THE METRIC SYSTEM FOR GENERAL USE

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It is not the purpose of this paper to urge the superiority of the metric standards over our present jumble of weights and measures. All persons of scientific training are, by personal experience, able to make this comparison and are without exception in favor of the metric system. Furthermore, the literature on this phase of the subject is very extensive.

It is intended, however, to call to your attention: First, that the adoption of the metric system by law for general usage in this country is inevitable—in fact, imminent. Second, that it will be the duty of the educational system, particularly science departments, both in school and out, to teach the public to understand, employ and appreciate metric units. For this purpose some simple suggestions for teaching the metric system are offered.

The Britten-Ladd Bill, which provides for the exclusive use of metric standards, will be presented to Congress this year. There is every reason why this bill should pass. Every important organization or profession that employs weights and measures has expressed a preference for the metric system. Many have already changed, finding that they have economized in time, men and materials by so doing. Figure I shows that only the United States and Great Britain have failed officially to recognize the tremendous advantages of a simple yet universal system of measurement. Nor are the units used in these two non-metric countries of the same values. It is apparent that in the competition for international trade we must employ measurements understood by those countries whose trade we seek. This consideration is of especial importance with regard to the South American countries whose credit is good anywhere and whose trade is necessary for the prosperity of American industries.

The metric system has been before the legislators of this country since 1790, when George Washington in his message to the First Congress urged its adoption. Thomas Jefferson, to whom belongs most of the credit for our decimal monetary system, emphasized the need of a similar system of weights and measures, as have

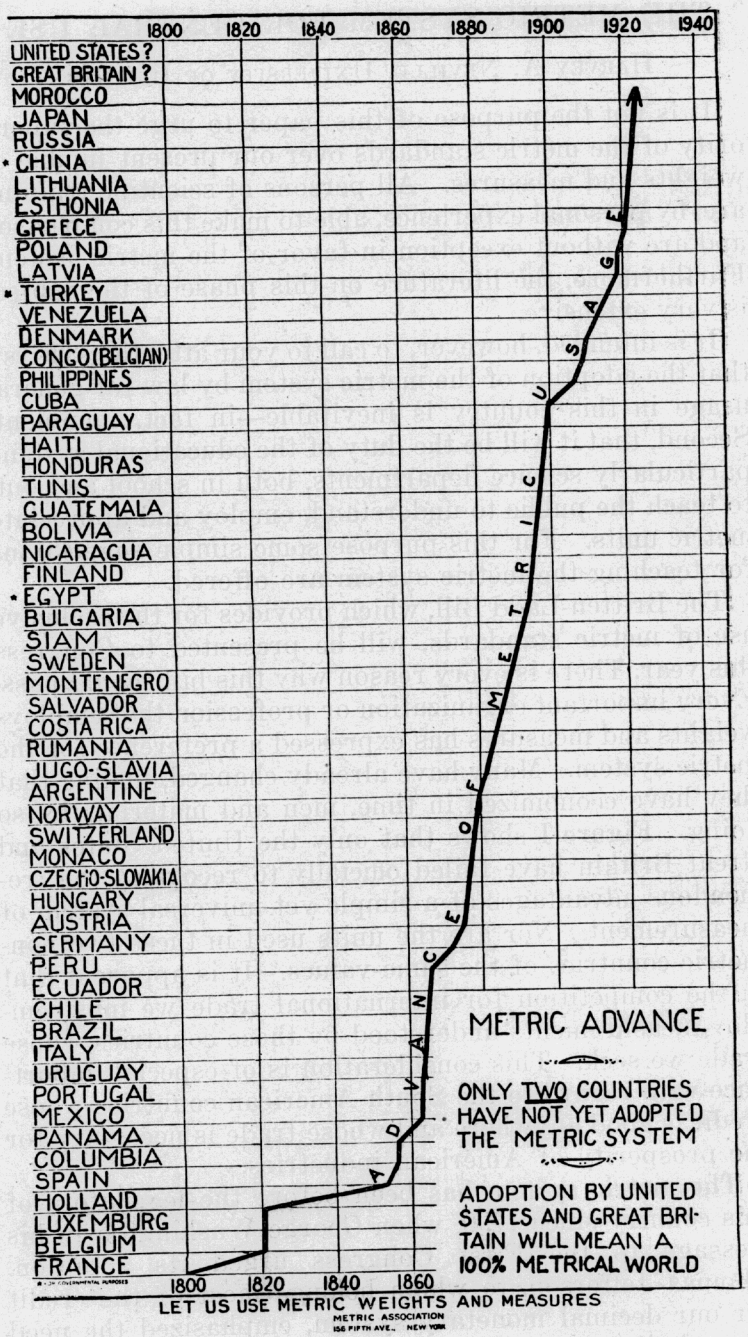
1800
1820
1840
1860
1880
1900
1920
1940
UNITED STATES?
GREAT BRITAIN?
MOROCCO
JAPAN
RUSSIA
CHINA
LITHUANIA
ESTHONIA
GREECE
POLAND
LATVIA
TURKEY
VENEZUELA
DENMARK
CONGO (BELGIAN)
PHILIPPINES
CUBA
PARAGUAY
HAITI
HONDURAS
TUNIS
GUATEMALA
BOLIVIA
NICARAGUA
FINLAND
EGYPT
BULGARIA
SIAM
SWEDEN
MONTENEGRO
SALVADOR
COSTA RICA
RUMANIA
JUGO-SLAVIA
ARGENTINE
NORWAY
SWITZERLAND
MONACO
CZECHO-SLOVAKIA
HUNGARY
AUSTRIA
GERMANY
PERU
ECUADOR
CHILE
BRAZIL
ITALY
URUGUAY
PORTUGAL
MEXICO
PANAMA
COLUMBIA
SPAIN
HOLLAND
LUXEMBURG
BELGIUM
FRANCE
ADVANCE OF METRIC USAGE
1800
1820
1840
1860
METRIC ADVANCE
ONLY TWO COUNTRIES HAVE NOT YET ADOPTED THE METRIC SYSTEM
ADOPTION BY UNITED STATES AND GREAT BRITAIN WILL MEAN A 100% METRICAL WORLD
LET US USE METRIC WEIGHTS AND MEASURES
METRIC ASSOCIATION
156 FIFTH AVE., NEW YORK

