WEIGHTS AND MEASURES AFTER THE WAR.

By Charles A. Stanuell, M.A., J.P.,
Ex-President.

[Read June 8, 1917.]

The title I have chosen for my paper may seem at first sight to be hardly suited for the present time when the world is full of wars and alarms, and comparatively few people are apparently thinking of commercial matters. I think I must therefore begin with some explanation as to how I came to the conclusion that it might be well to consider our system of weights, measures and coinage at the present time.

In my judgment the United Kingdom will be successful in the present awful struggle, but the country will suffer great injury to many trades and manufactures. We shall also be liable for enormous debts contracted in carrying out the greatest and most expensive war which has ever yet desolated the world.

In fact our resources as regards population, producing-power, and wealth will have been diminished, while at the same time we shall have incurred fresh and enormous liabilities. The National Debt will be at least ten times as great as it was before the war, perhaps twenty times as much, and the nation will have to bear the strain of raising the interest upon this enormous debt while our trade and commerce will have been seriously damaged or impaired by the general disturbance caused by the war in all commercial matters. We must contemplate the rebuilding of a half-ruined Empire, and to do this we have not only to restore our former business, but to develop it still further.

This, in my judgment, can only be done by increasing our trade, our commerce, our general sources of income as derived from our own and other countries, and at the same time removing, so far as we can do so, all possible hindrances to the spread of our trade with other nations.

Now, as regards the last, perhaps the very first difficulty which presents itself, and which greatly complicates our troubles is that our coinage is not by any means convenient. It is bad for us, but that is a trifle compared to the difficulty it causes with foreign traders, and, to make the difficulty still greater, our idea of weights and measures, I cannot call it a system, is perfectly absurd. It is appallingly difficult even to ourselves. We are accustomed to the eccentricities of our weights and measures , which are many, and their difficulties, which are manifold, but, being used to them, we accept them as inevitable.

I do not know how much time is actually bestowed upon arithmetic in our schools, but I do know that a very large percentage of the arithmetic lessons consist in endeavouring to teach children to memorise our weights and measures.

This simply means so much time taken up which might be far more profitably devoted to other branches of education, for instance, time might be found for foreign languages, which is one of our many " neglects." As a matter of fact our disregard of foreign languages may in part be ascribed to the fact that there is no time for them in our schools, owing to the complications of our bad arithmetical system. In my school we had five working hours, apart from preparation. One hour went daily to arithmetic, mostly tables and sums in reduction in the junior classes, half-an-hour twice a week to French.

To return to the subject, here is a specimen of our present coinage.

4	Farthings	make	1 penny.
12	Pence	,,	1 shilling.
20	Shillings	,,	1 pound.

When your attention is called to it you will observe that there is no fixed system. It by no means follows that because 12 pence make a shilling therefore twelve shillings make a pound. The number of units of small capacity required to make up the next larger denomination is purely arbitrary. This peculiarity is not confined to coinage, the same want of system or regularity prevails throughout, in fact our coinage is the least of our troubles.

This is bad for ourselves, but it is worse for foreigners. They have little knowledge of our coinage, and absolutely none of our weights and measures (small blame to them, say I) and hence they cannot readily tell what our coinage and weights and measures represent as compared with those to which they have been accustomed.

Hence in the very first opening of commercial relations with foreigners there is a most serious difficulty, the fact that we have a highly defective system of coinage, weights and measures.

It must be borne in mind that all commerce is practically the exchange of one commodity against another, money is only the medium through which this is effected, and when we measure goods and commodities in tons and the foreigner measures in kilograms, there is apt to be a difficulty.

I think it is clear to any reasonable man that the fact that our weights, measures and coinage are destitute of any system causes damage, and hinders our commerce, and until some rational system has been introduced into them damage and hindrance must continue.

On the other hand if we could introduce improvements into our so-called system, it would lead to improvements in our trade and commerce, which as I have just said it is absolutely necessary should be improved as much as possible.

I propose now to take our tables of weights and measures as used by ourselves, the tables which have been dinned into our ears since we first entered school.

The real fact is that we think we have a system of weights and measures, but really we have not got this advantage.

This is no doubt true of the Empire as a whole, which could very well happen when it includes India and Canada, South Africa and Anzac, but, what is infinitely worse, it is true of the British Isles properly so called, which certainly should practice uniformity among themselves.

This seems to be a rather bold statement, and I cannot expect it to be accepted without question. I will take an article of the very first importance: Corn.

