Thus the new value for the yard is smaller by 2 parts in one million than the 1893 yard. Numerical measures expressed in terms of the new unit will, therefore, be increased by 2 parts in one million.

Pound. The pound was defined in the 1893 Bulletin as:

$$1 \text{ pound (avoirdupois)} = \frac{1}{2.20462} \text{ kilogram}$$

The 1894 amendment based on a recent determination of the British Imperial pound, gave the ratio as:

$$1 \text{ pound (avoirdupois)} = \frac{1}{2.20462234} \text{ kilogram}$$

which results in the approximate relation:

$$1 \text{ pound (avoirdupois)} = 0.453\ 592\ 4277 \text{ kilogram}$$

Thus the new value for the pound is smaller by about 1 part in 10 million than the 1894 pound. Numerical measures expressed in terms of the new unit will, therefore, be increased by about 1 part in 10 million.

Changes concern science and precision tools. Such small changes are beyond the limits of accuracy by which many reference standards are now calibrated by the National Bureau of Standards, including the standards furnished to or calibrated for the State governments. Therefore, the refinements in the definitions of the yard and the pound will have no effect at all upon ordinary trade and commerce. The differences are significant, however, in a number of very precise metrological determinations such as are found in the precision machine tool and instrument industries and in certain scientific activities.

Standard inch. The value for the inch, derived from the value for the yard effective July 1, 1959, is exactly equivalent to 25.4 millimeters. It may be noted that this value was approved by the American Standards Association for "Inch-millimeter Conversion for Industrial Use" in 1933 (ASA Standard B48.1–1933), was adopted by the National Advisory Committee for Aeronautics in 1952, and has been adopted by many standardizing organizations in other countries.

Relation to grain. The new conversion factor for the pound is exactly divisable by 7 and results in the following exact value for the grain:

$$1 \text{ grain} = 0.064\ 798\ 91 \text{ gram}$$

The grain is the common unit of the avoirdupois, apothecary, and troy systems, there being 7000 grains in the avoirdupois pound and 5760 grains in the apothecary pound and in the troy pound.

Nautical mile. On July 1, 1954, it was announced that the Secretary of Commerce and the Secretary of Defense had agreed officially that the International Nautical Mile would henceforth be used within their respective departments. The International Nautical Mile is based on the meter and is equal to 1852 meters. Based on the yard-meter relationship then in use, the International Nautical Mile was shown as being equivalent to 6,076.10333 feet. Under the new conversion factor, the International Nautical Mile is equivalent to 6,076.11549 International feet approximately.

(For a detailed treatment of the Federal basis for weights and measures, see National Bureau of Standards Circular 593, The Federal Basis for Weights and Measures, for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., price 30 cents.)

[SEAL]

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Appendix 6. Adoption of the Wavelength Definition of the Meter

The following account concerning the adoption of the wavelength definition of the meter is quoted from the National Bureau of Standards Technical News Bulletin of December 1960:

Wavelength of Kr^{86} Light Becomes New International Standard of Length

On October 14, 1960 the world adopted a new international standard of length—a wavelength of light—replacing the meter bar which had served as the standard for over 70 years. The action was taken by the 11th General Conference on Weights and Measures, which met in Paris.

Dr. Allen V. Astin, NBS Director, headed the American delegation to the Conference. The delegation also included Louis Polk, President, Sheffield Corporation; Elmer Hutchisson, Director, American Institute of Physics; A. G. McNish, Chief, Metrology Division, NBS; T. H. Osgood, U.S. Scientific Attaché, London, and Marten Van Heuven and Benjamin Bock, U.S. State Department.

Other actions taken by the Conference included the establishment of a central facility at the International Bureau of Weights and Measures for international coordination of radiation measurements, confirmation of a new definition of the second of time, and adoption of refinements in the scales for temperature measurements.

The new definition of the meter as 1,650,763.73 wavelengths of the orange-red line of krypton 86 will replace the platinum-iridium meter bar which has been kept at Paris as an international standard for length since 1889 under the Treaty of the Meter.

These actions of the General Conference are of great importance to those engaged in precision measurements in science and industry. For many years the world has relied on a material standard of length—the distance between two engraved lines on the International Meter Bar kept at Paris Duplicates of the International Standard were maintained in the standards laboratories of other countries of the world. From time to time it was necessary to return these duplicates to Paris for recalibration, and occasionally discrepant results were obtained in these recalibrations. Also, there was doubt in the minds of some scientists regarding the stability of the International Meter Bar. The new definition of the meter relates it to a constant of nature, the wavelength of a specified kind of light, which

is believed to be immutable and can be reproduced with great accuracy in any well-equipped laboratory. Thus it is no longer necessary to return the national standards of length to Paris at periodic intervals in order to keep length measurements on a uniform basis throughout the world. Also it is possible to measure some dimensions more accurately in terms of the new definition than was possible before. The meter bars which have served as standards of length throughout the world for over 70 years will not be discarded or placed in museums because of this decision, the Conference said. They will remain important because of the ease with which they can be used for certain types of measurement and for comparison measurements between national laboratories.

This new definition of the meter will not materially change the measurement of length nor in any way the relation between the English and Metric units. Careful experiments performed at the National Bureau of Standards by the team of A. G. Strang, K. F. Nefflen, J. B. Saunders, B. L. Page, and D. B. Spangenberg immediately prior to the meeting of the Conference confirmed that the wavelength standard and the metal standard are in satisfactory agreement. The inch now becomes equal to 41,929.399 wavelengths of the krypton light.

Similar measurements performed by the National Research Council in Canada, by Dr. K. M. Baird and his associates, are in substantial agreement with the National Bureau of Standards results. By adoption of the new definition, the standard of length which has been used by spectroscopists for the past 50 years is brought into agreement with that used in other branches of science, thus increasing the unification of systems of measurement throughout the scientific world.

The orange-red wavelength is precisely described as the wavelength in vacuum of the radiation corresponding to the transition between the levels $2p_{10}$ and $5d_5$ of the atom of krypton 86.

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