FIG. I.

many other statesmen since that time. Contrary to the general impression, the metric system is not a French invention though France was the first country to adopt it legally. James Watt, the English scientist and engineer, originated and first published the decimal system of measurement using the four units now called Dollar, Meter, Liter, Gram. Undoubtedly, man first learned to count on his fingers, of which he has ten, so a decimal system is the natural outgrowth of the cave-man's adding machine. Furthermore, the Arabic system of numbers, one of the greatest inventions of all time, has ten ciphers so decimalization is its natural method.

With the Arabic numerals a child can perform with ease calculations that would have taxed the great mental powers of Julius Caesar, who had to use the clumsy Roman numerals. To the same extent a child in metric countries has the advantage of the American child in the arithmetic of weights and measures. As the *Chicago Tribune* puts the simile, in an editorial of February 3, 1925, the metric system is "a scientific system of weights and measures that compares with ours as a modern eight in line compares with a one lunger of a quarter century back."

It is with nothing less than sheer cruelty that we force upon school children the memorizing of absurd tables of measurements which few of us can (or would wish to) remember for long. Indeed, in this regard we probably feel grateful that the most amazing property of the human mind, according to an eminent psychologist, is not that it can remember a few things but that it can forget so much. No economy is more important than the economy of human time and effort, especially in the matter of education. In learning the metric system all there is to remember is given in Table 1—three units and six prefixes with decimal relations. An enormous amount of time and money—to say nothing of the patience of pupil and teacher—will be saved for education by taking our present "Tables of Weights and Measures" out of *Arithmetic* and putting them in *Ancient History.*

KILO	1000
HECTO	100
DEKA	10
METER LITER GRAM	
DECI	.1
CENTI	.01
MILLI	.001

TABLE I. The Metric System Condensed.

In addition to the fact that it is used by almost the whole world, the metric system has two intrinsic advantages. First, it is a *decimal* system, as just pointed out, and hence lends itself to slide rules and calculating machines and gives an easy relation to our decimal monetary system. Second, in the metric system the units of length, volume and weight are *interrelated* as shown in Figure 2. A volume of water, measured in cubic centimeters, may be conveniently used in place of a set of small weights. It is a simple matter to determine with a meter-stick the capacity of any container in liters by multiplying together its three dimensions expressed in centimeters and moving the decimal point three places to the left. Compare the relative amounts of mathematics involved in calculating the volume of the same box in liters and in quarts:

8 3/16 in.$\times 5\frac{1}{4}$ in.$\times 12\frac{1}{8}$ in.$\div 57\frac{3}{4} =$? Quarts.

20.8 cm. $\times$13.34 cm.$\times$30.8 cm.$\div$1000 = ? Liters.

How many workmen, or even college freshmen, could cope with the common fractions in the first calculation? The absence of any simple relation among our present

units is illustrated in Figure 3. The edge of a cube having a volume of one quart is incommensurable.