In England, corn of all kinds, so far as I know, is measured in bushels, pecks and loads. The price is generally quoted in bushels, and the bushel is a measure of capacity, containing by measurement eight gallons, the gallon itself measuring 277·274 cubic inches. It so happens that a gallon holds exactly 10 pounds of water, so an imperial bushel holds exactly 80 pounds of water, but corn is measured by bulk, not weight, and the bushel contains 2,218·2 cubic inches, a nice convenient number to remember.

It follows that as corn is not measured by bulk, a bushel of grain does not weigh 80 pounds, as grain is considerably lighter than water.

We should naturally expect that the same measure of capacity instead of weight would exist in Ireland, and at first sight this would appear to be true, owing to the fact that Irish farmers measure their wheat, barley, and oats by a measure called a " barrel."

If this were true it would simplify matters; you would merely have to get the size of the " barrel," as compared with the size of the bushel, and your troubles would be at an end.

I thought so myself when I first heard it, but I soon learned that a "barrel" was a weight, not a measure, and, what was perhaps worse, that:—

A barrel of	wheat	weighed	20	stone of 14 pounds,	280 pounds.
,,	barley	,,	16	,, ,,	224 pounds.
,,	oats	,,	14	,, ,,	196 pounds.

In fact, as you will see at once, not only is the Irish barrel a measure of weight, not capacity, but the barrels of the principal grains differ materially in weight.

The result is that if an Irish farmer consults a newspaper, he gets the London prices per bushel, which is of no assistance to him in estimating the value of his crop estimated by him by its weight.

I am merely giving this instance as typical, there are innumerable other local measures. For instance, in London the stone of 14 pounds is used for the living animal, the stone of eight pounds for the dressed meat.

In Norfolk and Suffolk herrings are measured by the "mease," which means 10,000 herrings by count. In Scotland they are measured by the "Cran," which by way of further confusion is a measure of capacity, amounting to 37½ bushels, and comprising, on an average, 750 herrings.

Again, eggs, if my memory serves me, are measured not by weight, or even in a round number, but by the "long hundred," which is not a hundred, but 120. It is rather like our "hundred-weight," which is not one hundred pounds, but 112, perhaps the most absurd and misleading of our weights, because it is so often used.

It would, however, take too much time to go into these local peculiarities, their number is really very great, and I have only referred to a few. There is a far more serious difficulty before us, and that is that there is no standard as to the number of small articles or "units" which will make up the next larger size or measure, either in coinage, length, quantity or weight.

This can best be shown by taking some examples and showing the want of system.

Take the coinage:—

2	Farthings	make	a halfpenny.
2	Halfpence	,,	a penny.
12	Pence	,,	a shilling.
2	Shillings	,,	1 florin.
2½	,,	,,	1 half-crown.
5	,,	,,	1 crown.
20	,,		
or 4	crowns	,,	1 pound.

The measure of length is no better.

12	inches	make	1 foot.
3	feet	,,	1 yard.
$5\frac{1}{2}$	yards	,,	1 perch.
320	perches	,,	1 mile (1760 yards).

As to weight, I pass over the fact that there is Troy weight as well as Avoirdupois, and I give only the latter.

16	ounces	make	1 pound.
14	pounds	,,	1 stone.
2	stone	,,	1 quarter.
4	quarters	,,	1 hundredweight (112 lbs.)
20	hundredweight (each 112lbs.) make 1 ton (2240 pounds).		

Now for liquids—

2	Pints	make	1 quart.
4	Quarts	,,	1 gallon.
8	Gallons	,,	1 bushel.

It is a remarkable fact, for which I cannot account, that our liquid measure is utterly inadequate. Bushels are not used in liquid measure: the gallon is the unit, and this is so small as to be useless for large quantities. It leads one to the idea that the only liquid measures were intended for milk, beer and spirits, and these on a very small scale.

When it comes to measuring large bodies of water, such as a water-reservoir, or the flow of a river, the statement that it amounts to so many gallons gives no idea of the actual quantity; the number of gallons seems enormous, for what the eye teaches us is quite a small quantity. If liquids were measured in cubic yards, or rather cubic metres, with decimals for lower denominations, the table would be far more easily dealt with.

I have thus taken our coinage, our weights and measures, and have shown that there is no uniformity in them.

Hence my remark that we have not got any system. For a system you require some working principle, which will relieve the memory from the necessity for carrying a number of miscellaneous facts or numbers. One of the most difficult things for anyone to do is to remember strings of irregular numbers without confusing them with others something like them.

