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Written by Jim Andrew in the late 1970s and reworked by him in 2008

OLD WEIGHTS AND MEASURES

"A pound of iron weighs more than a pound of gold but an ounce of iron weighs less than an ounce of gold." This statement was true before 1879 and is one example of the problems of old weights and measures.

The efficiency of early steam engines was expressed as the "duty" which was the weight of water in pounds that the engine could raise one foot by burning one bushel of coal. Were the pounds 'Troy' or 'Avoirdupois'? Troy was usually only used for precious metals but it had been used to weigh bread and some one might therefore use it to weigh water. The foot was virtually standard from 1300 but there were many different bushels available, giving a weight of coal from 79 lbs to 94 lbs.

This museograph will give the history of some of the weights and measures to be found or mentioned in the Museum. Tables of measures and conversions between measures will be given as well as some indication of the uses of those measures. Unfortunately it seems that, in the past, people used any convenient weight or measure which was available so that it can be very difficult to be precise about some quantities.

LENGTH

The foot is probably the longest serving identifiable measure in use today. The Greek foot was standardised at 12.14 of our inches by 440 B.C. The Roman foot was a little shorter at 11.7 of our inches. Unfortunately by Mediaeval times, though the foot was in use throughout Europe, there were very many different standards. The "Rhineland Foot" of over 13 of our inches, was used in the U.K. alongside the present English foot until 1500. The English foot was defined as 1/3rd of a yard by Edward I (1272-1307). Most of the different European feet were abandoned when the metric system was adopted last century but references to them may well be found in documents relating to the Industrial Revolution and to early scientific discoveries.

The inch is derived from the Roman "uncia" or one twelfth of a foot. The yard is derived from the Anglo-Saxon "gyrd" or (Measuring) stick and seems to have been fixed at about our yard since 1066. The Roman mile was 1,620 of our yards while our mile was fixed at 1,760 yards about 1550.

For many years the yard was fixed by the length of the Imperial Standard Yard, which was a metal bar kept in London, but the yard is now defined as 0.9144 metres and the metre is 1,650,763.73 wavelengths of the radiation from the Krypton-86 atom under specified conditions.

Normal Imperial Measurements of Length are;-

12 inches make 1 foot

3 feet make 1 yard

22 yards make 1 chain

10 chains make 1 furlong

8 furlongs make one mile of 1,760 yards

Other Measures were:-

100 links (each 7.92 inches) make 1 chain

5½ yards make one rod, pole or perch

a 'hand' (used to measure horses) is 4 inches

a league is 3 miles

a fathom is 6ft. or 2 yards

a cable is one tenth of a nautical mile

a nautical mile is 6,080 feet

In Ireland the perch was 7 yards and the mile was 2,240 yards.

Cloth Measure used the same yard as length measure but differently subdivided

2¼ inches make 1 nail

3 quarters make 1 Flemish ell

4 nails make 1 quarter

5 quarters make 1 English ell

4 quarters make 1 yard

6 quarters make 1 French ell

Different fabrics were measured in different ells and could even be bought by Flemish ell and sold by English ell.

AREA

The areas of small shapes are not too difficult to measure and calculate but irregular areas of land caused problems for many years. Land was measured by the amount of grain needed to sow it or of oxen to plough it. Eventually the area that a pair of oxen could plough in a day became known as an acre which is now defined as 4,840 square yards:

1 sq. ft. = 144 sq. inches 1 sq. yard = 9 sq. ft.

1 sq. pole or rod = 30¼ sq. yards (5½ x 5½)

1 chain (area) = 1 chain length x 1 chain length = 484 sq. yards

1 rood = 2½ chains (area) = 1210 sq. yards

1 acre = 4,840 sq. yards

1 sq. mile = 640 acres = 3,097,600 sq. yards.

ANGLES

Most people are used to measuring angles in degrees with 90° equal to a right angle and 360° in a circle. The degree is divided into 60 minutes (written 60') and each minute is divided into 60 seconds (written 60").

There are two other methods for measuring angles which may be encountered. The more common unit is the radian which is the angle that gives an arc equal to its radius. Thus one radian is 57.296° and it is subdivided in decimals.

A French system was developed, when the metric system was introduced where a right-angle was divided into 100 grades (written 100^g) and each grade was divided into 100 centigrades (not to be confused with a temperature which is now referred to as Celsius).

