DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
S. W. STRATTON, Director

MISCELLANEOUS PUBLICATIONS—No. 45

Buying Commodities By Weight or Measure

[Extracts adapted from Bureau of Standards Circular No. 55, Measurements for the Household]

DECEMBER 9, 1920

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BUYING COMMODITIES BY WEIGHT OR MEASURE*

I. INTRODUCTION

1. The Bureau of Standards' Relation to the Weights and Measures of Trade

Ever since its inception in 1901 the Bureau of Standards has taken the greatest interest in the elimination of fraud in commercial transactions. It has done all in its power to assist in establishing proper State and local inspection services over the weights and measures used in trade.

As early as 1902 local investigations of the efficiency of the inspection service in the city of New York were conducted by the Bureau. In 1904 the Bureau conceived the plan of inviting officials, having the custody of the State standards, to meet in Washington to study the weights and measures situation, and the first meeting was held at the Bureau in 1905. A meeting has been held each year since, which is known as the Annual Conference on the Weights and Measures of the United States. These meetings are very largely attended by weights and measures officials, by manufacturers, by representatives of commercial organizations, and other persons interested, and are an important factor in standardizing the laws and practices in relation to weights and measures throughout the country.

In 1909 the Bureau of Standards was authorized by Congress to undertake an investigation of the general condition of the weights and measures in commercial use throughout the United States. Through this investigation deplorable conditions were discovered. Only two or three States and a few of the larger cities maintained at that time any efficient inspection service, and negligence in this regard was costing the consuming public large sums of money and putting a premium on dishonesty in competition. Shortage in weights and measures was found to be a common condition. While there are many manufacturers and merchants who are honest in their dealings, there is another

* Reprinted from original plates of Circular of the Bureau of Standards No. 55, Measurements for the Household, without change of either figure numbers or table numbers, but slightly amended in several cases for the purposes of this publication.

class, who, either through fraud, carelessness, or ignorance, fail to deliver honest weight and measure to the consumer. The inaccuracy of scales and measures in use, and the weights of packages ready for delivery or already delivered confirm this view. The investigation mentioned above showed that every State in the Union was suffering in this respect, conditions being especially bad in those States which were entirely neglecting the subject.

TABLE 8

Summary of Apparatus Examined by Inspectors of Weights and Measures, Bureau of Standards

	Articles tested	Percentage correct or incorrect
Total number of scales tested	10 034	
Correct	5 535	55.2
Incorrect	4 499	44.8
Total number of weights tested (partly estimated)	12 211	
Correct	9 792	80.0
Incorrect	2 419	20.0
Total number of dry measures tested	5 656	
Correct	2 935	51.9
Incorrect	2 721	48.1
Total number of liquid measures tested	2 407	
Correct	1 761	73.2
Incorrect	646	26.8
Total apparatus of all kinds inspected	30 500	

Total number of stores visited, 3220

The Bureau's investigation showed that nearly 45 per cent of all the scales tested were 3 or more per cent in error, and when the rapidity with which a tradesman sells his wares is considered, even 3 per cent is a very important consideration; and when it reaches 12, as it did in a number of cases, the loss to the purchaser is a serious one. The honest dealer, as well as the purchaser, suffers from the existence of such fraud, since the possessor of such a fraudulent scale can apparently undersell him and yet actually receive more for his goods.

As an example, it was estimated that the consumers of the country lost annually more than $8 000 000 on short-weight deliveries of one staple article of food.

By framing a model State law and a model city ordinance, by interviewing governors, State legislators, and others on the general subject, and by issuing reports on the conditions found, the keenest interest was aroused. Since that time a large majority of the States and many important cities have passed weights and measures laws and ordinances and as a result of these enactments now have an increasingly efficient inspection service to enforce honesty in weight and measure.

FIG. 61.—*Straight-face spring scale with fraudulent sliding face*

This is used in buying. During the process of weighing the buyer slides the face downward, thus greatly decreasing the indicated weight and defrauding the seller.

The efficient officials of the States and cities realize that the best results can not be expected from the inspection services unless the persons whom they are appointed to protect understand what should be accomplished, and assist and cooperate in revealing bad conditions, and in thus obtaining competent enforcement of the laws. Therefore, any person having evidence of shortage in the weight or measure of commodities purchased should communicate with the local sealer or inspector of weights and measures, where there is such an officer. If it is found that the State or city has not taken an advanced stand in this matter and has no official to take charge of and investigate proper complaints, or has an official who is not inclined to take proper notice of the matters which arise, then a protest against this lack of pro-

tection should be lodged with the government of the city or State, coupled with a request that the matter be investigated and steps taken to remedy the condition. The most efficient way to obtain protection is, and should be, by the force of public opinion, and with a sufficient volume of protest, remedial legislation is practically assured.

FIG. 62.—*"Crab" or "handcuff" scale.*

The large ring, the large hook, and the larger capacity face and the small ring, small hook, and the smaller capacity face, are intended to be used together. By combining these parts incorrectly, results very greatly in error are obtained, the most common method of use resulting in shortages of 25 per cent.

The investigation by the Bureau of Standards and by others has clearly shown that some losses are likely to result from the improper, but not fraudulent, use of some types of relatively correct apparatus such as would be found in first-class stores. By far the larger individual losses, however, are those resulting from the use of false weights and measures and by intentional cheating, either with false or comparatively correct apparatus.

The methods of cheating and the types of false apparatus exhibit great variety. (See Figs. 7, 9, 11, 61, 62.) Among the different types of false capacity measures may be mentioned those having movable or false bottoms; measures having a portion of the height cut away from either the top or bottom; measures with staves removed and the hoops and bottom adjusted accordingly; "bottomless" measures which have relatively small diameters and high sides, and which—although they may contain the proper number of cubic inches—give incorrect quantities as they do not permit a proper heap; measures with false interiors, such as have been found in milk cans and measures for selling gasoline; and liquid measures used for dry commodities. This last practice is found in use to some extent in practically all parts of the country and results in a shortage of about 14 per cent. It is one of those practices which has come into use largely through "trade custom."

The use of correct scales of high quality is not always in itself a guarantee that correct amounts will be given, for it is possible

for the user of correct scales to manipulate them to his own advantage, but fraud is more often committed with apparatus that readily lends itself to that purpose. A type of scale which was formerly common among certain classes of dealers is the straight-face spring scale, designed to be held in the hand, with the graduated face made movable so that the dealer might lower or raise it so as to make the pointer indicate an amount less or greater than the true weight, according to whether he was buying or selling. Some even-arm balances of inferior construction may be made to indicate falsely by placing the weights and commodities in certain positions on the pans. This is done in an apparently unintentional manner by the dealer and would not be noticed by the customer unless he were familiar with the action of such scales. Counter beam scales with a removable scoop and counterpoise may very easily be used fraudulently by omitting the counterpoise when the scoop is in place. These are a few of many ways in which short weights or measures may be given even with apparatus which, upon a casual examination, may appear correct.

False apparatus is sometimes very crude in construction and this may easily be detected upon examination. The users of such apparatus depend to escape detection upon the unsuspecting attitude of the purchaser and their own dexterity in handling the apparatus. In the majority of instances, however, tests with standards are necessary.

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II. BUYING COMMODITIES BY WEIGHT OR MEASURE

1. Measurement as a Factor in Purchasing

Many careful housewives scrutinize the *apparent prices* charged for the various commodities and the *quality* of goods delivered. But unless the *quantity* actually delivered is determined, the *actual cost price* of the commodities is not ascertained. Dishonest merchants may attract trade by quoting prices lower than the prevailing market price and then, by delivering amounts short in weight or measure, actually receive either the full market price or even an enhanced price for the commodity. Not only do such merchants make illegal profits on their goods in this way, but they also attract trade to the detriment of merchants who quote a higher price but deliver full amounts and whose goods may therefore be even cheaper to the buyer than those of the dishonest competitor.

2. The Elimination of False Measure

When fraudulent short weight or measure is discovered the purchaser should take steps to have the offender punished, even if the loss on the individual purchase is small, since other losses from this cause may be important in the aggregate. To fail to do this neglects the rights of other purchasers at that store who may not have detected short weight or measure delivered to them, and also the right of the honest merchant to protection, since his trade may be taken away on account of prices in his competitor's store, which are apparently, but not actually lower ones. When any purchaser finds that short weight or measure is being delivered by any tradesman, a complaint should be made to the local sealer or inspector of weights and measures, and details of the imposition given. It is then the duty of the latter to prevent further fraud by this tradesman. Only by concerted action of purchasers can dishonest practices of this kind be completely checked.

