the Treasury Department (34th Congress, 3d Session, Senate Executive Document No. 27, p. 18):

The copy of the British standard commercial pound was compared with the American standard commercial pound—the weight used being that made by Mr. Hassler from the troy pound in the United States mint, and marked with a star (commonly designated as the *star pound*).

In the standards vault of the National Bureau of Standards there is preserved a 1-pound avoirdupois brass knob weight marked on the top surface of the knob with a star. Although positive identification is not possible, it seems not unreasonable to assume that this weight is the standard referred to in the Fischer and Bache texts. (See illustration p. 22.)

At present there is no United States national prototype avoirdupois pound constituting the ultimate national reference standard for avoirdupois standards of lower order. Laboratory sets of avoirdupois standards are in use, but these are derived from the national prototype kilogram.

5. Use of Metric System Officially Permitted

The next and perhaps the most important legislation enacted by Congress was the act of 1866 legalizing the metric system of weights and measures in the United States.

The act, which was passed July 28, 1866, reads as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That from and after the passage of this act it shall be lawful throughout the United States of America to employ the weights and measures of the metric system; and no contract or dealing, or pleading in any court, shall be deemed invalid or liable to objection because the weights or measures expressed or referred to therein are weights or measures of the metric system.

SEC. 2. *And be it further enacted*, That the tables in the schedule hereto annexed shall be recognized in the construction of contracts, and in all legal proceedings, as establishing, in terms of the weights and measures now in use in the United States, the equivalents of the weights and measures expressed therein in terms of the metric system; and said tables may be lawfully used for computing, determining, and expressing in customary weights and measures the weights and measures of the metric system.

(See tables on facing page.)

While the above act was being considered, Congress also considered a resolution authorizing the Secretary of the Treasury to furnish the States with metric weights and measures. Strange to say, this resolution, which logically should follow, was approved one day before the act legalizing the use of the metric system. It was a joint resolution and read as follows:

Be it resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Treasury be, and he is hereby, authorized and directed to furnish to each State, to be delivered to the governor thereof, one set of standard weights and measures of the metric system for the use of the States, respectively.

The work of making and adjusting these standards fell naturally upon the Office of Weights and Measures, and the first matter to be resolved was the choosing of the reference standards. The practice followed by those countries that had adopted the metric system of accepting the meter and the kilogram of the Archives of France as fundamental standards was followed by the United States. The question then was mainly one of securing authentic copies of these standards. Fortunately the Office of Weights and Measures had several copies of both standards of more or less authenticity on hand, but without hesitation the iron bar known as the "Committee Meter" and a platinum kilogram, known as the "Arago Kilogram," were selected.

The committee meter has already been mentioned as being one of the copies of the meter of the Archives, and thus a standard of considerable importance in the metric system. As stated before, this bar is made of iron, with a cross section of 9 by 29 mm, and its length is defined by the end surfaces, which are remarkably plane when one considers the age in which the bars were made. The bar bears the stamp of the committee, namely, a small ellipse. Three quadrants of the ellipse are shaded and the fourth one clear, except for the number 10,000,000, which indicates the number of meters in a meridian quadrant of the earth. In Hassler's report on the construction of the meters [14] it is stated, on the authority of Trallès, that all the meters agreed with the true meter within one-millionth part of the toise.[15] This is equivalent to about two millionths of a meter, the toise being equal to approximately 1.95 meters.

When Hassler came to the United States in 1805 he brought with him the committee meter, which he soon after presented to the American Philosophical Society of Philadelphia, Pa. Shortly after, when he was put in charge of the survey of the coast, the meter was placed at his disposal by the Philosophical Society, and he made it the standard of length for that work. Until 1890 all base measurements of the Coast Survey were referred to this meter.[16] Thus it was natural that this bar should be selected as the standard to which the State meters should conform.

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[14] H.R. Doc. No. 299, 22d Cong., 1st sess., pp. 75, 76.

[15] The toise was the French standard of length prior to the adoption of the meter, and all the geodetic measurements upon which the meter was based were made with the toise. Its length is 1.949+meters.

[16] Special Publication No. 4, U.S. Coast and Geodetic Survey.

