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The young gauger's best instructor

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Gauging performed both by the pen and sliding-rule.

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GAUGING

Performed both by the

P E N

AND

SLIDING-RULE.



IT is necessary that the young Gauger be well acquainted with the following Definitions, and that he should understand not only how to take dimensions, (which is best learned by practice) but also how to divide any irregular figure, or superficies, as **Brewers BACKS, TUNS, COOLERS, &c.** into the easiest and fewest regular figures they will admit of, that so their areas may be computed with the least trouble.

DEFI.

DEFINITIONS.

1. A **Point** is that which hath no parts, and is the very beginning of magnitude.

2. A **Line** is generated or produced by the motion of a point, and is supposed to have length without breadth.

3. A **Plain Surface**, or **Superficies**, is generated by the motion of a line, and hath length and breadth only.

4. A **Convex Superficies** is generated by the motion of a curve or crooked line, and may be well represented by the outside of a bowl.

5. A **Concave Superficies** is also generated by the motion of a curve or crooked line, and is truly represented by the inside of a bowl.

Note, The superficies of any thing is usually called its area.

6. A **Solid** is generated by the motion of a superficies, and is that which hath length, breadth, and thickness.

7. Two lines are said to be **Parallel**, when they are equally distant one from another in all their parts.

8. When one line is inclined towards another line in such manner, as if either or both were continued, they would meet; then the opening of these lines is called an angle; and according as those lines are nearer, or stand further off each other, that angle is said to be greater or lesser.

9. When one line standeth so on another, as to incline to neither side, but maketh the angles on each side thereof equal, each of those angles are called right angles; and the line so standing on the other, is called a perpendicular.

10. An *Obtuse Angle* is that which is greater than a right angle.

11. An *Acute Angle* is that which is less than a right angle.

Note, That in gauging, all superficieses or areas are always understood to be one inch deep, otherwise it could not be said, (as in the gaugers language it is) that the area of such a square or of such a circle, &c. is so many gallons.

Hence, all square inches mentioned in this treatise, are such squares [or rather cubes] whose lengths, breadths, and depths, are 1 inch.

And all circular inches, are such circles [or rather cylinders] whose diameters are 1 inch, and depths 1 inch.

How to Gauge all manner of SUPERFICIES.

To Gauge a Square.

Definition.

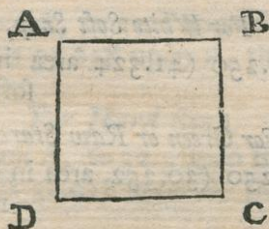
A square has four equal sides, and four right angles.

Rule.

Multiply the given side by itself, and the product will be the area in square inches, which divide by 144 for feet, 282 for ale gallons, 231 for wine gallons, 2150 for malt bushels, and for the new duties, as in the table, at page the 83d, &c.

Example.

Suppose the side A, B of the square A B C D, be 32.5 inches, what the area in feet, ale, wine, malt, tallow, &c.



Operation.

First, 32.5 multiplied by 32.5 is 1056.25, the area in square inches; then,

For

For Feet.

144) 1056.250 (7.335 area in feet.

For Ale or Beer.

282) 1056.250 (3.958 area in ale gallons.

For Wine or Cyder.

231) 1056.250 (4.572 area in wine gallons.

For Malt or Corn.

2150) 1056.250 (.491 area in malt bushels.

*For Tallow grofs.*30.28) 1056.250 (34.882 area in lb. of tallow
grofs.*For Tallow neat.*31.4) 1056.250 (33.638 area in lb. of tallow
neat.*For Hard Soap.*27.14) 1056.250 (38.918 area in lb. of hard
soap.*For Green Soft Soap.*25.67) 1056.250 (41.147 area in lb. of green
soft soap.*For White Soft Soap.*25.56) 1056.250 (41.324 area in lb. of white
soft soap.*For Green or Raw Starch.*34.8) 1056.250 (30.352 area in lb. of green or
raw starch.*By the Sliding-Rule.*

Set the proper divisor upon A, to the side of
the square upon B; then against the side of the
square upon A, you have the area upon B.

Operation.

For Feet.

Set 144 upon A, to 32.5 upon B; then against 32.5 upon A, is 7.335 upon B, the area in feet.

For Ale or Beer.

Set 282 upon A, to 32.5 upon B; then against 32.5 upon A, is 3.958 upon B, the area in ale gallons.

For Wine or Cyder.

Set 231 upon A, to 32.5 upon B; then against 32.5 upon A, is 4.572 upon B, the area in wine gallons.

For Malt or Corn.

Set 2150 upon A, to 32.5 upon B; then against 32.5 upon A, is .491 upon B, the area in malt bushels.