I might go on with other instances, but it is time to deal with a system I have already referred to, which is known as the decimal system, which is precisely like our numerical system, working always by tens.

The great Napoleon was largely instrumental in introducing this system into Continental Europe; it seems to have been applied first only to coinage, but it now applies also to weights and measures. I have not investigated whether the decimal system was applied first to coinage, and subsequently to weights and measures, or whether the whole system was put forward at the same time. The fact remains that on the European Continent the decimal system is in general operation for all measures. The two most important exceptions are the British and the United States of America.

I should mention that the United States use decimal coinage, but not decimal weights and measures.

As I have already said, the decimal system in outline is exceedingly simple. Ten is taken as the number of a small denomination required to make up the next higher denomination.

According to this system our coinage would run as follows:—

10 Farthings	would make	1 penny.
10 Pence	,,	1 shilling.
10 Shillings	,,	1 pound.

I am merely giving an example to illustrate the system of working by multiples of ten, and not considering the present value of the coins.

The French, and most nations of the European Continent, have applied the same decimal system not only to coinage, but to weights and measures, thus getting rid of the necessity for learning elaborate tables.

As a standard of length, the French adopted the length of a pendulum swinging once in a second, which is about 3 feet 3 inches. This they named a " metre," and it was written 1.

All other measures of length are multiples or sub-multiples of the metre. For instance, on the descending side a "centimetre" is one-hundredth of a metre; on the ascending side a "kilometre" is 1,000 metres. A kilometre is, therefore, about 1,000 of our yards.

Similarly, they have a standard measure of capacity, called a litre. A litre contains the volume of a cubic decimetre—i.e., the cube of the tenth part of a metre.

As a matter of fact, comparing this with our measure, a litre is equivalent to 1·76172 imperial pints; and as two pints make a quart, and four quarts a gallon, the litre is less than a quarter of a gallon, and is thus a very small unit—to my mind, far too small as a standard.

Our own liquid measure is absolutely our worst system of all. We have nothing above a gallon, and measuring the contents of a reservoir or lake in gallons is simply absurd.

The whole decimal system, whether of coinage, weight or capacity, rests upon the simple fact that it takes 10 of the lower denomination to make one of the next denomination.

This at one fell swoop gets rid of all the elaborate weights and measures to which we have been accustomed; all our elaborate rules for reduction of tons to ounces and miles to inches are swept away. There are no tables to learn.

It may be remarked, as a possible explanation, that the ancient Romans did not possess the decimal system of notation which we possess, and how they performed the operations of multiplying and dividing is somewhat of a mystery. Probably they used the abacus. Let anyone try to multiply in Roman notation, say, XCVIII. by LVI., and he will soon find himself in difficulties. As a matter of fact, I believe that the decimal notation originated in India, and spread to Bagdad about the eighth century, and only reached the British Isles a hundred or two hundred years after the Norman Conquest.

I need hardly say that various European nations, particularly the British and French, must have had a fair system of weights, measures and coinage long before Magna Charta in 1215. This, to some extent, accounts for the old measures of "hands," breadths," "feet," "cubits." There is no trace of any decimal system in them.

Of course I am by no means the first to take up this decimal system, even in this Society, for I found it had been treated in a paper read before the Society nearly thirty years ago by my friend, ex-Lord Chief Justice Cherry. (Journal, vol. ix., p. 2921). I have a copy of the essay, which showed very plainly the immense disadvantages of the existing system.

He did not deal with the system of weights or measures, but only with the coinage. I will summarise his views.

He proposed a new coinage, of which the following is an example:—

10 Farthings (of old value)	were to form	1 Doit.
10 Doits	,,	1 Florin.
10 Florins	,,	1 Pound.

You will at once see that his system worked upward from a very small unit. It took 100 farthings to make up two shillings, or rather one florin.

According to this system, in many respects excellent, the effect of leaving the farthing unaltered would be to make the "Pound" worth £1 0s. 10d.

This was not the result of accident. The idea was deliberate, and the system was based upon two propositions:

"1. That there should be as few changes as possible.

"2. That the coins which remained unchanged should be the smaller and not the larger denominations, to quote the author's own words: 'As the reason for continuing our existing coins is to convenience the poor, it follows that it is these coins and not those of the rich which should remain—the penny is, in this respect, more important than the pound.'"