This course might be more often followed were it not for the fact that the average woman objects, and rightly objects, to appearing in municipal court as complainant or witness in the ac-

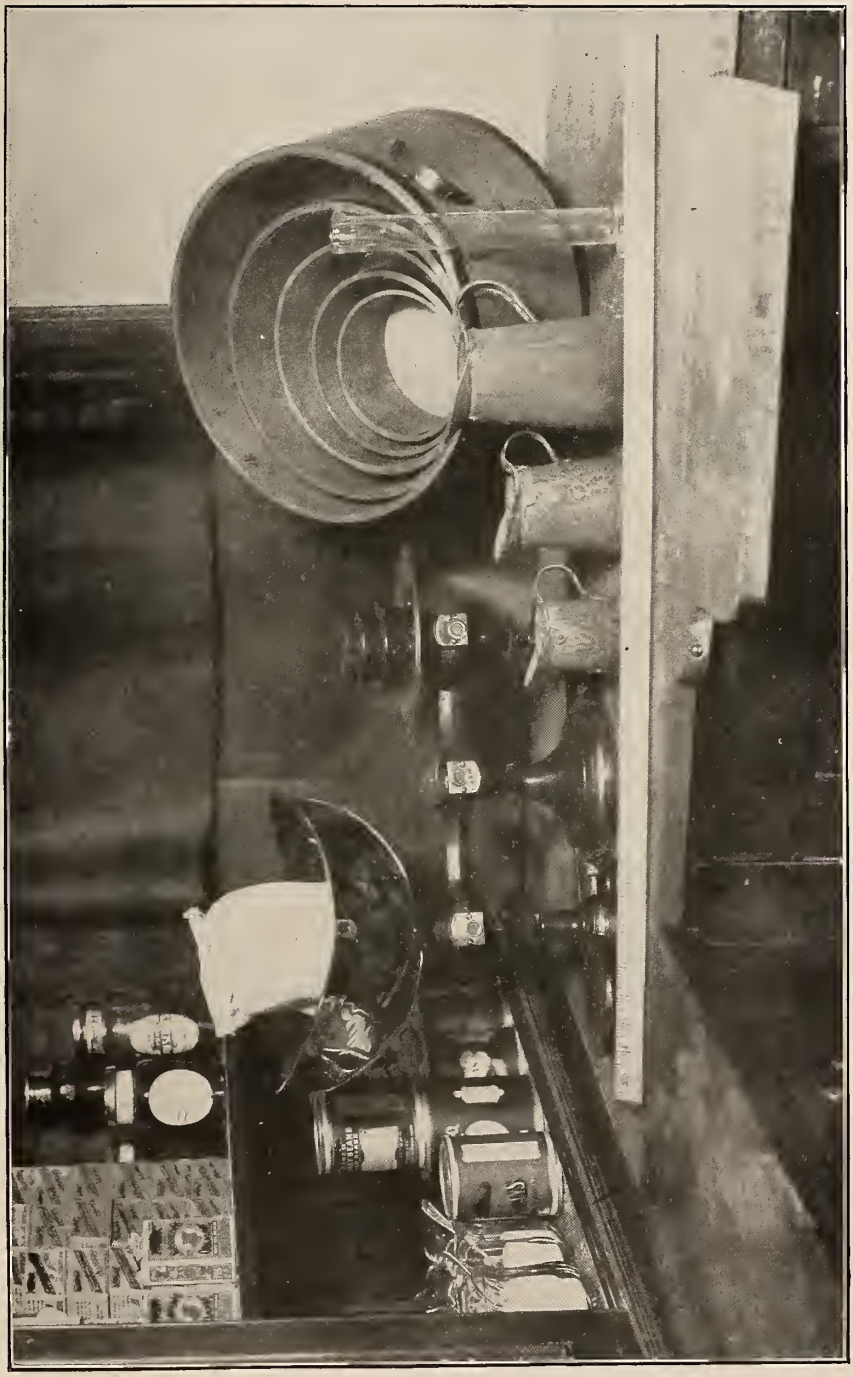

FIG. 2.—*Household weights and measures test set, A*

This equipment is suggested primarily for checking commodities purchased, but is adapted to many other household uses.

tion. But this is not necessary. The official receiving such a complaint need not take action upon the facts of the particular case or cases presented. Its only effect may be the pointing out of a merchant whose business methods are questionable, and he may then proceed to obtain information and evidence on his own account. If upon investigation he is unable to gather evidence of fraud, it indicates that the shortages discovered may have been accidental and not the general rule; but if he does obtain such evidence he may safely proceed on the assumption that the frauds are deliberate ones, and his duty to proceed against the merchant and to remedy conditions by legal action will be clear.

3. National Net-Content-of-Container Law

Congress recently enacted a law which is a very great aid in the buying of foodstuffs in package form. This law is an amendment to the pure-food act, and is popularly known as the "net-weight amendment." In brief, it requires that foodstuffs in package form must bear a statement showing the net amount of commodity actually contained in the package. Up to this time, in purchasing food commodities in the original package, the housewife has usually been limited to comparisons of quality and apparent price, which is of course the price per package. In comparing two brands of a food in packages of equal size these comparisons were trustworthy. When there was a difference in the size of package, however, economy in buying could not be obtained from a knowledge of these two factors alone. (See Fig. 8.) There might be a large difference in price per unit of quantity which would outweigh an apparent difference in price per package, or slight difference in the quality; but with the quantity labeled upon each package the purchaser has all essential facts at hand to compare unit prices.

Thus, we may compare two brands of package goods. Two packages of raisins sell for 25 cents and 30 cents per package, respectively. The purchaser might consider that the 30-cent brand was worth 5 cents (or 20 per cent) more than the 25-cent brand, but upon examination of the labels, however, if it appeared that the latter contained 16 ounces and the former only 12 ounces, he might conclude that the difference in price outweighed the advantages conceded for the higher priced package.

Again, a package of crackers may sell for 25 cents per package and crackers in bulk for 25 cents per pound. The purchaser might consider the package goods more desirable and disregard the weight. Under these conditions the package brand would naturally be selected. But the quantity is now marked on the package. Suppose in the case mentioned above the weight is 10 ounces. The cost per pound of the package goods is therefore 40 cents and of those in bulk 25 cents, The knowledge thus conveyed, that the brand somewhat better in quality or flavor was 60 per cent higher in price, might entirely outweigh the slight difference in quality and persuade the purchaser that the bulk goods were the better for the purpose. Therefore the careful

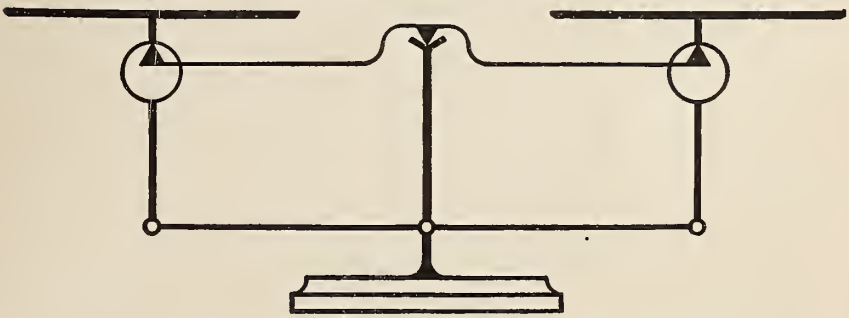

FIG. 3.—*Diagram of the equal-arm balance.* (*See Figs. 1 and 2*)

The pans of this balance are carried on the knife edges (the triangles shown at the bearing points under the pans, at equal distances from the center or fulcrum knife edge). The scale comes to balance when the weights on the two pans are equal. The load to be weighed is placed on one pan and known weights are added to the other until the scale is in balance. The correct name for this type is "the equal arm stabilized scale."

purchaser should first examine the labels on the packages, observe the net contents, and determine therefrom the price per unit weight. If these precautions are neglected, much of the value of an excellent protective statute will be lost.

4. Household Weights and Measures Test Set

(*a*) ACCURACY NEEDED IN HOUSEHOLD MEASUREMENT OF PURCHASES.—Every household should have a set of weights and measures by which purchases may be checked, and short weight or short measure detected. The measuring apparatus should be well made and of sufficient accuracy. Otherwise the measurements will not be reliable enough to warrant making a definite complaint, except in cases of considerable shortage.

FIG. 4.—*Household weights and measures test set, B*

This equipment is suggested primarily for checking commodities purchased, but is also adapted to many other household uses.

If measurements made with apparatus of uncertain reliability show small apparent shortages, suspicion should fall upon the apparatus, not the dealer, until the apparatus has been checked by suitable standards.

The purchasers of measuring apparatus will seldom be able unaided to verify its accuracy. They should therefore have the various pieces tested and sealed by the local sealer of weights and measures at the time of purchase. They should preferably be purchased with the understanding that acceptance will depend upon passing the official tests.

(*b*) APPARATUS SUITABLE FOR HOUSEHOLD INSPECTION.—The set of apparatus (see Figs. 2 and 4) should include the following:

Weighing scale.—A scale of from 10 to 30 pounds capacity or more, graduated to 1 ounce or less. (A 20-pound scale will be suitable.)

Liquid measures.—One quart, 1 pint, and ½ pint. A 4-ounce glass graduate subdivided to 1 dram or less for measuring small quantities of liquids and determining the errors on larger amounts.

