four basic standards, i.e., physical constants of time, length, voltage, and resistance into a mass redefinition. There are parallels between old and new controversies. In the 1970's and 80's the controversy was in the changeover from standard cells to the Josephson effect as voltage reference. A slightly similar and briefer one concerned the ohm and QHE. Today's discussion is about changing definitions from an artifact mass standard to the Planck constant (or Avogadro constant) using the different methods as realization. The mass redefinition concerns are two orders of magnitude down from those of voltage, and the discrepancies between h are probably more systemic rather than artifact related (or not) as compared to the Josephson effect testing. This shows how far electronic metrology has progressed but also that is it not completed research. The conclusion summarizes the latest efforts on the watt balances.