I quite appreciate the idea, but I cannot say that I concur with it. My view is that we should have the best possible money system for the whole nation, the community as a whole, not the class which has the least of it. Considering that the vast money transactions of the country dealing with £1 or upwards, as compared with those dealt with in farthings, it was, I think, fallacious to make the standard too small. The French franc is notoriously a failure for serious operations, and centimes in practice are unknown. The French halfpenny or sou is written 5. The Americans declare that their dollar is too small, and they do not reckon anything below 5 cents. in small coinage commercial transactions.

My own view is, that the standard should be, say, £1, with decimals under that value.

My reason is that I wish to reckon easily in large amounts. There is little work done in tenths of a penny. The franc is so small that it takes 25 of them to equal our £1. Hence, by a small unit, you have many more lines of addition, subtraction, multiplication and division. A British £5 is expressed in at least three digits in French coinage 125 francs, more if strict accuracy be essential. In America £1 is expressed by two digits, 20 dollars (with the same extension for strict accuracy). An American "millionaire" is the proud possessor of $1,000,000, equivalent to our fifth of a million dollars, £200,000.

To illustrate my meaning of fewer figures, I will give an illustration.

A man buys, say, 500 articles at 25 francs each, and he works out 12,500 francs as the price.

Using American currency, the 500 articles at 5 dollars would cost $2,500.

Using British currency, he buys 500 at £1, and it works out at £500.

For long columns of figures the difference between adding in hundreds of thousands, five digits in France, four in America and three in the United Kingdom is considerable.

In all respects but this, I think that Lord Chief Justice Cherry's solution of the metric coinage system a sound one.

I have digressed a little from my main subject to deal with this question of the coinage, and I now go back to the general system of weights and measures.

It is possible that some people may express surprise that the decimal system of weights and measures now in general use, I believe, in Continental Europe, was not adopted universally by the world, like the Hindoo discovery of decimal notation. It is still more peculiar that the two most important commercial and manufacturing countries in the world—the United States and the British Empire—stand apart from the nations who have adopted the metric system in its entirety, not only for money, but for weights and measures.

It certainly appeared to me that the fact that these two great commercial powers, probably the greatest in the world, did not see their way to adopting it, made me hesitate to do so, and also caused considerable doubt in my mind as to whether the metric system of weights and measures was so perfect as it looked.

It led me, in fact, to consider the question whether there might not be some obstacle in actual fact which did not fit in with the system, perfect as it appeared to be in theory.

I have considered it for a long time; it is more than three years since I first tried to account for the fact, and it was only recently that I arrived at a conclusion on the subject. My objection is a very short one.

Briefly and tersely expressed, I find that the standard unit in weights and measures under the decimal system is too small. You have to use too many figures to express anything like a really large number, space, or weight. Instead of large units, such as miles, tons, square miles, by using small units, metres, grammes and litres, you get into numerous digits before there is any necessity. I use the word "digit" for a single figure.

I will explain what I mean by an example:

A British ton is, in round numbers, 1,000 kilograms, and a kilogram is 1,000 grammes, so that we should write that a British ton is 1,000,000 grams.

Similarly, in length, a mile is approximately 1,624 metres, and a sovereign is about 25 francs.

Long strings of digits are to be avoided, as they take time to write, and they are exceedingly difficult to remember accurately. The larger the number of digits or single figures required to express an amount, the greater the probability of a mistake.

This difficulty, it so happens, can be very readily seen when an example of it is taken from our own liquid measure, which, as I have said, is the worst we have:—We are told that a stream of so many thousand gallons passes an observer in a minute. The number seems enormous, yet it will hardly turn the smallest water-wheel. Again, we are told that a reservoir contains so many million gallons, and it seems enormous. It is only when you find that a single cubic foot of water is equal to about six gallons that we begin to find that the big figures in gallons mean very little in cubic yard capacity.

In other words, the standard is too small; it is like giving the distance from the earth to say the moon in inches.

I will take another instance. French weights are generally given in kilograms, which means 1,000 grams and a kilogram is approximately 2 lbs. avoirdupois.

To my mind, the redeeming features of this system is its adherence to the decimal system, which renders many operations automatic; but owing to the adoption of very small units it is practically hopeless to deal with large quantities. You have too many digits, using that word for single figures.

I have already alluded to the singular fact that the two great Naval Powers have stood aloof from the decimal system in weights and measures, and I attribute it to this adoption of an unworkable small standard in weights and measures. I think there can be no doubt that the one redeeming feature of our complicated system is that our unit for commercial transaction is a comparatively large one. The mile is a fairly good one for large or long distances, the ton is a good measure for large weights. The £1 is a good standard for large sums. All these are readily understood: they act as large standards, and convey a single, large definite idea. I have to except the gallon from this, and I would suggest a cubic metre when we come to measuring our rivers, canals, water supply, drainage works and reservoirs. With a cubic metre as a standard, the results would be comprehensible.