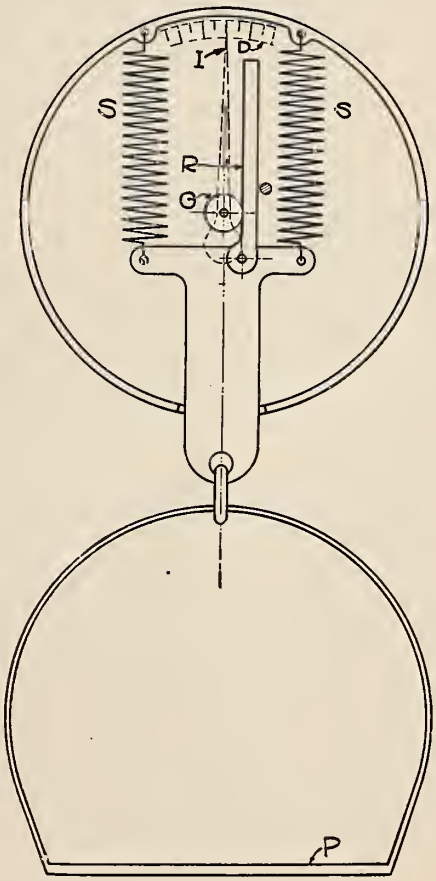

FIG. 5.—*Diagram of the spring balance*

The load placed on the pan P stretches the two springs S, S. The motion of the cross bar below the springs is transmitted through the vertical toothed bar or rack R turning the small gear G, mounted on a spindle bearing the pointer I. The pointer rotates over the dial, a portion of which with the pointer is shown in dotted outline.

Dry measures.—Nest of ½ bushel to 1 quart. (See following discussion as to the advisability of these.)

Length measures.—A yard measure, or a tape 3 or 6 feet in length.

The specifications and tolerances to which the apparatus should conform are usually obtainable at the local inspector's office. However, certain suggestions may be of value in this connection.

(*c*) THE WEIGHING SCALE.—Several varieties of scales for the purpose of household weighings are obtainable. A very convenient form is a hanging pan spring scale of about 10 or 20 pounds capacity. A scale of this type has several advantages. It automatically indicates the weight of articles placed upon it. (See Fig. 5.) It has, moreover, no loose weights which are liable to be mislaid. It may be suspended from a bracket on the wall and therefore does not require table space. If a folding bracket is employed to swing the scale back against the wall, no space that can be otherwise utilized to advantage is required. A fairly accurate scale of this character can be purchased for a reasonable sum.

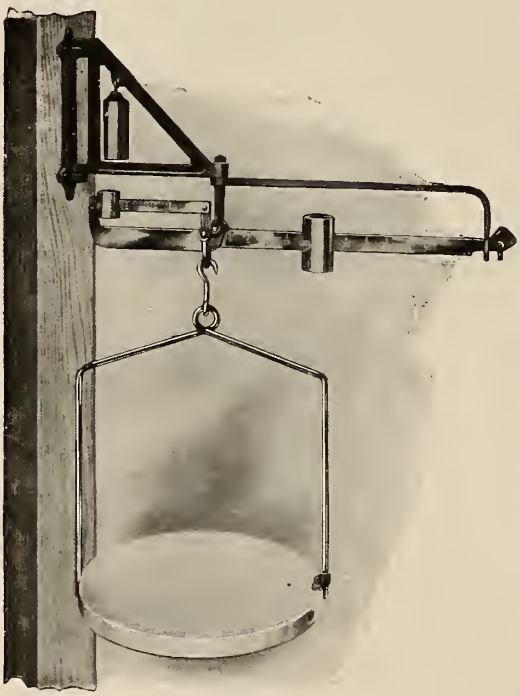

FIG. 6.—*Folding household scale of the steelyard type*

If table space is available, however, a counter beam scale of either the equal or unequal arm type may be preferred. (See Fig. 3.) This has the advantage of being more reliable, but the cheaper ones do not automatically indicate the weight, but require the addition of loose weights or the moving of a sliding poise. Counter beam scales are usually higher in price than spring scales.

Another type of scale which is very suitable and which combines many of the advantages of each of the types mentioned above, is a beam scale of the steelyard type designed to hang from a bracket, and to fold back against the wall when not in use. Such a scale often has a larger capacity than the common forms of the types described above and thus may be used for every occasion which may arise. Scales of this construction, designed expressly for household use, are now on the market. (See Fig. 6.)

A type of spring scale has been much used in the past, namely, the so-called "family" scale, having the commodity pan or platform above the spring. Many of these are very cheap (often costing only $1 or less) but have been found exceedingly inaccurate. Unless exceptionally well built and correspondingly higher in price, this type is useless in properly checking the weight of deliveries of commodities received.

(*d*) LIQUID MEASURES AND GRADUATE.—The liquid measures should be cylindrical, or conical with the top diameter smaller than the bottom diameter, and made of metal, enameled ware, composition, or similar and suitable material. They should be strong and rigid enough to withstand ordinary usage without becoming bent, indented, or otherwise damaged.

The graduate may be cylindrical or conical in shape. The former is usually somewhat more accurate, while the latter is somewhat cheaper, is more easily cleaned, and can often be more readily procured. The graduation marks should be correctly placed and plainly numbered, so as to indicate readily the capacity of the graduate at all points. They should also be straight, clear-cut, and of sufficient length to allow accurate readings to be made.

(*e*) DRY MEASURES.—The dry measures should be made of metal, or of well-varnished wood with a metal band around the top, or of similar and suitable material. They should preferably be cylindrical. If they are conical, the top diameter should exceed the bottom diameter by an amount not exceeding 10 per cent of the latter.

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The diameters should in no case be less than those given below:

Measure	Minimum diameters
	Inches
½ bushel	$13\frac{3}{4}$
1 peck	$10\frac{7}{8}$
½ peck	$8\frac{1}{2}$
2 quarts	$6\frac{5}{8}$
1 quart	$5\frac{3}{8}$
1 pint	4

(*f*) LENGTH MEASURES.—The yard measure should be made of well-dried wood with metal ends, or entirely of metal, or of other material of which the form and dimensions remain reasonably permanent under normal conditions. It should be subdivided into inches and their fractions, and also into the customary fractional subdivisions of the yard, i. e., halves, quarters, eighths, and sixteenths.

The tape should be of steel, or of wire-woven cloth when such construction gives it sufficient strength and permanency. At least 1 yard of this tape should be subdivided as above.

5. The Use of the Household Set in Checking Amounts of Commodities

The method of using this test set of weights and measures is quite simple, and the proper use will in most cases be evident to the housewife. Only a few suggestions upon the less obvious points, therefore, need be made here.

(*a*) USE OF SCALE, IN GENERAL.—The scale must be handled carefully and be kept *clean* and *dry*. The scale must also be kept *in balance*, otherwise every indicated weight will be incorrect. The ordinary counter beam scale is *in balance* if the beam comes to rest midway between the two stops which limit the swing. On a scale with a reading face, such as a spring scale, the indicator should point *exactly* to a definite and clear zero graduation.

Upon nearly every scale means of adjustment are provided by the manufacturer. Thus, a counter balance of the beam type is adjusted by turning the adjusting screw or balance ball, or by adding weight to or subtracting it from the shot cup under the

pan, or by altering the amount of balancing material wherever placed. Some spring scales may be adjusted as described. Others are adjusted by loosening a screw in a slot in the indicator, turning the latter on its pinion to the proper position, and then tightening the screw. If the scale has a glass face, this must be removed before the adjustment can be made. A properly constructed scale will rarely get out of balance. Therefore these adjustments on such a scale will not often have to be made.

For weighing on a beam scale the commodity should be placed on the pan; the beam should be brought to a balance by moving a sliding poise or by adding and subtracting loose weights. The weights used should be accurately totaled or the exact graduation on the weighing beam read.

In weighing a commodity on a scale which automatically indicates the weight, it is necessary only to make the reading carefully. Fractional parts of ounces are sometimes estimated by noting the exact position of the indicator between divisions.

If when reading the scale different readings are obtained upon moving the eye to the right or left, or up or down, it is necessary to take care that the eye is squarely in front of the point of the scale which is being read.

If a commodity exceeds in weight the capacity of the scale, it may sometimes be divided into two or more parts for checking purposes, each not to exceed the capacity of the scale. By adding the separate weights of the various portions the total weight of the amount purchased is found.

The weight desired and the weight which should be furnished is always the net weight of the commodity, i. e., the commodity itself without wrappings or coverings of any kind. Therefore a commodity should not be weighed in a cardboard carton, or other heavy coverings, or, if weighed with these, the coverings should thereafter be weighed separately and this weight subtracted from the gross or total weight.

(*b*) MEAT.—When shortages are found in the weight of meat purchased, a common excuse of the dealer is that the meat was trimmed after being weighed, and it has often been found that this excuse was used to cover up frauds in such sales. Therefore

the housewife should require that all meat trimmings should be delivered to her by the dealer. This is fair, since they have been purchased and paid for at regular prices; and it is economical since they are often of use to the careful housewife. When such a demand is made, the total weight delivered should never be less than the amount charged for, and if it is so found a shortage may legitimately be claimed.

(*c*) POULTRY AND FISH.—Poultry drawn and dressed after weighing can not easily be checked as to weight, since the housewife will seldom desire to have the feathers, head, claws, etc., delivered. By observation or experiment one can soon learn what shrinkage in weight is naturally to be expected, and an investigation should be made in cases in which this proper shrinkage is exceeded. In cases in which fish are cleaned after weighing, similar precautions should be observed.

(*d*) GOODS IN ORIGINAL PACKAGES.—The purchaser should read the labels on the packages of goods purchased and the accuracy of the statements of quantity should be checked. If the contents are not to be removed at once, the package may be weighed gross when purchased and the weight noted on the outside. When empty the container may be weighed, and this weight, subtracted from the gross weight noted previously, gives the net weight. The law requires that this should equal that printed on the label.