WEIGHT

The Roman standard of weight was a copper bar known as an "as" or "libra". Our abbreviation 'lb' for a pound comes from the libra and our ounce from the Roman "uncia", a twelfth part of a libra. By Mediaeval times the pound was in almost universal use but nearly every country defined it differently. The pound was also used as a unit of money and as capacity.

In 1303 the Assize of Weights and Measures in England decreed that "an English penny shall weigh 32 grains of wheat dry and twenty pence make an ounce. 12 ounces make a pound and a gallon of wine weighs 8 pounds. 8 gallons make a London bushel." This pound was the Tower pound so that the pound (money) was a pound weight of silver and made 240 silver pennies.

Towards the end of the fourteenth century two different pounds were introduced. The pound Troy, from the town of Troynes in France and the pound Avoirdupois, from the French for heavy goods. These pounds influenced U.K. weights up to metrication.

The pound which we normally use was defined as the weight of the "Imperial Standard Avoirdupois Pound" kept in London but is now defined as 0.45359237 of the International Prototype Kilogramme which is kept in Paris.

The common factor to the systems used in the U.K. in the last three or four centuries is the "grain".

Avoirdupois weights were used for all "normal weighing"

437½ grains made 1 oz. (ounce)

16 oz. (7000 grains) made 1 lb. (pound)

14 lb. make 1 stone

2 stones make 1 quarter

4 quarters make 1 cwt. (hundred weight) of 112 lb.

20 cwt. make 1 ton of 224 lb.

Troy weights were used for precious metals, jewels, bread (until the 18th century) and in some philosophical (scientific) experiments.

24 grains make 1 dwt. (pennyweight)

20 dwt. make 1 oz.

12 oz. make 1 lb. of 5760 grains

Thus 1 lb. Troy = 0.82 lb. Avoirdupois

and 1 oz. Troy was abolished in 1878 and the dwt. in 1968. Decimal divisions of the oz. Troy were adopted from c1900.

Apothecaries weights used the same oz. and lb. as Troy but with different subdivisions. They were used for weighing medicines when making up prescriptions.

20 grains made 1 scruple

3 scruples made 1 dram

8 drams made 1 oz.

12 oz. made 1 lb.

This system went out of use c1900.

CAPACITY

Two types of capacity measure were developed with one to measure liquids and the other for solids such as seed, grain, salt, sand, coal and shellfish. Some quantities were common to both systems but were not necessarily of the same size. Many different standards existed until the Weights and Measures Act of 1824 set new standards though many of the old standards were used until the end of the 19th century.

The Imperial Gallon is derived from the old ale gallon while the U.S. gallon is derived from the old wine gallon.

Liquid Measure (Imperial post 1824)

4 gills make 1 pint

2 pints make 1 quart

4 quarts make 1 gallon (of 277.274 cubic inches)

1 firkin or quarter barrel is 9 gallons

1 Kilderkin or half barrel is 18 gallons

1 Barrel is 36 gallons

1 Hogshead of ale is 54 gallons

1 Hogshead of wine is 63 gallons

1 Pipe is 126 gallons

1 Tun is 252 gallons

Older Measures

1 ale gallon was 282 cubic inches Pre 1688 1 barrel of beer was
36 gallons

1 wine gallon was 231 cubic inches 1688 - 1803 1 barrel of beer or
ale was 34 gallons

1 Hogshead of wine could be 43 to 46 gallons

8 gallons made 1 Firkin of ale 1803 - 1824 1 barrel of ale
or beer was 36 gallons

9 gallons made 1 Firkin of beer A ton of shipping was 42 cubic feet

Pre 1688 1 barrel of ale was 32 gallons

Dry Measure (Imperial post 1824)

2 pints make 1 quart

2 quarts make 1 pottle

2 pottles make 1 gallon (of 269 cubic inches)

2 gallons make 1 peck

4 pecks make 1 bushel of 2150.4 cubic inches

8 bushels make 1 quarter of corn

36 bushels make 1 chaldron of coal

The Winchester or standard bushel was a cylinder of 18 1/2 inches diameter and 8 inches deep.

After 1st January 1836 coal was only to be sold by weight and not volume but, though a "weight bushel" was adopted, it was not very uniform.

1 Cornish bushel was 94 lbs. of coal (Leans Engine Report)

1 London bushel was 82 1/2 lb. of coal

1 Standard bushel was 86 lbs. of coal

1 Imperial bushel was 79 to 82 lb. of coal

1 Winchester bushel was 79 to 82 lb. of coal

The London Imperial Chaldron was 25 cwts. of coal but the Newcastle Chaldron was 53 cwts. of coal.