I candidly confess that I gave the matter up, but after a long interval it occurred to me to apply to the Decimal Society, which exists for the purpose of introducing a decimal system of coinage, weights and measures, and I accordingly did so in the following letter:—

Dublin, 3rd February, 1917.

DEAR SIR,

In the year 1914, when I was President of the Statistical Society of Ireland, I had some correspondence with your Society on the Decimal System, as I thought that on the re-establishment of peace there would be an effort to push British manufactures in foreign countries, and I felt that our hopeless chaos of weights and measures were an overwhelming objection to pushing our sales abroad. You then very kindly sent me some particulars of the Decimal System.

So far as I grasped the system, it appears to me to be highly rational in most respects; but I feel one grave objection, the Unit is far too small.

Take the metre, roughly a yard, and apply it to the distance from Liverpool to New York, roughly 3,000 miles. You are in double figures of KILOMETRES by the time you have travelled six nautical miles, and the distance of 3,000 miles has to be represented by, roughly, 5,400 kilometres.

As regards coinage, I understand that the idea is to make the florin the Unit. Then at the first £1 you are in double figures for addition, etc. In fact, addition and subtraction are evidently more burdensome under the metric system than under the existing chaos. Take, for instance, a ship's tonnage, the number of figures required to express the tonnage of an Atlantic liner of, say, 20,000 tons would be appalling if expressed in kilograms.

It may be that your system has been modified in some way to meet these objections, but I have encountered them in my attempts to popularise the system.

In other words, I have met with objections from several persons, NOT to the decimal system, but to the standard on which the decimal system is based.

Perhaps you could see your way to explaining to me whether my opponent's objection is well founded, particularly as regards coinage.

If it be well-founded, I should like to have suggestions for improvements.

If it be ill-founded, I should like to know what is the fallacy in the argument.

Pray do not think that I desire to be captious. I have only an ordinary average intellect, and the probability is that the general average of the British public are in the same predicament as I am—i.e., of genuine honest doubt.

I am, yours truly,

CHARLES A. STANUELL.

The Secretary of the Decimal Association,
Finsbury Court, Finsbury Pavement,
London, E.C.

The following is the reply I received:—

Finsbury Court, Finsbury Pavement,
London, E.C.
6th February, 1917.

DEAR SIR,

I am in receipt of your letter of the 3rd inst., for which I thank you.

It does not appear to me that the difficulties you mention are very great, as other countries using the metric system do no appear to have found any trouble with the number of figures.

I cannot agree with you that addition and subtraction are more burdensome under the metric system than with our present confusion, as in the former case the sums are in simple arithmetic, and there is no conversion from one unit to another.

In the United States, accounts are always quoted in dollars, however large they may be.

Large weights in the metric system would not be quoted in kilograms, but in "tonnes" of metric tons—i.e., 1,000 kilograms.

One of the reasons why this Association suggested the florin is that it entails the use of only two decimal places in common with other countries. Amounts, however, can be converted into £'s at sight.

I hope that this letter disposes of your difficulties; but, if it does not, I shall be glad to hear from you again.

Yours faithfully,

E. Merry,

Acting Secretary.

I confess that I did not think that there was any use in continuing the correspondence. It seemed to me to be absolutely clear that my position and that of the Decimal Association could not be reconciled. In other words, my objections were to its use in PRACTICE; the Association were retaining their THEORY without reference to practice, and I let the matter drop.

It was only lately that a singular sentence in the Secretary's reply struck me.

It runs:—" Large weights in the metric system would not be quoted in kilograms, but in 'tonnes" of metric tons—i.e., 1,000 kilograms."

The papers sent to me did not contain any tables of ' tonnes '; the use of these would remove much of the difficulty as regards weight.

There is not, in fact, very much between the Decimal Association and myself. It would appear to be very much a question where the decimal point should be placed. I want a large unit: take the £1 as unit with decimals below it. The Decimal Association want a Florin as unit with decimals below it. The same idea runs through all their weights and measures, an intense keenness for small figures and a neglect of large standards.

My reason for asking for large standards is, that I have noticed that comparatively few persons can reckon in long series of figures. If a man be offered a choice between a ton of some material and 30,000 ounces of the same material, the chances are he will choose the 30,000 ounces. It looks so much bigger in figures, yet the single ton is far heavier than 30,000 ounces.