(*e*) LIQUIDS IN BULK.—If a liquid commodity is purchased in bulk and only partly fills the receptacle in which it is delivered, upon pouring it into the measure of the *nominal* size corresponding to the amount purchased, it should completely fill that measure. If it does not fill the measure the delivery is short. If more of the same liquid of the same grade is at hand, the shortage can be immediately determined by putting a definite, noted quantity of the liquid into the graduate and from this amount completing the filling of the measure. The difference between the quantity of liquid remaining in the tolerance graduate and the original amount put in it is the shortage.

If there is not at hand any more of the commodity, the liquid under test may be poured out of the measure and the measure filled up with water to the same point that the commodity

reached. This can usually be done by observing the top of the wet ring around the measure left by the commodity. Then by completing the filling of the measure with water from the graduate, the shortage may be found in the manner described above.

(*f*) LIQUIDS IN CONTAINERS.—Liquid commodities bought in bottles, cans, or other containers may be checked as above described, or the following method may be found easier. The point to which the container is filled is first noted and the contents removed. Then, if the container is of the nominal size of one of the liquid test measures, this *measure* is filled with water until the water is just level with the top. This is then poured into the *container* until it is filled to the same point as before. If any water remains in the measure, the delivery is short by this amount. By pouring this into the graduate and noting its amount the shortage is determined. (Be sure that the container is filled to the same point in the test that it was when delivered, as the amount *actually delivered* and not the *capacity* of the container itself, is of importance in this case.)

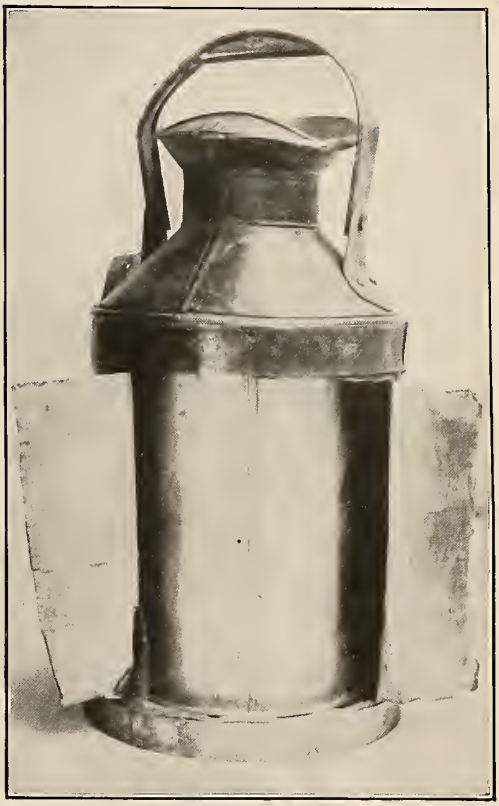

FIG. 7.—*Fraudulent 5-gallon measure (with side partially cut away, showing 3-gallon can inside)*

The purchaser sees only the 5-gallon measure but the 3-gallon measure is the one which is filled—a delivery 40 per cent short resulting.

When the container is not of the standard size of one of the test measures, the test is made as before, except that one of the

measures must be filled more than once, or various measures and the graduate must be used and the error determined on the last amount added. For example, if a bottle is marked "One gallon," the quart must be filled and poured into the container four times, and the shortage, if any, determined on the last measure-full added.

Again, a bottle may be marked "1½ quarts." In this case the quart measure is filled and poured into the container, and then the pint is filled and poured in. In this case the amount remain-

FIG. 8.—*Three bottles of extract (front and side views)*

This shows the impossibility of correctly estimating the quantity of contents from apparent size of the container. The bottle which is apparently smallest holds the most and vice versa.

ing in the pint measure is the total shortage, and this is determined as before.

A container may be marked "12 fluid ounces." As there are 16 fluid ounces in a pint, or 8 fluid ounces in a half-pint, the ½-pint test measure and the 4-ounce graduate may be employed, or the 4-ounce graduate may be filled three times.

(*g*) USE OF GRADUATES.—To avoid mistakes in reading cone graduates, it should be noted that these are sometimes more finely subdivided at the base than at the top. For example, a

4-ounce graduate may be subdivided to ½ dram for the first 2 drams, to 1 dram for the next 6 drams, to 2 drams for the remaining capacity up to 2 ounces, and to 4 drams, or half an ounce, for the interval between 2 and 4 ounces.

In filling the graduate to or reading it at any mark the graduate should be held level, and the readings should be made at the main surface of the liquid. The small amount of liquid which creeps up the sides of the glass to a point higher than the main surface of the liquid in the graduate should be disregarded.

(*h*) RECEPTACLES USED.—The size of a container or receptacle is of importance when a certain amount of liquid commodity in bulk is ordered from the merchant and there is sent to the store a receptacle in which this amount is to be placed. Such containers may not actually hold the amount ordered, yet often the container is filled and the amount *ordered* is charged for. "Gallon" and "half-gallon" oil cans, so-called, are often of a much smaller capacity. "Quart" bottles frequently hold only one-fifth of a gallon, or even less. Pails, demijohns, jugs, and other receptacles are not reliable as measures. Therefore, by means of the measures in the test set, determine the actual capacity of all receptacles that are to be used in buying. See that they contain at least the full amount to be purchased in them.

(*i*) SALE OF DRY COMMODITIES.[1]—Dry commodities, when sold in definite quantities, are commonly sold throughout the country in one of three ways, namely, by weight, by dry measure, or by numerical count. Since the method of sale in the last-mentioned way is usually legal when the commodities are such as are susceptible of sale in this manner, and since the method of buying and checking in retail sales is entirely obvious and presents no difficulties, no further mention will be made of it in the following pages. Sales by liquid measure, while common in some sections, are illegal and are therefore not considered here. It should also be noted that the sale of these commodities by guesswork methods, as by the "bag" or "sack," are also neglected as not being germane to the following discussion. It may be said generally that the

[1] Ordinarily the term "dry commodity" means anything not in liquid form which is bought and sold, but for the sake of conciseness and brevity the term will be used in this circular as limited to those dry products which are susceptible of measurement by dry capacity measures.

purchaser, for his own protection, should always demand some definite amount.

Formerly the more common practice was to sell potatoes, apples, onions, and other similar bulky commodities, as well as dried beans, seeds, and other small commodities, by measure. This was not universally true, since in the States of the Rocky Mountain and Pacific Coast sections such commodities have always been

FIG. 9.—*Comparison of deliveries of "bottomless" type of measure and of the ordinary dry measure (both measures having the same capacity)*

The bottomless measure has so small a diameter that a proper heap can not be obtained. Moreover the small diameter causes stacking, which leaves large unfilled spaces in case of bulky commodities. When the potatoes in the right-hand measure (which contains the correct amount) are transferred to the "bottomless" measure on the left, the potatoes overflowing on the table represent the shortage in delivery of this measure.

sold exclusively by weight, and the growing tendency in the East and Middle West is to sell these commodities in this manner. Massachusetts, Ohio, Wisconsin, and Chicago, for example, have enacted legislation prescribing sales by weight. This is a long step forward, because the use of dry measures is very unsatisfactory and unreliable.

This Bureau strongly advises all purchasers to order dry commodities by weight and to insist that they be sold to them in

this way. This method of dealing, it is believed, will be the prevailing method in the future, since the dry-measure method has always been unsatisfactory not only to the consumer but to the careful merchant as well.

In checking dry commodities by weight it will be necessary to have a list of the weights per bushel included in the laws of the State. These are given for the commoner commodities in Table 9.[2]

FIG. 10.—*Comparison of deliveries of liquid quart and of dry quart*

Dry commodities are often illegally sold by the smaller liquid measure. The beans on the table show the resulting shortage on a quart of commodity so measured.

One need, therefore, only check the weight of the commodity with the weight required by law.

Since it may not be possible in all cases to obtain dry commodities by weight, a set of dry measures is suggested in the household testing outfit. If it is practicable, however, these measures should be omitted.

[2] If a complete list of all commodities for which a legal weight is established by any State is desired, this can be procured from this Bureau upon request for Circular No. 10 of the Bureau of Standards. This circular is revised from time to time and changes made in the light of the latest legislation.

If dry commodities are obtainable only by dry measure, the buyer should understand what he is entitled to when buying in this manner. The majority of the States allowing sales by measure require by law that large or bulky commodities, when sold by measure, be sold by "heaped measure." This term is variously defined as "heaped in the form of a cone, the outside of the measure to be the base of the cone, and such cone to be as high as the article will admit," or "heaped as high as may be without special effort or design." The heaped bushel is usually considered under either of these definitions to be 1¼ "struck" bushels, i. e., in a heaped measure four-fifths of the whole amount of commodity will be contained up to the rim of the measure and one-fifth will be stacked in a conical form above the rim of the measure. Even a larger "heap" than this has been required. Therefore, in checking the delivery of bulky commodities by means of a dry measure, the measure should be well heaped up, since, if it is not, one is not receiving the full amount of commodity to which he is entitled. The term "bulky commodities" is in no case entirely itemized in the law, but includes potatoes, onions, beets, carrots, apples, pears, plums, peaches, Indian corn in the ear, cucumbers, parsnips, green peas unshelled, rutabagas, tomatoes, turnips, and some others. "Struck measure," however, is required for dried beans, peas, and shelled corn, berries and nuts of all kinds, seeds, wheat, oats, rice, and other cereals, etc.