In 1793 a bushel of water was said to be 5 pecks.

The following statement of measures was printed in Gulch's "Literary and Scientific Register and Almanack" in 1872 and should be remembered by all who research matters involving old weights and measures!

The Winchester Bushel contains 2150.42 cubic inches, or 4 pecks; the *Waterside* measure contains 5 pecks. The old standard Scotch pint or sterling jug contains about 104 cubic inches, or 3 imperial pints; and the Scotch gallon contains 3 imperial gallons. The Scotch wheat firloft contains 24¾ Scotch pints; and the Scotch barley firloft, 31 Scotch pints. In Chester wheat is sold at 75 lbs. the

bushel, or 9.23-28 gallons. In Cornwall (Launceston and Callington) the customary bushel is 16 gallons; at Helston, Falmouth, St. Austell, and Truro, the bushel consists of 24 gallons; at Redruth it is sold per 196 lbs. Cornish bushel; at St. Columb. 186 lbs, and at Bodmin, 62 lbs., per imperial bushel. In Devon a sack contains 40 gallons, a bag 16 gallons (in some parts 32 gallons); at Hertford wheat is sold sometimes by the bushel of 8 gallons, sometimes by the old bushel of 10 gallons, sometimes by weight, varying from 62 lbs. imperial, or 64 lbs. Winchester, to 80lbs. old 10 gallons; in Norfolk, by the coomb of 4 bushels; in Northumberland (Alnwick, Morpeth, and Hexham markets) per new boll of 16 gallons; in Bedford and Wooller markets by the old boll of 48 gallons; in Salop the bushel is 75 lbs. net; York (North Riding), 63 lbs. per bushel; West Riding, at Wakefield corn exchange, per bushel of 60 lbs.; at the farmers market, per the load of 3 bushels or 24 gallons measure, or load weighing 12 stone 12 lbs. (or 180 lbs.) to 14 stone (or 196 lbs.); at Leeds, Barnsley, Pontefract, Doncaster, Selby, Otley, Knaresborough, Ripon, Skipton, and Snaith, the same as at one or the other of Wakefield markets; Wales (Anglesea), at 63 lbs. per bushel; at Brecon, by the bushel of 8 gallons and the bushel of 10 gallons; Cardigan, 63 lbs.; Carmarthen, 64 lbs; Flint, by the hobbit of 21 gallons, or 168 lbs.; Glamorgan (borough of Swansea), by the bushel or sack of 24 gallons, or by a measure called 'a peck', containing 6 gallons. In the eastern part of the county there is also a bushel measure in use called 'the Welsh Bushel'. In Montgomery and Radnor the bushel is 10 gallons, or 80 lbs weight. All local weights and measures are abolished, and a standard adopted that all grain, meal, flour, butter, and potatoes shall be sold by the Avoirdupois, by the score of 20 lbs., by the cwt. of 100 lbs., and by the ton of 2,000 lbs.; and that all hay, straw, turnips, and mangold-wurtzel shall be sold by Avoirdupois, by the score of 20 lbs., by the cwt. of 100 lbs., and by the ton of 2,000 lbs.

CONCLUSION

The details given above illustrate the problems associated with old weights and measures. It is hoped that the reader will not be misled by old documents. There are many other old measurements such as fothers, bolls and tods which have not been mentioned but may be found in the books listed below. The Museum has some experience in dealing with old weights and measures and anyone who is having problems in tracing a particular quantity is invited to write to the Museum for assistance.

Jim Andrew
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ORIGINAL SOURCES

"The Schoolmaster's Assistant" T. Dilworth 1793
"Ures's Dictionary of Arts, Manufactures and Mines" 187'?

MODERN BOOKS

1. "Man and Measurement" K. Ellis 1973 - A very reasonable general account but without any tables of weights and measures.
2. "British Weights and Measures - A History from Antiquity to the 17th Century"
R. E. Zupko. A very good reference book with many excellent tables of British quantities and extensive lists of foreign weights and measures.
3. "The Law of Weights and Measures" O'Keefe 1966. A useful introductory section on early regulations. The body of the book is rather heavy reading but excellent for checking the legality of quantities used in the U.K.
4. "Unite of Measurement - An Encyclopaedia Directory" S. Dresner 1971. All modern units and some old ones are listed and defined.
5. "Scales and Weights - A Historical Outline" B. Kisch 1975. Good coverage of the subject with many excellent illustrations.
6. "The Weights and Measures of England" R. D. Connor 1987. Good coverage of subject and well illustrated.