9. Wavelength Definition of the Meter

It is obvious that exactness in units must have its basis in standards that are as permanent and exact as possible. Ever since 1890 when Michelson made his famous measurements of the wavelength of light in terms of the meter, metrologists have been giving consideration to the idea of defining the meter in terms of the wavelength of light. Researches by many scientists have been carried out to find a wavelength generally acceptable for use as an ultimate standard and to specify the conditions of its use. Finally, on October 14, 1960, the 11th General Conference on Weights and Measures adopted a new definition of the meter as 1 650 763.73 wavelengths of the orange-red radiation of krypton 86, or more specifically in scientific terms, as 1 650 763.73 wavelengths in vacuum of the radiation corresponding to the transition between the levels $2p_{10}$ and $5d_5$ of the krypton 86 atom.

The National Bureau of Standards has adopted this definition (see appendix 6, p. 30), and thus it will not be necessary for the United States prototype meter No. 27 to be taken to the International Bureau for comparison as has been done in the past—in 1903,[18] 1922, 1956, and 1957—where its relation to the international prototype meter has been found to remain essentially constant.

The international prototype meter will continue to be maintained at the International Bureau and comparison of national prototypes with it will continue to be made. Likewise, the national prototype meters at the National Bureau of Standards will continue to be used for many precise calibrations of length standards.

An interesting sidelight on the change in the definition of the yard is found in measurements made just prior to April 1893 indicating that

$$1 \text{ U.S. yard} = 0.914\,399\,80 \text{ meter}$$

or

$$1 \text{ meter} = 39.370\,09 \text{ U.S. inches}$$

a relation which differs by only 2 parts in 9 million from the value finally adopted in 1959. The observers, however, had in mind the value given in the 1866 law and noted that the value 1 meter=39.3700 inches "is evidently sufficiently precise for geodetic purposes and has the advantage of being convenient and easily remembered."

Although some thought has been given to a possible definition of the kilogram in terms of some invariable physical phenomenon instead of in terms of a material standard, no satisfactory solution has yet been discovered. The U.S. national prototype kilogram No. 20 was compared with international standards in 1937 and 1948 with excellent results.

10. Other Definitions of Units

Three other changes in the weights and measures field have occurred during the past 60 years. First, there was the change made in 1911 in the law defining the troy pound. At that time the words "the standard troy pound of the Bureau of Standards of the United States" were substituted for the description of the troy pound of the Mint.

Next, in 1913, the international metric carat was defined as the equivalent of 200 milligrams, thereby eliminating the use of a number of unofficial or semiofficial carats.

Third, in 1954, the Secretary of Commerce and the Secretary of Defense agreed to use the international nautical mile in their respective departments instead of the older U.S. nautical mile. (See appendix 4, p. 28.) The practical effect of this action was that the use of the U.S. nautical mile has virtually disappeared.

11. Current and Historical Standards of Length and Mass at the National Bureau of Standards

This history of weights and measures in the United States concludes with a descriptive list of some of the more important standards of length and mass either (a) currently in use or (b) not in current use but of historical interest, that are in the custody of the National Bureau of Standards.

Standards Currently in Use

Meter 27.—National prototype meter, a line standard made of platinum-iridium, Tresca cross section (modified X), received by the United States from the Inter-

[18] In 1903 there was an apparent shortening of approximately 0.4μm in meter bar No. 27, but subsequent observations showed that there had been no shortening of this bar, but rather a lengthening of the two laboratory meter bars used in the comparisons and small errors in the coefficients of thermal expansion of the bars involved.