6. State Laws Relating to Dry Commodities

In the matter of the sale of dry commodities, the laws of the various States differ. There is wide divergence in the wording employed in the various statutes, and many have never been interpreted by the higher courts. However, information is given below as to the force and effect which it is believed the legislatures intended to give to the statutes.

(*a*) STATES REQUIRING SALES BY WEIGHT.—Some States have laws requiring that all dry commodities be sold by weight, while others require that those for which a legal weight has been established, be so sold. In the latter class when a unit of dry measure is called for, this must be determined by weight in accordance with the standard schedule of weights per bushel. In some of these

States a special contract may be made by the parties, specifying some other method of sale.

The list of States follows: Florida, Idaho, Indiana, Iowa, Kansas, Massachusetts, Nebraska, Nevada, Ohio, Oregon, South Dakota, Utah, and Wisconsin.

In these States purchasers may demand that all orders be actually weighed before delivery, and that full weight as specified in the State law be delivered. It is desirable for purchasers to check the deliveries by weight and compare them with the standard legal weight.

(*b*) STATES REQUIRING DEFINITE WEIGHTS.—In the second class may be grouped a number of States having statutes similar to each other in wording and apparently similar in legal effect. These statutes read somewhat as follows: "The bushel shall consist of, or will mean, a stated weight," sometimes with the qualification, "When sold by the bushel." This list includes: California, Delaware, Illinois,[3] Kentucky, Michigan, Minnesota, Missouri, Montana, New Jersey, New Mexico, New York, North Dakota, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Vermont, and West Virginia.

In these cases it appears to be the clear intent of the legislatures that the weights stated in the laws should be delivered by the dealers, whether the commodities in question are actually weighed or whether they are measured. Therefore, although the purchaser has no legal right to demand that the commodities be weighed by the dealer before delivery, it appears to be perfectly proper to check delivery by weight and to demand that the legal weight be delivered in all cases. As in the first group, some of these States allow the statute to be superseded by special agreement and, therefore, the purchaser should be careful to refrain from any action from which such agreement might be inferred.

(*c*) STATES ESTABLISHING LEGAL OR STANDARD WEIGHTS.—The next group are those States which establish a legal or standard weight per bushel, usually without a provision for a special agreement clause: Alabama, Arkansas, Colorado, Connecticut, Georgia, Louisiana, Maine, Maryland, North Carolina, and Rhode Island.

[3] In some of the cities of Illinois, notably Chicago, the conditions given under the first class of States obtain, on account of a city ordinance to that effect.

This list is shown separately from that immediately preceding on account of the distinctive wording of the laws. The meaning is not essentially different and therefore the checking should be done in the same way as is suggested there.

(*d*) STATES REQUIRING DEFINITE WEIGHTS FOR SALES BY WEIGHT.—The States in the next list establish a legal weight for various commodities, but specifically limit it to apply to cases where the sale is actually made upon a basis of weight: District of Columbia,[4] Mississippi, New Hampshire, New Jersey, and Virginia.

In these States if the purchaser has not demanded that the transaction be upon a weight basis, the purchase must be checked by the use of dry measures.

(*e*) STATES NOT REGULATING THIS MATTER.—Arizona, Washington, and Wyoming have no law establishing standard weights per bushel or requiring sales of dry commodities by weight.

While dry measures appear to be legal in these States, the usual practice is to sell dry commodities by weight and therefore they will usually be checked by weight.

(*f*) CHECKING DRY COMMODITIES BY DRY MEASURES.—In States of all the above classes if a legal weight for any dry commodity is not established and it is not provided that dry commodities be sold by weight only, the checking must be done by dry measures.

(*g*) INTERPRETATION OF STATE LAWS.—A legal question is presented whether many of the above laws require for fractional parts of the bushel, such as pecks, quarts, etc., the same fractional parts of the legal weight established. However, a reasonable view of the matter would be that such was the intention of the law. Therefore, when a peck, quart, or other fractional part of a bushel is purchased, the weight calculated by multiplying the legal bushel weight by the fractional part of the bushel purchased may be used for checking purposes.

7. Purchasing Commodities

(*a*) IN GENERAL.—When a housewife makes her purchases in person she should watch carefully the manner of selling the commodities in the store, for here frauds can often be avoided, and complaints made at once will be very effective.

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[4] The weight per bushel of potatoes only is established by law in the District.

The first precaution to be observed is always to order a definite amount of a commodity. When practicable, the buyer should avoid asking for a "basket," a "can," or a "pail," since these terms are not definite, or for "10 cents' worth," or a "quarter's worth," etc., since in many such cases he will not know to how much he is entitled, but rather he should specify a "pound," a "quart," a "peck," etc., as the case may be.

Next, the unit price of the commodity should be known, since lack of this knowledge will prevent ascertaining the accuracy of the price charged, even though full weight and measure is delivered.

Also it is businesslike to see that the exact amount in terms of weight or measure is recorded upon your sales slip or bill and not merely the kind of commodity and the total price of the amount delivered.

(*b*) By weight.—In buying commodities by weight, the buyer should note that the scale is correctly balanced before the commodity is put upon it, since many errors or frauds result from scales set "fast."

While the commodity is being weighed the purchaser should read the scale. If it is an equal arm scale operated with loose weights, it must be brought to balance. It should be seen that the proper weights are on the pan. If the scale has a poise sliding over a graduated beam, the beam must balance correctly and the poise be in the proper notch. If the scale is automatic, having a pointer traveling over a reading face, or a graduated face revolving past a fixed point, the amount of weight indicated by the instrument after the pointer or chart has come to rest should be verified.

(*c*) By liquid measure.—In observing sales by liquid measure the buyer should see that the measures are clean, properly filled, and that the *full* amount of the contents is poured out.

(*d*) By dry measure.—In observing sales by dry measure one should see that the measure actually holds its full apparent capacity; for example, that there is no false bottom in it. When the measure has been filled, take care that bulky commodities are not stacked into it in such a way that large spaces are left between the individual units and around the sides of the measure. Bulky commodities should be well heaped up and fine commodities fill the measure level full. Also one should make sure that all of the commodity in the measure is actually delivered.

(*e*) By linear measure.—In observing sales by linear measure the buyer must see that commodities like cloth are not unduly stretched, and if counter tacks are allowed in place of linear measure, that the proper tacks are employed and the measurement is not made from one end to an intermediate tack marking some fractional part of the full length purchased.

(*f*) Checking total price charged.—When the commodity has been weighed or measured, the total price should be checked by multiplying the amount purchased by the unit price so as to

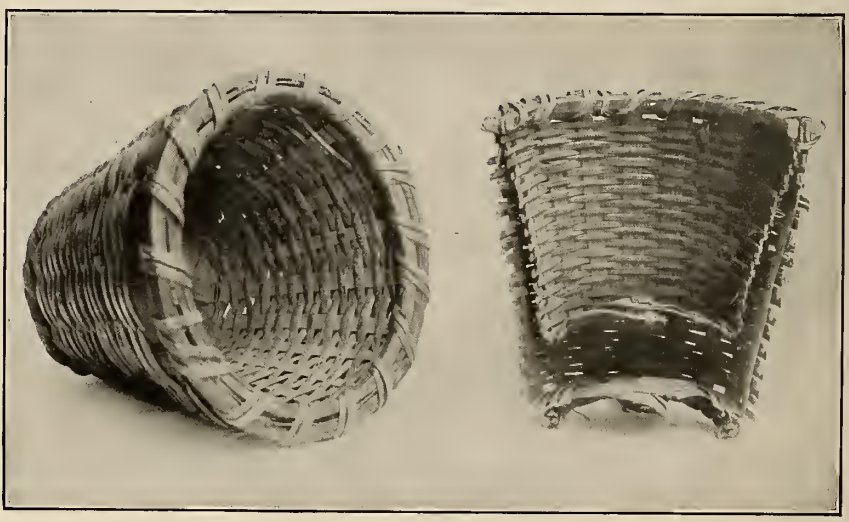

Fig. 11.—*Fraudulent basket (with side partially cut away exposing smaller basket woven inside, making false sides and bottom)*

The purchaser sees only the outside basket but the inside basket is the one that is filled—a delivery short by an amount equal to the difference in sizes resulting.

check any inaccuracy in the dealer's computation. In many sales, especially in the sale of meats, where even pounds are not often delivered, it is very easy for the dealer, either accidentally or with fraudulent intent, to overcharge a few cents on a purchase.

The above precautions are given to assist in preventing the delivery of short amounts, but should not be relied upon to the exclusion of the use of the test set of weights and measures in the home. For it should be remembered that even though the amounts delivered are correct according to the merchant's apparatus, still the accuracy of the latter may be uncertain.

8. Special Methods of Checking Certain Commodities and Containers

(*a*) Coal.—After coal has been delivered, its weight can be checked only roughly. If shortages are suspected, the details should be reported to the local inspector, who should be able to reweigh the coal furnished, or at any rate check the weight of the next delivery, if notified when this will occur. A weight ticket should be furnished by the seller, showing the net weight of the coal claimed to be delivered. The quantity of coal delivered may be roughly checked by ascertaining the amount in the bin, provided this is empty before the new coal is put in. If the bin is rectangular, with a level bottom and vertical sides, this is accomplished as follows: Measure the exact length and the exact width of the bin in feet and fractions of a foot. Then level off the top of the coal and measure its depth in the same unit. The product of the length and width of the bin, multiplied by the average depth of the coal will be the number of *cubic feet of coal* in the bin. Multiply this result by the *weight of the coal per cubic foot*, as given below, and the product will be the approximate number of *pounds* of coal in the bin. This evidence alone would not be accepted by a court, but it may be used to detect gross shortages and as a basis of complaint to the local sealer.

