Interview de Barry N. Taylor (11 mai 2010)

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Dr. Barry N. Taylor is a NIST Scientist Emeritus in the Fundamental Constants Data Center (FCDC) in the Atomic Physics Division of the NIST Physics Laboratory. He has served in this capacity since his retirement from NIST in March 2001 after over 31 years of Federal Service.

Research Interests
Current research activities focus on the periodic CODATA compilations of recommended values of the fundamental physical constants and on the development and establishment of an improved International System of Units (SI).

1) Why did the NIST and the USA get interested in the redefinition of the kilogram, while metrological questions were traditionally handled by Europe and especially by France?

I don't agree with the premise of your question. It may have been the case in the 19th century, but certainly not in the 20th and 21st. North America, meaning the USA and Canada, have been active participants in international metrology for at least the last 100 years.

What was the primary motivation ?

The definition of the kilogram is the only SI base unit definition that depends on the non-invariant property of a martial artifact. Experimental evidence indicates that the mass of the international prototype of the kilogram, or IPK, kept in a vault at the BIPM, varies with time. In this day and age, it is simply unacceptable to have one of the most important SI base units defined in terms of the varying mass of a piece of Pt-Ir cast over 125 years ago.

2) Do you think it is a good thing that metrological researches' funds are public ? What do you feel about the role of the state in this matter?

The expenditure of public funds is justifiable when the result benefits the public at large, that is, when it is for a public good rather than for a private good. Certainly the establishment and maintenance of reliable measurement standards is a public good since it benefits all members of society. The establishment of national metrology institutes such as NIST by virtually all of the governments of industrialized societies shows that this view is universal.

3) Why did the NIST choose to work on the watt balance project rather than on the Avogadro one ?

In fact, NIST (then NBS, the National Bureau of Standards) was an early pioneer in the determination of the Avogadro constant NA by the XRCD (x-ray crystal density) method, having published a result
in the early 1970s. Also, until recently, it was an active participant in the International Avogadro Cooperation or IAC, the current international effort involving a number of different laboratories to determine the Avogadro constant with a relative uncertainty of a few parts in 108.

In the late 1970s, as Chief of the NBS Electricity Division, I decided that we should un-

dertake a watt balance experiment because it represented a new and more accurate way to realize the definition of the ampere (SI base unit of electric current). Only after the discovery of the quantum Hall effect in 1980 did it become a method for measuring the Planck constant h. In the late 1990s, the experimental progress in the development of the watt balance had reached the point where serious consideration could be given to its use as the basis for a new definition of the kilogram in terms of a fixed value of h.

4) According to you, will there be any potential applications/consequences due to the redefinition (on the long-range or on the short-range) ?

See the attached justification for redefining the kilogram in terms of h, the ampere in terms of e (the elementary charge), the Kelvin in terms of k (the Boltzmann constant), and the mole in terms of NA.

5) What is the role of the CODATA Task Group on Fundamental Constants in this matter? Some French actors told me that this Task Group was not really cooperative and transparent to others; what do you think about this statement ?

The CODATA Task Group on Fundamental Constants (TGFC), of which I am a principal member, is responsible for periodically reviewing (now every 4 years) all of the data related to determining the values of the fundamental constants and for compiling from these data (by the method of least squares) a set of recommended values of the constants for use by all scientists and technologists throughout the world. The CODATA recommended values for h, e, k, and NA will be those adopted for the new definitions of the kilogram, ampere, Kelvin, and mole, respectively.

The criticism that the TGFC is not really cooperative and transparent to others has absolutely no basis in fact. We take pride in being fully transparent in what we do and in explaining what we do in complete (some may say excruciating) detail. We also interact extensively with both the experimentalists and theoreticians whose results we use. Please look at our most recent publication (98 journal pages) to see how thorough we are in explaining what we do---here is a link to it :

http://physics.nist.gov/cuu/Constants/RevModPhys_80_000633acc.pdf

6) Why did you think in 2005 that the decision was to be quickly made? Do you still feel this way? Do you think, as Mr. Bordé does, that French actors are dogmatic on this matter, while Anglo-Saxon act or show themselves to be more pragmatic ?

I will admit that my colleagues and I (Mills, Mohr, Quinn, and Williams) are all Anglo Saxons, but that fact played no role in our belief that we could proceed with the redefinition of the kilogram earlier rather than later. We simply believed that there was nothing really to be gained by worrying about every possibility of making a mistake and waiting until each of those possibilities was reduced to near zero. We did not see in 2005, and we still don't see in 2010, any reason to postpone the redefinitions. Any future work that shows that we might not have chosen quite the correct values of h, e, k, and NA can easily be handled by appropriately modifying the mise en pratique for the affected unit (or units). Once the values for these four constants are chosen, they need never be changed. Perhaps our position is due to the fact that the five of us are what might be called «progressives,» while many of our colleagues, especially in the field of mass metrology, are what might be called «conservatives.» You might say that we only wear belts OR suspenders, never belts AND suspenders.