My objection to the Decimal System as now proposed is, that it looks more to the small things than to the large. The standards are too small. At present the system is impracticable, but the true system is there; and, personally, I think that a carefully considered decimal system of coins, weights and measures could be devised if practical men and theorists met together.

I believe also that such a system would be an immense advantage in the extension of our trade and commerce; and as I said at the beginning: "We must contemplate the rebuilding of a half-ruined Empire, and to do this we have not only to restore our old business, but to develop it still further."

Copy. UNIVERSITY COLLEGE,
EARLSFORT TERRACE, DUBLIN,
9th January, 1917.

DEAR MR. STANUELL,

I am much obliged for the proof of your interesting paper on "Weights and Measures after the War," and regret that I was unable to be present to hear it read.

I am in hearty agreement with your thesis. I think our complicated and cumbersome old system ought to have been swept away long ago—that it has formed, and (unless done away with) will continue to form an almost insuperable barrier to complete commercial intercourse between ourselves and foreign countries.

Unlike you, I do not apprehend any difficulty from the comparative smallness of such units as the florin, metre, gram, &c.

It seems to me to be merely a question of shifting the decimal point. Once we have got accustomed to the new system we shall all be wondering how we ever "put up with" the old one so long.

I would suggest that at the same time the centigrade scale of thermometry be introduced. Of the three existing systems we have—with curious indifference to results—adopted the least convenient, that of Farenheit, which is of course, based on a ludicrous error, that of supposing that the lowest possible temperature is that of an ice and salt mixture.

Yours very truly,

C. A. Stanuell, Esq. E. J. McWEENEY.

APPENDIX.

THE METRIC SYSTEM.

The metric system of weights and measures has four sets of units, one for length, one for surface, one for volume and the fourth for weight. Each of the four sets contains seven units, so there are only 28 units in the system. The four sets are so similar that a knowledge of one explains the others. Let us consider the set for length.

Kilometer	=1000	meters	= 39370	inches	=1093·6 yards	=nearly ⅝ mile.	
Hektometer	= 100	„	= 3937·0	„	=109·36 yards		
Dekameter	= 10	„	= 393·70	„	=10·936 „	nearly ½ chain.	
METER	= 1	„	= 39·370	„	=1·0936 „		
Decimeter	= 0·1	„	= 3·9370	„			
Centimeter	= 0 01	„	= ·39370	„	30 centimeters = 1 foot nearly.		
Millimeter	= 0 001	„	= ·039370	„	25 millimeters = 1 inch nearly.		

Abbreviations—Kilometor=km, Meter=m, Centimeter=cm, Millimeter=mm.

The meter is seen to be the middle unit of the set, three being greater and three less. By knowing the length of the meter we can easily remember the lengths of the six other units for they are 10, 100 and 1,000 times greater or less than it. The names of these six derived units are formed by the six words put before the name of the middle unit, each word having a proper meaning namely—deka, hekto, kilo, mean 10, 100 and 1,000 times greater, and deci, centi, milli, mean 10, 100 and 1,000 times less. The hektometer and dekameter are very seldom used.

The three other sets are the same as that for length except that each has a different middle unit.

The middle unit of surface is the "ar" (=100 square meters), but of this set only the hektar (=2·471 acres), is in common use.

The middle unit of volume is the liter (=1 cubic decimeter=nearly 1¾ pints). In this set the hektoliter (=22 gallons) and the liter alone are common. For larger volumes, as in the case of firewood, a middle unit called the "ster" (=1 cubic meter) is sometimes used. Capacity and bulk are merely different names for volume.

The "gram" (=15·4323 grains) is the middle unit of weight. The other common units of this set are the kilogram (kg), the centigram (cg), and the milligram (mg). A thousand kilograms are called the metric ton and it is nearly the English ton.

An admirable feature of the metric system is the connection between weight and length, the kilogram of water being equal in volume to the cubic decimeter or liter, consequently the cubic centimeter (cc) of water weighs a gram, the cubic millimeter a milligram, and the cubic meter a ton.

The meter is nearly 10 per cent. longer than the yard and the kilogram 10 per cent. heavier than two pounds.

The reader can understand that the metric system abolishes compound arithmetic through counting by tens, and requires for its 28 units only 10 words, viz.: meter, ar, liter and gram, as neutral units and deci, centi, milli, deka, hekto, kilo, for forming derivatives.

The scheme was designed to be different from any then in use among foreign nations and so to avoid international jealousy.

The shortest distance on the earth's surface from pole to equator is 10,000,000 meters = 10,000 kilometers.