The average weight per cubic foot of anthracite (hard) coal varies with the size into which it is broken, and with the kind of coal or the vein from which the coal comes. The latter variation is nearly 10 per cent, but the figures given below are the average of several different kinds and will probably represent the average coal purchased within 2 or 3 per cent. Red-ash coal is somewhat lighter than that giving white ashes, hence, two sets of values are given below:

Average Weight of Anthracite Coal in Pounds per Cubic Foot

Size	White ash	Red ash
Egg	57.0	53.5
Stove	56.5	52.5
Nut	55.5	52.0
Pea	53.5	51.0
Buckwheat	53.0	50.5

The weight of bituminous (common soft) coal varies even more than that of anthracite, according to the locality from which the coal comes, and about the best figure that can be used is 47 to 55 pounds per cubic foot.

Example.—Find the number of pounds of a white ash anthracite coal of nut size in a bin 6 feet long and 4 feet 3 inches wide, with vertical sides, the coal filling the bin to an average depth of 2 feet 6 inches. Then, following directions and taking from the above table the weight of a cubic foot of white ash nut coal as 55.5 pounds:

Area of bottom = 6 feet by 4.25 feet = 25.5 square feet.
Volume of coal = 25.5 square feet by 2.5 feet = 63.75 cubic feet.
Weight of coal = 63.75 by 55.5 = 3538 pounds.

If in this case 2 tons of coal were charged for, and the measurements were accurately made, the purchaser may be fairly certain that full weight has not been delivered.

In a few localities, notably Maryland, District of Columbia, and Philadelphia, coal is required to be sold by the gross or long ton of 2240 pounds, while in others the net or short ton of 2000 pounds will ordinarily be employed.

(*b*) Wood in cords.—In purchasing wood by the cord one is entitled to and should receive for each cord, wood consisting of or equivalent to a pile, closely stacked, 8 feet in length, 4 feet in breadth, and 4 feet in height. This is true whether the wood is in 4-foot lengths or whether it has been sawed and split before purchasing. This latter point has been much misunderstood in the past, and because wood may shrink somewhat when the 4-foot wood is sawed and split, many dealers have assumed that a lesser amount of wood in this condition may be delivered for a cord. There is no authority for this contention, and it must be considered that a less amount of wood than 128 cubic feet, whatever be its condition at the time of sale and purchase, is not a cord.[5] If, however, one buys a cord of 4-foot wood, *to be sawed*

[5] This is not true in Minnesota, where the law provides as follows (Laws of 1913, chap. 560, sec. 5): "*Standard Measurement of Wood.*—In all contracts for sale of wood, the term 'cord' shall mean 128 cubic feet of wood, in 4 foot lengths; and if the sale is of 'sawed wood,' a cord shall mean 110 cubic feet when ranked, or 160 cubic feet when thrown irregularly or loosely into a conveyance for delivery to the purchaser; and if the sale is of 'sawed and split wood,' a cord shall mean 120 cubic feet, when ranked, and 175 cubic feet when thrown irregularly and loosely into a conveyance for delivery."

and split before delivery, he may only demand 128 cubic feet of 4-foot wood, and must bear whatever natural shrinkage occurs in the process of sawing and splitting.

To check the number of cubic feet of wood in any pile of the shape of a rectangular solid, measure the length, width, and height of the pile in feet and multiply these three dimensions together. The result is the number of cubic feet of wood in the pile. (When the ends of the sticks are beveled, only one-half of the length of the beveled part, usually known as the kerf or scarf, is to be included in the measurement of the width.)

(*c*) Ice.—In checking the weight of deliveries of ice, the best method of procedure is to weigh it immediately upon delivery. If the piece of ice purchased weighs more than the scale will indicate, a rough check can be obtained by multiplying the volume of the cake by the weight per unit of volume.

The weight of ice is 57.5 pounds per cubic foot; or, there are 30 cubic inches in a pound.

The volume of the ice is determined as follows: If the piece furnished is a rectangular solid, that is, having a square or rectangular base and vertical straight sides, accurately measure the length, width, and height of the ice in the same unit, and multiply these dimensions together. The result will be the volume of the ice.

Example.—Find the weight of a piece of ice in the shape of a rectangular solid 15 inches long, 10 inches wide, and 8 inches high. Then, following directions:

Volume, 15 by 10 by 8 inches = 1200 cubic inches.
Weight = 1200 ÷ 30 = 40 pounds.

(*d*) Determining capacity of tanks, boilers, silos, etc.—If it is desired to measure the capacity of a tank an approximate result can be obtained by measuring the dimensions and computing from these the cubical contents. In the following the methods of determining the capacity of cylindrical and of rectangular tanks will be described. Care should be taken not to apply the formulas to tanks of other shapes, since the results obtained would be incorrect.

The measurements should always be of inside dimensions. If outside dimensions are the only ones which can be readily determined, and the thickness of the material is known, the inside

dimensions can be obtained by subtracting the thickness of the walls from these outside dimensions.

(*e*) RECTANGULAR TANK.—In the case of a tank with a rectangular base and vertical straight sides, multiply the length by the width by the height, expressed in the same unit of length.

(*f*) CYLINDRICAL TANK.—In the case of a tank of the shape of a cylinder, the formula for computing the capacity is as follows:

$$\text{Capacity} = 0.785\ d^2h,$$

where d = the diameter and h = the height.

Having determined the diameter and the height of the tank in the same unit; for example, in feet: Square the diameter, that is, multiply it by itself, and multiply the result by the height. Multiply the product by 0.785 and the result is the capacity of the tank in terms of the cube of the unit of length; in this example, cubic feet. (If the circumference is more easily obtained than the diameter, the former may be measured and the diameter computed by means of the formula

$$d = \frac{c}{3.14}$$

where d = the diameter and c = the circumference.)

If the result is desired in gallons or in bushels, the result of the calculation may be reduced to these units as follows:

To reduce cubic inches to gallons divide by 231.

To reduce cubic feet to gallons multiply by 7.48.

To reduce cubic inches to struck bushels, divide by 2150. To reduce to heaped bushels divide by 2750. To reduce cubic feet to struck bushels divide by 1.244; to reduce to heaped bushels divide by 1.59.

(*g*) DETERMINING PERCENTAGE OF SHORTAGE.—The importance of the shortage in a delivery depends upon its amount compared with the total amount of commodity; or, in other words, the percentage of shortage. Thus, a shortage of 1 ounce on a total purchase of 10 pounds is often unimportant. An error of 1 ounce on each of ten 1-pound packages is, however, a serious one, since the shortage on the same total weight of 10 pounds is 10 ounces. The percentage of shortage is determined as follows: Divide the shortage by the total amount of commodity, *expressed in the same*

unit. One hundred times this is the percentage of shortage. This percentage of shortage indicates the number of cents a buyer loses on the dollar by reason of the shortage.

To illustrate the percentage of shortage, consider a shortage of 1 ounce on 10 pounds. The shortage is given in ounces. Therefore, reduce the total amount to ounces, in order to have both figures in the same unit. There are 16 ounces in 1 pound. Therefore in 10 pounds there are 160 ounces. Divide 1 (the shortage) by 160 (the total amount) which gives 0.00625, or 0.625 per cent. Therefore, the total loss on a purchase of one dollar's worth is 0.62 or $\frac{5}{8}$ of a cent. Similarly, a shortage of 1 ounce on a pound would be 6.2 per cent, or 6 cents on the dollar.

FIG. 60.—*Measures used in the kitchen*

For cooking and other purposes in the kitchen, the following capacity measures are useful: A four-ounce glass graduate, a teaspoon measure (with half and quarter fractions), and a cup measure (of glass or metal). The cup measures shown have the same capacity (8 fluid ounces), although the thinner walls of the aluminum measure make it smaller in appearance.

III. KITCHEN MEASURES

1. Kitchen Measuring Appliances

In the kitchen more accurate weights and measures are gradually coming into common use as the units used are becoming better defined. Domestic science departments of schools and colleges are largely responsible for this advance.

The basis of the kitchen system of weights and measures is the standard cup, a measure holding 8 fluid ounces—that is, one-half liquid pint—and used to measure either dry or liquid commodities.

One of these cups, subdivided into thirds, fourths, or both, should be procured, since the ordinary china cups vary greatly in size. A special set of spoon measures (from one-fourth teaspoonful up) will be found convenient, since ordinary spoons also vary in size. Moreover, neither the ordinary cup or spoon is adapted to measuring of fractions of their capacity.

2. Equivalents of Capacity Units Used in the Kitchen

The measures of capacity used in the kitchen are based upon the standard cup, as follows:

3 teaspoonfuls	=	1 tablespoonful=4 drams
4 tablespoonfuls	=	1/4 cupful=2 fluid ounces
1/2 cupful	=	1 gill=4 fluid ounces
2 gills	=	1 cupful=8 fluid ounces
1 cupful	=	8 fluid ounces
2 cupfuls	=	16 fluid ounces
16 fluid ounces	=	1 pint
4 cupfuls	=	1 quart

In the above table all measures are level full. The equivalents given will permit the use of the large glass graduate for measuring liquids in cooking.