For Tallow grofs.

Set 30.28 upon A, to 32.5 upon B; then against 32.5 upon A, is 34.882 upon B, the area in lb. of tallow grofs.

For Tallow neat.

Set 31.4 upon A, to 32.5 upon B; then against 32.5 upon A, is 33.638 upon B, the area in lb. of tallow neat.

For Hard Soap.

Set 27.14 upon A, to 32.5 upon B; then against 32.5 upon A, is 38.918 upon B, the area in lb. of hard soap.

For Green Soft Soap.

Set 25.67 upon A, to 32.5 upon B; then against 32.5 upon A, is 41.147 upon B, the area in lb. of green soft soap.

For

For white Soft Soap.

Set 25.56 upon A, to 32.5 upon B; then against 32.5 upon A, is 41.324 upon B, the area in lb. of white soft soap.

For Green or Raw Starch.

Set 34.8 upon A, to 32.5 upon B; then against 32.5 upon A, is 30.352 upon B, the area in lb. of green or raw starch.

Note, You may find the area of a square in all these denominations at one set of the rule, by the lines C and D; thus,

First, put the sliding-piece C, the reverse way into its place, then, set unity on the line C, to the side of the square upon D; and against the several gauge-points for squares (as in the table at page 83) upon D, you have the area upon C.

*To Gauge a Parallelogram.**Definition.*

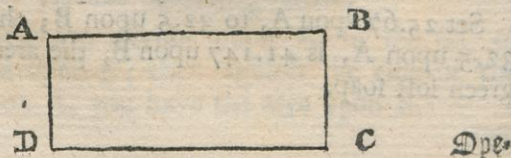
A parallelogram hath four right angles, and its two opposite sides equal, and parallel.

Rule.

Multiply the length by the breadth, and the product is the area in square inches; then divide by 282 for ale gallons, 231 for wine gallons, and 2150 for malt bushels.

Example.

Suppose A B C D be a parallelogram, whose length A B or C D is 54.2 inches, and its breadth A D or B C, 28.1 inches; what is the area in ale and wine gallons, and malt bushels?



Operation.

First, 54.2 multiplied by 28.1, is 1523.02, the area in square inches; then,

For Ale or Beer.

282) 1523.020 (5.4007 area in gallons.

For Wine or Cyder.

231) 1523.020 (6.593 area in gallons.

For Malt or Corn.

2150) 1523.020 (.708 area in malt bushels.

By the Sliding-Rule.

Set the divisor upon A, to the length upon B; then against the breadth upon A, you have the area upon B.

Operation.

For Ale or Beer.

Set 282 upon A, to 28.1 upon B; then against 54.2 upon A, you have 5.4007 upon B, the area in gallons.

For Wine or Cyder.

Set 231 upon A, to 28.1 upon B; then against 54.2 upon A, is 6.593 upon B, the area in gallons.

For Malt or Corn.

Set 2150 upon A, to 28.1 upon B; then against 54.2 upon A, is .708 upon B, the area in malt bushels.

Note, After this manner you must work for any other question (whether in tallow, soap, &c.) by making use of the proper divisors.

To Gauge a Rhombus, or Rhomboides

Definition.

1. A Rhombus hath four equal sides, but no right angle.
2. A Rhomboides hath its two opposite sides equal, but no right angle.

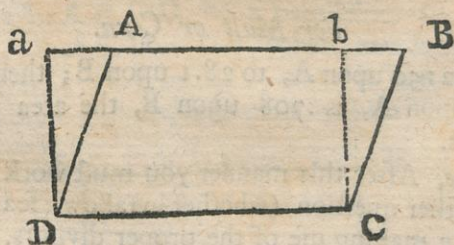
Note, Parallelograms having the same base, and being between the same parallel lines, are equal; therefore the parallelogram $abcd$, is equal to the rhombus, &c. $ABCD$; whence the following

Rule.

Multiply the length, by its perpendicular height, (or breadth) and the product is the area in square inches, which divide by 282 for ale gallons, 231 for wine gallons, and 2150 for malt bushels.

Example.

Suppose $ABCD$ be a rhomboides, whose side AB or DC is 82.3 inches, and $Cb = 51.2$ inches, (being the nearest distance between the two sides AB and CD) what is the area in ale and wine gallons, and malt bushels?



Opera-

Operation.

First, 82.3 multiplied by 51.2 is 4213.76 the area in square inches; then,

For Ale or Beer.

282) 4213.760 (14.942 area in gallons.

For Wine or Cyder.

231) 4213.760 (18.241 area in gallons.

For Malt or Corn.

2150) 4213.760 (1.959 area in bushels.