In Figure 4 is shown an easy method of remembering the approximate differences between the units now in use and the metric units. The relations shown are accurate enough for most purposes. The adoption of the metric system will perform a very important service in removing the confusion due to the fact that certain units of the same name have different values. People in the United States who are engaged in trade with Great

FIG. II. The Relation of Length, Volume and Weight in the Metric System.

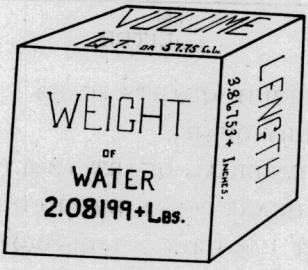

FIG. III. The Absence of Relation among our Present Units. The edge of a Quart cube is incommensurable.

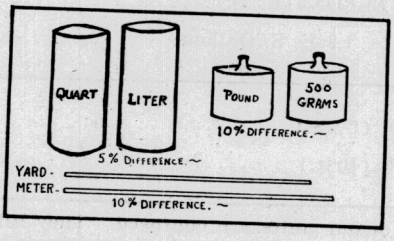

FIG. IV. The Approximate Difference between Present and Metric Units.

Britain or Canada are constantly distressed by the unfortunate situation shown in Table 2. Our own internal confusion is quite sufficient as illustrated in Table 3. Most people are ignorant of the existence of two kinds of quarts or of the fact that the quart for measuring solids is 16 1/3% greater than the liquid quart.

Metric units have already been adopted by our government for many specific purposes. They are used in all the scientific departments and as a basis for our coinage —as Table 4 will show. The carat used for weighing precious stones is officially defined as a metric weight. It seems extremely unfortunate that we should dissipate our educational energy by teaching two different systems of measurement. Arithmetic teaches the old units; the fundamental sciences in college or high school introduce and employ the metric units; engineering, medicine and other professions whose members have had thorough experience with metric units go back to the old units in their practice. From the standpoint of educational economy one system or the other should be discarded.

It is believed that this is a particularly opportune time to make the change to the international standards. A

1 LITER
= 1.0567 LIQUID QUARTS (U. S.)
= .9081 DRY QUART
= .8798 IMPERIAL QUART (Brit.)
IMPERIAL QUART 20% > LIQUID QUART.
DRY QUART 16 1/3 % > LIQUID QUART.
IMPERIAL GALLON.....277 Cu. in.
STANDARD GALLON (U. S.).....231 Cu. in.
British Gallon = 1.2 U. S. Gallons.
Hundredweight (U. S.).....100 Lbs.
Hundredweight (Brit.) .....112 Lbs.

TABLE II.—Many of our units are confused. They differ from those of Great Britian, the only other non-metric country.

1 Lb. Butter = 16 Oz. = 7000 Grains = 454 Grams.
1 Lb. Gold = 12 Oz. = 5760 Grains = 373 Grams.
1 Qt. Beans = 1/8 Peck = 67.2 Cubic inches.
1 Qt. Molasses = 1/4 Gal. = 57.75 Cubic inches.
130 Kinds of Bushels now in Use in U. S.
391 Different Units have been called "POUND".
282 Different Units have been called "FOOT".

TABLE III.—More Confusion! If your grocer uses the same kind of quart measure for liquids and solids he is cheating you to the extent of 16⅓% on the solids.

FAMILIAR METRICS
1 CARAT weighs 1/5 g. or 200 mg.
1 "NICKEL" weighs 5 grams.
1 "DIME" is 1 mm. thick (or thin) and weighs 2.5 grams.
(Other silver coins accordingly)
A POSTAGE STAMP is 2 x 2.5 cm. and weighs about 50 mg.
1 DROP of WATER is about 1/20 cc. and weighs about 50 mg.
1 TEASPOONFUL is about 4 cc.
1 FLUID OUNCE is about 30 cc.
1 CUPFUL is 8 Fluid ounces.

TABLE IV.—The Metric System may best be taught by relating it to articles and units already in everyday use.

considerable proportion of our population is already familiar with metric units. Some have learned them from science courses in schools; some from service in the army —especially those who went to France. The great interest in popular science, particularly radio, has brought familiarity with metric terms to many. The recent

Olympic Games in France called to the attention of the world the metric units of distance at least. Many manufacturing companies—the Goodyear Rubber Company, for example—have found it an economic advantage to change to metric units on their own initiative. This answers the objection often raised that the change will be too expensive for industrial concerns. In most cases the change will not mean changing the size of anything but only the numbers by which it is labelled.

Practically all of the opposition to the metric system is due to misapprehensions based upon ignorance and to the strong factor of tradition. Ignorance can usually be cured by information; and the tradition becomes inverted when it is realized that the metric system is English and not French in origin, while the so-called English system really came from Germany who was progressive enough to discard it when she found something better.