In Table 7 are given equivalents of units commonly used in cooking and for other household purposes.

TABLE 7

2. Equivalents of the Common Capacity Units Used in the Kitchen

Units	Fluid drams	Teaspoonfuls	Tablespoonfuls	Fluid ounces	1/4 cupfuls	Gills (1/2 cupfuls)	Cupfuls	Liquid pints	Liquid quarts	Cubic centimeters	Liters	Units
1 fluid dram equals...	1	3/4	1/4	1/8	1/16	1/32	1/64	1/128	1/256	3.7	0.004	Equals 1 fluid dram
1 teaspoonful equals...	1 1/3	1	1/3	1/6	1/12	1/24	1/48	1/96	1/192	4.9	0.005	Equals 1 teaspoonful
1 tablespoonful equals.	4	3	1	1/2	1/4	1/8	1/16	1/32	1/64	15	0.015	Equals 1 tablespoonful
1 fluid ounce equals...	8	6	2	1	1/2	1/4	1/8	1/16	1/32	30	0.030	Equals 1 fluid ounce
1/4 cupful equals.....	16	12	4	2	1	1/2	1/4	1/8	1/16	59	0.059	Equals 1/4 cupful
1 gill (1/2 cupful) equals	32	24	8	4	2	1	1/2	1/4	1/8	118	0.118	Equals 1 gill (1/2 cupful)
1 cupful equals	64	48	16	8	4	2	1	1/2	1/4	237	0.237	Equals 1 cupful
1 liquid pint equals....	128	96	32	16	8	4	2	1	1/2	473	0.473	Equals 1 liquid pint
1 liquid quart equals..	256	192	64	32	16	8	4	2	1	946	0.946	Equals 1 liquid quart
1 cubic centimeter equals	0.27	0.20	0.068	0.034	0.017	0.0084	0.0042	0.0021	0.0011	1	1/1000	Equals 1 cubic centimeter
1 liter equals	270	203	67.6	33.8	16.9	8.45	4.23	2.11	1.06	1000	1	Equals 1 liter

IV. APPENDIXES

Appendix 1. Legal Weights per Bushel of Various Commodities

Jurisdiction concerned	Apples									Corn									
	Apples [a]	Apples, dried	Barley	Beans [a]	Beets	Blue-grass seed	Buckwheat	Carrots	Clover seed	Corn [a]	Indian or maize	Shelled	Corn meal [a]	Cotton seed [a]	Cranberries	Cucumbers	Flaxseed (linseed)	Hemp seed	Hungarian grass seed
Federal Government	[b]50		[b]48	[b]60			[b]42			[b]56							[b]56		
Alabama		24	47	60								56	[c]46	32					
Arizona																			
Arkansas	[d]50	24	48	[c]60		14	52		60			56	48	33½			56		
California			50				40				52								
Colorado			48	60		14	52		60		56		50					44	
Connecticut	48	25	48	60	[f]60		48	50	60		56		50	[g]44			55		
Delaware											56		[c]44						
District of Columbia																			
Florida	[d]48	24	48	[h]60								56	48	[i]32					
Georgia		24	47	[c]60		14	52		60			56	[c]48	30			56	44	
Hawaii			48								56								
Idaho	[d]48	24	48	60	56	[j]14	50	50	60		[k]70	56	48				56	44	50
Illinois	[d]50	24	48	[c]60	60	14	52	50	60		56	56	[l]48	32	33	48	56	44	50
Indiana	48	25	48	60	60	14	50	50	60			56	50		33	48	56	44	
Iowa	48	24	48	[m]60	56	14	48	50	60	[n]50		56	48			48	56	44	50
Kansas	50	24	48	60	60	[j]14	48	50	60		[k]70	56				48	56	44	
Kentucky		24	47	[c]60		14	56		60			56	50				56	44	50
Louisiana			32							56									
Maine	44	25	48	60	60		48	50	60	56			50	[g]44			56	44	48
Maryland	[d]50	28	48	[m]60		14	48	50	60			56	48				56	44	50
Massachusetts	48	25	48	60	60		48	50	60		56	[o]50	50	[g]44	32		55		
Michigan	48	22	48	60		14	48		60			56	50		40		56	44	50
Minnesota	[d]50	28	48	60	50	14	50	45	60	[n]48		56			36	48	56	50	48
Mississippi		26	48	[c]60		14	48		60			56	[c]44	32			56	44	50
Missouri	48	24	48	60		14	52	50	60			56	50	33		48	56	44	48
Montana	45		48	60	50	14	52	50	60			56	50				56	44	50
Nebraska	48	24	48	[m]60	56	[j]14	50	50	60	[n]50	[k]70	56	48			48	56	44	
Nevada	[d]48	24	48	60	56	[j]14	50	50	60		[k]70	56	48				56	48	50
New Hampshire	48	25	48	[p]60	60		48	50	60	[o]50	56		50		32		56		
New Jersey	48	25	48	60	60	14	48	50	60		56		50	[g]44	32	48	56	44	50
New Mexico	45	24	48	60	56	14	52	50	60	56	56		50	32		48	56	44	50
New York	48	25	48	60			48	50	60		56		50	[g]44			55		
North Carolina	[d]48	24	48	[q]60	50	14	50	50	[r]60		56			[i]30		48	56	44	48
North Dakota	50	28	48	60	60	14	42	45	60			56			36	48	56	50	48
Ohio	48	24	48	60	56		50	50	60		[k]68	56	48				56	44	50
Oklahoma	48	24	48	60	60	14	52	50	60			56	50	32		48	56	44	48
Oregon																			
Pennsylvania	45	25	47	[m]60	56	14	48	50	60			56	50		40	50	56	44	50
Rhode Island	48	25	48	60	50		48	50	60			56	50	[g]44			56	44	50
South Carolina	[d]50	24		[m]60	50	14	50	50	[r]60			56	[c]48	[s]30		48	56	44	48
South Dakota	48	24	48	[m]60	56	14	48	50	60	56			50			48	56	44	50
Tennessee	[d]50	24	48	[m]60	50	14	50	50	[r]60			56	[c]50	28		48	56	44	48
Texas	[d]50	28	48	[c]60	60	14	52	50	60			56	[c]50	32	32	48	56	44	48
Utah																			
Vermont	48		48	60	60		48	50	60		56	56	50		32	48	55		50
Virginia		28	48	[q]60		14	48	50	60			56	48	30			56	44	48
Washington	[d]45	28	48				42		60		56						56		
West Virginia	[d]48	24	48	[m]60	56	14	52	50	60	56			[t]48	[i]32	36	[u]50	56	44	50
Wisconsin	44	25	48	60	50	14	50	50	60		56		50	[v]44	35	[u]50	56	44	48
Wyoming																			

[a] Not defined.
[b] For customs purposes only.
[c] Bolted; unbolted, 48 pounds.
[d] Green apples.
[e] White beans.
[f] Sugar beets and mangel-wurzel.
[g] Sea-island cotton seed; upland cotton seed, 30 pounds.
[h] Shelled.
[i] Sea-island cotton seed, 44 pounds.
[j] Native blue-grass seed; English blue-grass seed, 22 pounds.
[k] Indian corn in ear.
[l] Unbolted, 48 pounds.
[m] Dried beans.
[n] Sweet corn.
[o] Cracked corn.
[p] Small white beans.
[q] Soy beans.
[r] Red and white.
[s] Seed of long staple cotton, 40 pounds.
[t] Bolted, 46 pounds.
[u] Green.
[v] Sea-island cotton seed.