By the Sliding-Rule.

Set the divisor upon A, to the length upon B; then against the breadth (or height) upon A, you have the area upon B.

Operation.

For Ale or Beer.

Set 282 upon A, to 82.3 upon B; then against 51.2 upon A, is 14.942 upon B, the area in ale gallons.

For Wine or Cyder.

Set 231 upon A, to 82.3 upon B; then against 51.2 upon A, is 18.241 upon B, the area in wine gallons.

For Malt or Corn.

Set 2150 upon A, to 82.3 upon B; then against 51.2 upon A, is 1.959 upon B, the area in malt bushels.

*To Gauge a Triangle.**Definition.*

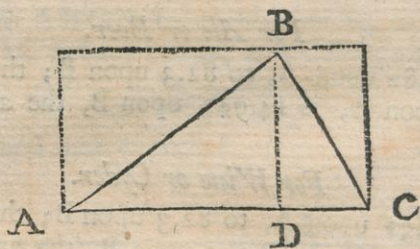
A triangle is a figure bounded with three right lines : every triangle is equal to half its circumscribing parallelogram ; whence this

Rule.

Multiply the base (AC) by half the perpendicular (BD) (or the perpendicular by half the base) and the product is the area in square inches, which divide by 282 for ale gallons, 231 for wine gallons, and 2150 for malt bushels ?

Example.

Suppose ABC be a triangle, whose base AC is 38.6 inches, and perpendicular height BD is 30.2 inches, what is the area in ale and wine gallons, and malt bushels ?

*Operation.*

First, 38.6 multiplied by 15.1 (the half of BD) is 582.86, the area in square inches ; then,

For

For Ale or Beer.

282) 582.860 (2.066 area in gallons.

For Wine or Cyder.

231) 582.860 (2.523 area in gallons.

For Malt or Corn.

2150) 582.860 (.271 area in bushels.

By the Sliding-Rule.

Set the divisor upon A, to the base of the triangle upon B; then against half the perpendicular height upon A, you have the area upon B.

Operation.

For Ale or Beer.

Set 282 upon A, to 38.6 upon B; then against 15.1 upon A, is 2.066 upon B, the area in ale gallons.

For Wine or Cyder.

Set 231 upon A, to 38.6 upon B; then against 15.1 upon A, is 2.523 upon B, the area in wine gallons.

For Malt or Corn.

Set 2150 upon A, to 38.6 upon B; then against 15.1 upon A, is .271 upon B, the area in malt bushels.

H

To

*To Gauge a Trapezium.**Definition.*

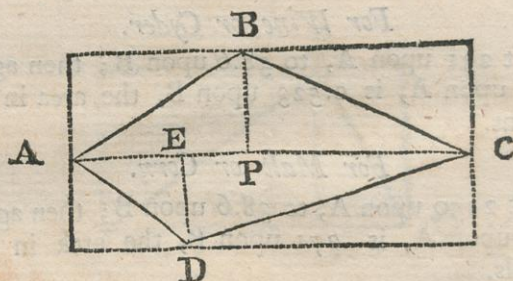
A Trapezium is a figure consisting of four unequal sides.

Rule.

Add the two perpendiculars together, and multiply that sum by half the diagonal, and the product is the area in square inches, which divide by 282 for ale gallons, 231 for wine, and 2150 for malt bushels.

Example.

Suppose ABCD be a trapezium, whose diagonal AC, is 108 inches, the perpendicular BP 38 inches, and the perpendicular DE 34.5 inches; what is the area in ale and wine gallons, and malt bushels?

*Operation.*

First, 38 inches added to 34.5 inches, is 72.5 inches, which multiply by 54 (the half of 108) the product is 3915.0, which is the area in square inches; then,

For

For Ale or Beer.

282) 3915.000 (13.882 area in gallons.

For Wine or Cyder.

231) 3915.000 (16.948 area in gallons.

For Malt or Corn.

2150) 3915.000 (1.820 area in bushels.

By the Sliding-Rule,

Set the divisor upon A, to the sum of the two perpendiculars upon B, then against half the diagonal upon A, you have the area upon B.

Operation.

For Ale or Beer.

Set 282 upon A, to 72.5 upon B; then against 54 upon A, is 13.882 upon B, the area in gallons.

For Wine or Cyder.

Set 231 upon A, to 72.5 upon B; then against 54 upon A, is 16.948 upon B, the area in gallons.

For Malt or Corn.

Set 2150 upon A, to 72.5 upon B; then against 54 upon A, is 1.820 upon B, the area in bushels.