MEASURES OF LENGTH

Metric denominations and values		Equivalents in denominations in use	
myriameter *	10 000 meters	6.2137	miles.
kilometer	1 000 meters	0.62137	mile, or 3,280 feet and 10 inches.
hectometer	100 meters	328	feet and 1 inch.
dekameter	10 meters	393.7	inches.
meter	1 meter	39.37	inches.
decimeter	1/10 of a meter	3.937	inches.
centimeter	1/100 of a meter	0.3937	inch.
millimeter	1/1000 of a meter	0.0394	inch.

MEASURES OF CAPACITY

Metric denominations and values			Equivalents in denominations in use	
Names	Number of liters	Cubic measure	Dry measure	Liquid or wine measure
kiloliter or stere*	1 000	1 cubic meter	1.308 cubic yards	264.17 gallons.
hectoliter	100	1/10 of a cubic meter	2 bushels and 3.35 pecks	26.417 gallons.
dekaliter	10	10 cubic decimeters	9.08 quarts	2.6417 gallons.
liter	1	1 cubic decimeter	0.908 quart	1.0567 quarts.
deciliter	1/10	1/10 of a cubic decimeter	6.1022 cubic inches	0.845 gill.
centiliter	1/100	10 cubic centimeters	0.6102 cubic inch	0.338 fluid ounce.
milliliter	1/1000	1 cubic centimeter	0.061 cubic inch	0.27 fluid dram.

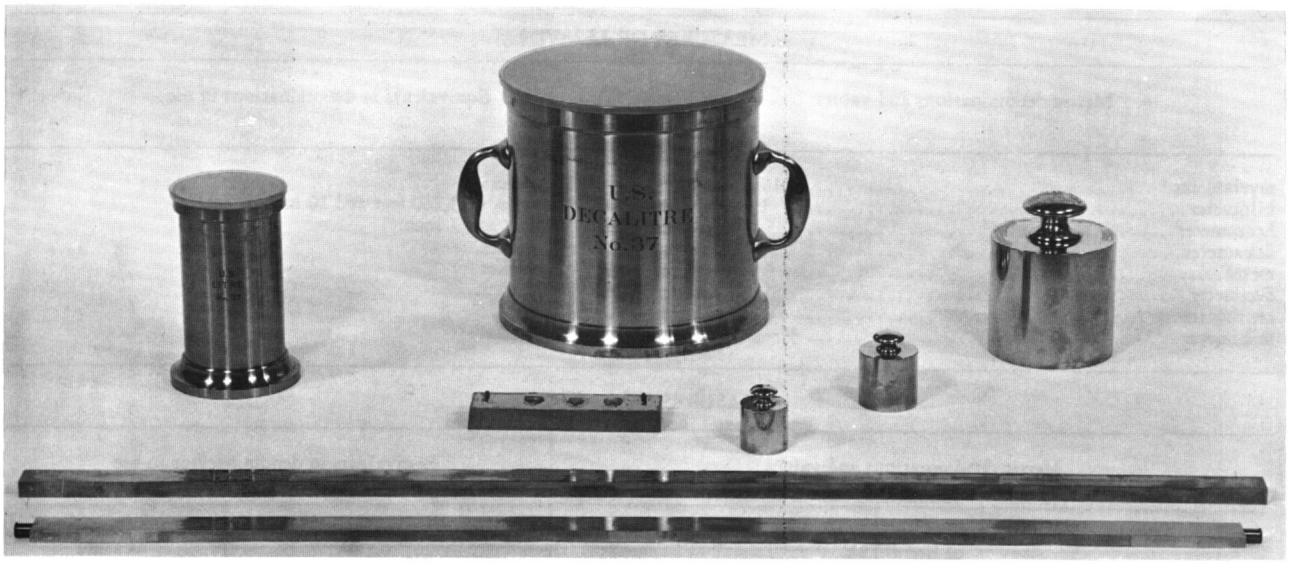
MEASURES OF SURFACE

Metric denominations and values		Equivalents in denominations in use	
hectare	10000 square meters	2.471	acres.
are	100 square meters	119.6	square yards.
centare	1 square meter	1,550	square inches.