Appendix 1. Legal Weights per Bushel of Various Commodities—Continued

Jurisdiction concerned	Millet	Oats	Onions		Orchard grass seed	Parsnips	Peaches[a]	Peanuts (or ground peas)	Pears[a]	Peas		Potatoes		Rye	Timothy seed[t]	Tomatoes	Turnips[a]	Wheat
			Onions[a]	Onion sets						Green peas, unshelled	Peas[a]	Potatoes	Sweet Potatoes					
Federal Government		[b]32	[b]57				[b]50		[b]50		[b]60			[b]56				[b]60
Alabama		32									60	60	55	56			55	60
Arizona																		
Arkansas	50	32	57		14						60	60	50	56	60		57	60
California		32												54				60
Colorado		32	57									60		56	45			60
Connecticut		32	52			45					60	60	54	56	45		[c]50	60
Delaware																		60
District of Columbia												60						
Florida	50	32	56				[d]54	22	55			60	56	56			54	60
Georgia		32	57					25			60	60	55	56	45		55	60
Hawaii		32												56				60
Idaho	50	32	57				48				[e]60	60	50	56	45	56	55	60
Illinois	50	32	57	[f]30	14	50	48	[g]20	58	32	[h]60	60	50	14	56	45	56	55	60
Indiana	50	32	57		14	55	48		50			60	55	14	56	45	60	55	60
Iowa	50	32	52	[f]28	14	45	48	22	45	50	[h]60	60	50	14	56	45	50	55	60
Kansas	[i]50	32	57				48		45		[e]60	60	50		56	45	56	55	60
Kentucky	50	32	57	[j]36	14			24			60	60	55		56	45		60	60
Louisiana		32													32				60
Maine	50	32	52		14	45	48	[g]20	58		60	60	54	14	56	45	56	[e]50	60
Maryland	[k]50	32	54		14	40	[l]40	22			[m]60	60	60	14	56	45	60	60	60
Massachusetts		32	52			45	48	[g]20	58	28	[n]60	60	54		56	45	56	55	60
Michigan	50	32	54		14						60	60	56	14	56	45		58	60
Minnesota	48	32	52	[f]28	14	42	48	22	45		[n]60	60	55	14	56	45	50	55	60
Mississippi	50	32	57					24			60	60	54		56	45		55	60
Missouri	50	32	57	[o]28	14	44	48		48	56	[p]60	60	56	14	56	45	45	[q]42	60
Montana		32	57			50			45		60	60			56	45		50	60
Nebraska	50	32	57	[f]28	41	50	48	22	45		[h]60	60	50	14	56	45	56	55	60
Nevada	50	32	57			50	48				[e]60	60	50		56	45	56	56	60
New Hampshire		32	52			45	48	[g]20	58		60	60	54		56	45	56	55	60
New Jersey	50	32	57	[o]28	14	50	48	[g]20	58		[h]60	60	54	14	56	45	56	55	60
New Mexico	50	32	57	[f]30	14	42	48	22	48		60	60	50		56	45	50	56	60
New York		32	57								60	60	54		56	45			60
North Carolina	50	32	[r]57	[f]28	14	50	[r]50	22	[r]56		[h]60	56	56	14	56	45	56	50	60
North Dakota	50	32	52	[f]28	14	42		22	45		60	60	46		56	45	50	60	60
Ohio	50	32	56	[s]28		50	48				60	60	50		56	45	56	60	60
Oklahoma	50	32	57	[o]28	14	44	48	22	48	56	60	60	55	14	56	45	45	[q]42	60
Oregon																			
Pennsylvania	50	32	50	[s]28	14	50	48	22	50	56	[h]60	60	54	14	56	45	60	60	60
Rhode Island	50	32	50			50	48				60	60	54		56	45	56	50	60
South Carolina	[t]50	32	[r]56	[f]28	14	50	[r]50	23	36		[h]60	60	50	14	56		56	50	60
South Dakota	[t]50	32	52	[f]30	14	48	48	20	45	50	[h]60	60	54	14	56	45	50	55	60
Tennessee	[t]50	32	[r]56	[u]28	14	50	[r]50	23	[r]56	30	[h]60	60	50	14	56	45	56	50	60
Texas	50	32	57	[f]30	14	50	50	[g]20	58		60	60	55	14	56	45	55	55	60
Utah																			
Vermont	50	32	52			45	48	[g]20	58	48	60	60	54	14	56	45	56	60	60
Virginia	50	32	57		14	50		22			[v]60	56	56	40	56	45	60	55	60
Washington		32							[w]45			60			56				60
West Virginia	50	32	55	[f]28	14	42	48	23	50		[h]60	60	50	14	56	45	56	55	60
Wisconsin	50	32	50	[s]32		44	48		48		60	60	54	14	56	45	56	42	60
Wyoming																			

a Not defined.
b For customs purposes only.
c Common English turnips.
d Green peaches.
e Shelled, dry.
f Top sets; bottom sets, 32 pounds.
g Roasted; green, 22 pounds.
h Dried.
i Hungarian.
j Bottom onion sets.
k German and American.
l Peaches (peeled); unpeeled, 32 pounds.
m Cowpeas; dried peas, 60 pounds.
n Smooth; wrinkled, 56 pounds.
o Top onion sets.
p Including split peas.
q Common turnips.
r Matured.
s Not stated whether top or bottom sets.
t German, Missouri, and Tennessee millet seed.
u Bottom onion sets, 32 pounds.
v Black-eyed and other cowpeas.
w Green.

APPENDIX 2

TABLES OF WEIGHTS AND MEASURES

Apothecaries' Fluid Measure

60 minims = 1 fluid dram
8 fluid drams = 1 fluid ounce
16 fluid ounces = 1 liquid pint
8 liquid pints = 1 gallon
(British measures differ from above)

Apothecaries' Weight

20 grains = 1 scruple
3 scruples = 1 dram
8 drams = 1 ounce
12 ounces = 1 pound

Avoirdupois Weight

27 11/32 grains = 1 dram
16 drams = 1 ounce
16 ounces = 1 pound
25 pounds = 1 short quarter
28 pounds = 1 long quarter
4 quarters = 1 hundredweight { short hundredweight = 100 pounds; long hundredweight = 112 pounds }
20 hundredweight = 1 ton { short ton = 2000 pounds; long ton = 2240 pounds }

Circular Measure

60 seconds = 1 minute
60 minutes = 1 degree
90 degrees = 1 quadrant
4 quadrants = 1 circle or circumference

Cubic Measure

1728 cubic inches = 1 cubic foot
27 cubic feet = 1 cubic yard
144 cubic inches = 1 board foot
128 cubic feet = 1 cord

Dry Measure

2 pints = 1 quart
8 quarts = 1 peck
4 pecks = 1 bushel
1 barrel (for fruit, vegetables, and other dry commodities) = 7056 cubic inches = 105 dry quarts

Kitchen measures. See Section 3, page 35

Linear Measure

12 inches = 1 foot
3 feet = 1 yard
5 1/2 yards = 1 rod or pole
40 rods = 1 furlong
8 furlongs = 1 statute mile (1760 yards, or 5280 feet)
3 miles = 1 league

Linear Measures (special)

1000 mils = 1 inch
72 points = 1 inch
4 inches = 1 hand
7.92 inches = 1 surveyor's link
9 inches = 1 span
6 feet = 1 fathom
40 yards = 1 bolt (cloth)
10 chains = 1 furlong
6080.20 feet = 1 nautical mile = 1.1516 statute miles

Liquid Measure

4 gills = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
31 1/2 gallons = 1 barrel
2 barrels = 1 hogshead

Paper Measure

For small papers the old measure is still in use:

24 sheets = 1 quire
20 quires = 1 ream (480 sheets)

For papers put up in cases, bundles, or frames the following measure is now used:

25 sheets = 1 quire
20 quires = 1 standard ream (500 sheets)

Square Measure

144 square inches = 1 square foot
9 square feet = 1 square yard
30 1/4 square yards = 1 square rod or perch
160 square rods = 1 acre
640 acres = 1 square mile
36 square miles = 1 township (6 miles square)

Surveyor's Measure

7.92 inches = 1 link (Gunter's or surveyor's)
100 links = 1 chain (=66 feet)
80 chains = 1 mile

Surveyor's Area Measure

625 square links = 1 (square) pole or square rod
16 (square) poles = 1 square chain (surveyor's)
10 square chains or 160 square rods = 1 acre
640 acres = 1 square mile
36 square miles = 1 township

Time Measure

60 seconds = 1 minute
60 minutes = 1 hour
24 hours = 1 day
7 days = 1 week
365 days = 1 year
366 days = 1 leap year

Troy weight

24 grains = 1 pennyweight
20 pennyweights = 1 ounce
12 ounces = 1 pound (Troy)

Carat (for precious stones) = 200 milligrams. The carat was formerly an ambiguous term having many values in various countries.

Karat (fineness of gold) = 1/24 (by weight) gold. For example, 24 karats fine = pure gold; 18 karats fine = 18/24 pure gold.

International Metric System

In the international metric system the fundamental unit is the meter—the unit of length. From this the units of capacity (liter) and of weight (gram) were derived. All other units are the decimal subdivisions or multiples of these. These three units are simply related; e. g., for all practical purposes 1 cubic decimeter equals 1 liter and 1 liter of water weighs 1 kilogram. The metric tables are formed by combining the words "meter," "gram," and "liter" with the six numerical prefixes, as in the following tables:

Prefixes		Meaning		Units
milli-	= one thousandth	$\frac{1}{1000}$	0.001	"meter"[a] for length
centi-	= one hundredth	$\frac{1}{100}$	.01	
deci-	= one tenth	$\frac{1}{10}$	.1	
Unit	= one		1	"gram"[a] for weight or mass
deka-	= ten		10	
hecto-	= one hundred		100	
kilo-	= one thousand		1000	"liter"[a] for capacity

[a] One meter = 39.37 inches; 1 liter = 1.0567 liquid quarts: 1 gram = 0.035 avoirdupois ounce.

UNITS OF LENGTH		UNITS OF CAPACITY		UNITS OF WEIGHT (OR MASS)	
millimeter=	0.001 meter	milliliter=	0.001 liter	milligram=	0.001 gram
centimeter=	.01 "	centiliter=	.01 "	centigram=	.01 "
decimeter=	.1 "	deciliter=	.1 "	decigram=	.1 "
METER=	1 "	LITER=	1 "	GRAM=	1 "
dekameter=	10 "	dekaliter=	10 "	dekagram=	10 "
hectometer=	100 "	hectoliter=	100 "	hectogram=	100 "
kilometer=	1000 "	kiloliter=	1000 "	kilogram=	1000 "

UNITS OF AREA

The table of areas is formed by squaring the length measures, as in our common system. For land measure 10 meters square is called an "ARE" (meaning "area"). The side of one are is about 33 feet. The hectare is 100 meters square, and, as its name indicates, is 100 ares, or about 2 1/2 acres.