

large, but the average value of the various denominations agreed fairly well with the weights and measures in use in Great Britain at the time of the American Revolution.

Without waiting for authority from Congress the Treasury Department took immediate steps to correct the situation by having constructed, under Hassler's direction, the necessary weights and measures for the

customs service. The divergencies among the weights and measures in use in the customs service were directly opposed to the spirit of the Constitution, which requires that all duties, imposts, and excises shall be uniform throughout the United States,¹⁰ and the Secretary of the Treasury felt fully authorized in taking steps to secure uniformity when discrepancies were found.

3. Units and Standards

Before weights and measures could be constructed, however, it was necessary for the Treasury Department to decide upon certain units and to adopt standards, that is, the material representatives of these units.

A clear understanding of the difference between "units" and "standards" will aid the reader in the sections that follow.

A *unit* is a determinate quantity (that is, one established by definition) in terms of which values, quantities, amounts, or magnitudes are expressed. Being fixed by definition, a unit is itself independent of physical conditions—as, for example, temperature—even though it may be defined in relation to some object that is affected by such conditions. Thus a particular unit of capacity may be defined as a volume of a specified number of cubic inches; the United States gallon is so defined—as a unit of 231 cubic inches. Or again, a particular unit of length may be defined as a distance corresponding to the interval between certain engraved lines on a certain metal bar when measured under specified conditions, including those of the support and the temperature of the bar; until October 1960 the meter unit was so defined in relation to the international meter bar.

A *standard* is the physical embodiment of a unit. In general a standard is not independent of physical

conditions and is a true embodiment of the unit only under specified conditions. Thus a 1-gallon metal standard will have a capacity of 1 gallon only when the standard is at a certain temperature; at any other temperature the capacity of the standard will have been increased or decreased as a result of the expansion or contraction of the metal caused by the temperature change. Or again, a length standard having a nominal value of one yard will have an actual value of one yard only when at one particular temperature and when supported in a certain manner; a lowering of its temperature will cause the standard to shorten, a raising of its temperature will cause it to lengthen, and a change of the manner in which it is supported may introduce a change in its length.

When a unit is defined in terms of a standard, the latter acquires a fundamental character; the International Prototype Meter was such a standard until the meter unit was redefined in 1960. Standards are classified into groups, according to their character, the order of their accuracy, and the order of their legal or other importance. Thus there are, for example, international and national "prototypes," State "reference" standards, "laboratory working" standards, "field" standards, and various "classes" of standards established largely on the basis of design and accuracy.

4. Early United States Standards

The units finally adopted by the Treasury Department in 1832 were the yard of 36 inches, the avoirdupois pound of 7,000 grains, the gallon of 231 cubic inches, and the bushel of 2,150.42 cubic inches. The standard yard adopted was the 36 inches comprised between the 27th and the 63d inches of a certain brass bar, commonly designated as an 82-inch bar, prepared for the Coast Survey by Troughton of London. Hassler had brought this bar to the United States in 1815, after he had been detained in Europe for several years by the War of 1812. The 36-inch space referred to was supposed to be identical with the English standard at 62 °F, although it had never been directly compared with that standard.

It is evident from Hassler's reports that he regarded the English yard as the real standard of length of the United States and the Troughton scale merely as a copy whose length should be corrected if it was subsequently found to differ from the English yard; and this view was taken by others who subsequently had charge of our standards, as will be shown later on.

The avoirdupois pound adopted by Hassler as the standard for the Treasury Department was derived from the troy pound of the Mint according to the equivalent, 1 avoirdupois pound equals $\frac{7,000}{5,760}$ pounds troy. This was the accepted relation in this country as well as in England; hence both the troy and avoir-

¹⁰ Article I, sec 8, clause 1.