References

[1]Judd, Wallace P., "A New Case for the Calculator", *Learning, The Magazine For Creative Teaching,* March 1975, pp.41-48.

[2]Berger, Ivan, "Calculators Get Smaller, Smarter and Cheaper", *Popular Mechanics,* December 1974, pp.70-75.

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Who Gives a Gram About Scruples?

by *Dr. Forrest L. Coltharp*
Department of Mathematics
Kansas State College of Pittsburg

The following article by Dr. Forrest Coltharp illustrates a problem that has been effectively solved in much of Canada. However, some of us are still in need of defending the metric conversion in our communities where resistance is continuing despite government directives requiring the change. This study may give you new ideas for overcoming resistance, or it may provide interesting reading. In any case, I include it as an item that has value to each reader within the limits of his imaginative application of the ideas and reasonings presented.

What does the United States of America have in common with the following countries?

Barbados	Oman
Burma	Nauru
Gambia	Sierra Leone
Ghana	South Yemen
Jamaica	Tonga
Liberia	Trinidad
Muscat	

You will find that all other countries in the world, except those listed above and the United States, have already adopted the Metric System of weights and measures, or have committed themselves to a change in the near future. Japan converted to the Metric System between 1951 and 1962. Great Britain adopted a ten year plan of implementation in 1965. South Africa will complete her switch to the Metric System during 1975. New Zealand began an eight year plan of conversion in 1969, and both Australia and Canada announced commitments to change in 1970.

Is it any wonder that if we are to compete in the world trade market, we must convert to the Metric System of weights and measures? Many of our multinational corporations are already in the process of converting, such as IBM, General

Motors, Boeing, RCA, Ford, John Deere and International Harvester. Suppliers to General Motors, as an example, will eventually switch their products to Metric Standards or suffer the loss of business. When one of the nation's largest manufacturers initiates a formal program to convert its products to the Metric System, it is bound to push the entire country toward a metrication program.

You might ask "How does this affect you as an individual?" Both directly and indirectly. Have you read the side panel of your favorite cereal box lately? Did you notice the contents of your canned goods are being measured in cubic centimeters or grams? Have you encountered metric measurements in patterns supplied by Simplicity or McCalls? What will you do when a great-sounding recipe involves metric measures? Ford's Mustang II is powered by 2.3-liter engine being built in the country's first all-metric engine plant. Do you have a set of metric wrenches ready to handle home repairs?

We know that most adults feel more comfortable with the familiar English system of weights and measures. You know that twelve inches make a foot and three feet make a yard; there are two cups in a pint, two pints in a quart and four quarts in a gallon. You may even know how many ounces there are in a pound, but do you know how many rods in a furlong? Do you know how many cubic inches in a quart? How many scruples in an ounce? What is a pennyweight? What is the difference between a liquid quart and a dry quart?

If you are able to answer all of these questions, then you are to be congratulated. If you cannot, you should not feel bad because most people are not familiar with all of these terms. Even measurements you feel you do know might be questionable. Did you know that in our English system of weights and measures, we have two kinds of pounds, two types of miles, two types of quarts, eight kinds of tons, and fifty-six different sizes of bushels? With this background information about our English system of weights and measures, you can obviously see that what we have to work with leaves much to be desired.

Perhaps you are wondering what is meant by *A* Metric System? It is simply a system in which the basic units are in a "tens" relationship to each other. Our monitary or coinage system is in a decimal or "tens" relationship, that is: 10 pennies equal one dime and 10 dimes equal one dollar. Our English system of weights and measures is certainly not in a tens relationship since 10 inches is not equal to one foot and 10 feet does not equal one yard. The advantage of such a system based on a tens relationship in one word would be SIMPLICITY.

What then is *THE* Metric System that we have been promoting? According to the Metric Association, Inc., "The Metric System simply and logically coordinates the measurements of length, area, volume, and mass (or weights) into one DECIMALIZED system." Hence, there are basically three principles that a system of weights and measures should include:

(1) A standard unit of measure (length, volume, or mass) based on some unchanging absolute standard which is highly reproducible,

(2) the basic units of length, volume, and mass should be interrelated and,

(3) the system should be based on a decimal system.

Our English system has only the first principle, while the Metric System has all three.

The standard units of the English system of weights and measures have some very strange origins historically. For example, the inch was defined as three grains of barley corn laid side by side. King Charlemagne decreed that a foot would be the length of his royal foot, while some other king established the yard as the distance from his nose to the end of his outstretched arm. Other units have even stranger origins.

The basic standard unit in the Metric System is the meter which is used to measure length. The meter was defined originally by a group of scientists belonging to the French Academy of Science at about the time of the French Revolution. A meter was defined at that time as 1/10,000,000 of the distance from the north pole to the equator along the meridian which ran through Paris, France. The meter was more precisely defined later as 1,650,763.73 wavelengths of the orange-red light from the isotope krypton-86. Neither of these methods of establishing the standard unit for the Metric System seems reproducible in your kitchen, home workshop, or classroom laboratory. However, by using a scientific instrument known as an interforometer, which is used to measure length by means of light waves, the meter is highly reproducible in laboratories throughout the world. Hence, principle number one is satisfied by both the English and the Metric System of weights and measures.

The second principle of a desired system of weights and measures is the interrelation between the basic units of length, volume and mass (or weight). This principle is possessed by the Metric System, but not the English system. There are two simple facts; one that relates dry volume to liquid volume and one that relates volume to weight.

In determining the volume of a box you would multiply length times width times height and the volume would be in terms of cubic measure according to the dimensions of the box. If you wanted to fill the box with liquid, the volume would be measured in liters. The fact that interrelates length and volume is: "one cubic decimeter (or 1000 cubic centimeters) of liquid is defined as one liter." If you then wanted to find the weight of the box filled with liquid, the weight would be measured in grams. The fact that interrelates volume and weight is: "one liter of water at its maximum density weighs one kilogram" or "one milliliter of water at 39.2°F (or 4°C) at sea level weighs one gram."

There are 10 summarizing facts that you should know in order to understand and appreciate the Metric System. They are:

(1) The *meter* is the basic unit of length (a little longer than a yard).

(2) The *liter* is the basic unit of volume (a little more than a quart).

(3) The *gram* is the basic unit of mass or weight (about the weight of a paper clip).

(4) *Deci* means tenths (decimeter is a tenth of a meter).

(5) *Centi* means hundredths (centiliter is a hundredth of a liter).

(6) *Milli* means thousandths (milligram is a thousandth of a gram).

(7) *Deca* means ten times (decaliter is 10 liters).

(8) *Hecto* means hundreds (hectometer is 100 meters).

(9) *Kilo* means thousands (kilogram is 1000 grams).

(10) Ability to multiply and divide by ten and powers of ten.

The use of prefixes on the basic units (meter, liter, and gram) denotes powers of ten and satisfies the third principle of a desired system of weight and measures (i.e., it should be based on a decimal system). The prefixes are used on each of the three basic units, but I shall use meter as an example of what they mean. A decimeter is 1/10 of a meter or .1 meter. Another way to indicate this is to say 10 decimeters equal 1 meter. A centimeter equals 1/100 of a meter, or .01 meter, or 100 centimeters equal 1 meter. A millimeter is 1/1000 of a meter, or .001 meter, or 1000 millimeters equal 1 meter. The prefixes deca, hecto, and kilo are self explanatory.

It will take time and practice to become familiar with the basic units and the prefixes used with the Metric System. We hope that this introduction has been helpful.