WEIGHTS

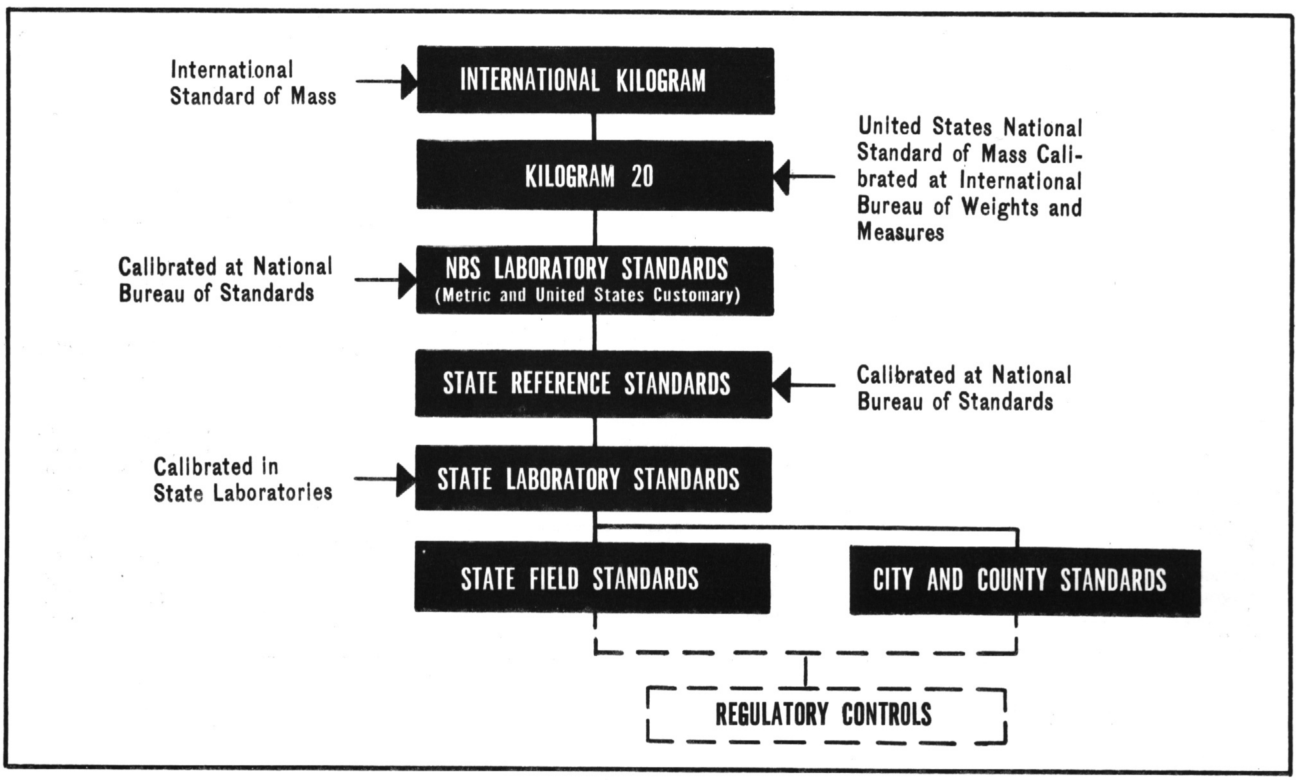
Metric denominations and values			Equivalents in denominations in use	
Names	Number of grams	Weight of what quantity of water at maximum density	Avoirdupois weight	
millier*or tonneau *	1 000 000	1 cubic meter	2204.6	pounds.
quintal*	100 000	1 hectoliter	220.46	pounds.
myriagram*	10 000	10 liters	22.046	pounds.
kilogram or kilo*	1 000	1 liter	2.2046	pounds.
hectogram	100	1 deciliter	3.5274	ounces.
dekagram	10	10 cubic centimeters	0.3527	ounce.
gram	1	1 cubic centimeter	15.432	grains.
decigram	1/10	1/10 of a cubic centimeter	1.5432	grains.
centigram	1/100	10 cubic millimeters	0.1543	grain.
milligram	1/1000	1 cubic millimeter	0.0154	grain.

*Ed. Note: These terms are obsolete.



Metric standards of length, mass, and capacity, furnished to the States under the joint resolution of Congress of July 27, 1866.

In the illustration the liter (litre) and the dekaliter (decalitre) are at the upper left and center, each with a slicker plate in position. The weights are centrally positioned. In the foreground are two meter bars, the upper one a line standard and the lower one an end standard.



Progression of standards.

The Arago kilogram was procured in 1821 by Gallatin while minister of the United States to France and was sent to this country, together with a platinum meter. The certificate of Arago, the celebrated physicist, which accompanied these standards, states that the kilogram differs from the original kilogram of the Archives by less than 1 mg. The weight is a platinum cylinder with flat bases, the edges being slightly rounded. The height and diameter are nearly equal, being approximately 39.5 mm each. There is no stamp or distinguishing mark of any kind, except near the center of one base there is a faint lathe or tool mark of circular form, thus: ⊙. The weight is contained in a square mahogany box, on the cover of which is a circular silver plate bearing the inscription "Kilogramme comparé pour son Poids à l'Etalon Prototype des Archives de France, et verifié par M. Arago. Fortin fecit." (Kilogram compared for its weight with the prototype standard of the Archives of France, and verified by Mr. Arago. Made by Fortin.) No particulars of Arago's comparison with the kilogram of the Archives were furnished, and consequently it is not known what means he used in making his comparison nor whether he reduced his weighings to vacuo. It was not until 1879 that the Arago kilogram was compared with other standards of recognized authority. It is true that it was compared between 1852 and 1873 with two kilograms in the possession of the Office of Weights and Measures, but as both of these weights were of brass and of unknown density, no great reliance could be attached to the results. In 1879, however, it was taken to England and there compared with the British platinum kilogram in the custody of the Standards Office. This comparison indicated that the Arago kilogram was 4.25 mg light, but this result could not be considered conclusive, on account of certain assumptions made in the reduction to vacuo and also in regard to the correction to the British kilogram.

In 1884 the weight was taken from the Standards Office in London, where it had been since 1879, to the International Bureau of Weights and Measures at Paris and there compared with two auxiliary kilograms whose values in terms of the kilogram of the Archives were known with the greatest accuracy. The result obtained from the comparison confirmed that previously obtained from the comparison with the British kilogram, the result giving

$$\text{Arago kilogram} = 1{,}000 \text{ g} - 4.63 \text{ mg}.$$

As the weights supplied to the States were to be made of brass, it was more convenient to compare them with a brass standard, and in order to do this two secondary brass standards were carefully compared between the years 1873–1876 with the Arago kilogram and afterwards used in all the work of adjustment and verification. One of the kilograms, known as the Silbermann kilogram, was presented to the United States by France in 1852, together with a number of other weights and measures. The other kilogram used was one made in the Office of Weights and Measures and was identical in form and material with the kilograms subsequently furnished to the States.

As the unit of capacity in the metric system is defined as the volume of the mass of 1 kilogram of pure water at the temperature of maximum density, the most convenient way to adjust such measures, and in fact all capacity measures, is by weighing the water they contain. The only two material standards that need to be considered, therefore, in connection with the metric weights and measures furnished to the States in accordance with the act of 1866 are the committee meter and the Arago kilogram described above.

By the end of 1880 practically all the States had been supplied with sets of metric weights and measures consisting of the following denominations:

Length measures	One brass line meter. One steel end meter.
Capacity measures	One liter made of brass. One dekaliter made of brass.
Weights	One 10-kilogram made of brass. One kilogram made of brass. One ½-kilogram made of brass. One gram made of brass. One set of small silver weights from 4 decigrams to 1 milligram.

6. International Standards of Weights and Measures

It is necessary at this point to go back a few years and give an account of the establishment of the International Bureau of Weights and Measures, since the present fundamental standards of length and mass for practically the whole civilized world result from the establishment of that institution.

In response to an invitation of the French Government, the following countries sent representatives to a conference held in Paris on August 8, 1870, to consider the advisability of constructing new metric standards: Austria, Colombia, Ecuador, France, Great Britain, Greece, Italy, Norway, Peru, Portugal, Russia, Spain, Switzerland, Turkey, and the United States of America, 15 countries in all. This confer-