*To Gauge a Regular Polygon.**Definition.*

All figures that have more than four sides, and those all equal, are called regular Polygons; and of such figures, that of five equal sides is called a Pentagon; that of six equal sides is called a Hexagon; that of seven equal sides is called a Heptagon, &c. From hence it is plain that they take their name from the number of angles and sides that bound them.

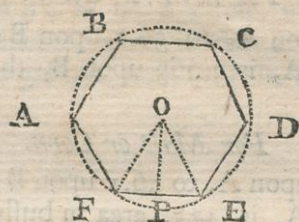
Note. The area of any regular polygon, is composed of so many triangles as there are number of sides in the polygon; wherefore all regular polygons may be measured by one general rule.

Rule.

Multiply half the sum of the sides, by the nearest distance of any side from the center, and the product is the area in square inches; which divide by 282 for ale gallons, 231 for wine gallons, 2150 for malt bushels.

Example.

Suppose ABCDEF be a hexagon, whose sides are each 18.7 inches, and the nearest distance from the center to the middle of any side, as OP, is 16.32, what is the area in ale and wine gallons, and malt bushels.

*Operation.*

First, 18.7 multiplied by 6, is 112.2—the sum of the sides, the half of 112.2 is 56.1, which multiplied by 16.32 is 915.552, the area in square inches; then,

For Ale or Beer.

282) 915.552 (3.246 area in gallons.

For Wine or Cyder.

231) 915.552 (3.963 area in gallons.

For Malt or Corn.

2150) 915.552 (0.425 area in bushels.

By the Sliding-Rule.

Set the divisor upon A, to half the sum of the sides upon B; then against the perpendicular upon A, is the area on B.

Operation.

For Ale or Beer.

Set 282 upon A, to 56.1 upon B; then against 16.32 upon A, is 3.246 upon B, the area in gallons.

H 3

For

For Wine or Cyder.

Set 231 upon A, to 56.1 upon B; then against 16.32 upon A, is 3.963 upon B, the area in gallons.

For Malt or Corn.

Set 2150 upon A, to 56.1 upon B; then against 16.32 upon A, is .425, area in bushels.

*To Gauge a Circle.**Definition.*

A Circle is a plain figure, whose area is bounded or limited by one continued line, called the Circumference or Periphery of the Circle, and is every where equally distant from the middle point or center.

The diameter of a circle is a line drawn through the center, ending at the periphery on each side, and divides the circle into two equal parts.

Rule.

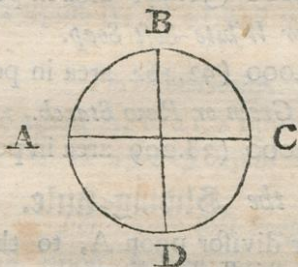
Multiply the diameter of the circle by itself, and the product is the area in circular inches *, which divide by 183.34 for feet, 359 for ale gallons, 294 for wine, 2737.47 for malt, 38.55 for pounds of tallow gross, &c. as in the foregoing table, at page the 83d.

* Or, square the diameter, and multiply it by .7854 a decimal, and the product is the area in square inches.

Example.

Example.

Suppose ABCD be a circle whose diameter AC is 41.2 inches; what is the area in feet, ale gallons, wine gallons, malt bushels, tallow pounds, &c. &c.



Operation.

First, 41.2 (the diameter) being squared or multiplied by itself, is 1697.44, the area in circular inches; then,

For Feet.

183.34) 1697.44000 (9.258 area in feet.

For Ale or Beer.

359) 1697.440 (4.728 area in gallons.

For Wine or Cyder.

294) 1697.440 (5.773 area in gallons.

For Malt or Corn.

2737.47) 1697.44000 (.627 area in bushels.

For Tallow Gross.

38.55) 1697.44000 (44.032 area in pounds.

For Tallow Neat.

39.98) 1697.44000 (42.457 area in pounds.

For Hard Soap.

34.56) 1697.44000 (49.115 area in pounds.

For Green Soft Soap.

32.68) 1697.44000 (51.941 area in pounds.

For White Soft Soap.

32.54) 1697.44000 (52.164 area in pounds.

For Green or Raw Starch.

44.32) 1697.44000 (38.299 area in pounds.

By the Sliding-Rule.

Set the proper divisor upon A, to the diameter upon B; then against the diameter upon A, you have the area upon B.

*Operation.**For Feet.*

Set 183.34 upon A, to 41.2 upon B; then against 41.2 upon A, is 9.258 upon B, the area in feet.

For Ale or Beer.

Set 359 upon A, to 41.2 upon B; then against 41.2 upon A, is 4.728 upon B, the area in gallons.

For Wine or Cyder.

Set 294 upon A, to 41.2 upon B; then against 41.2 upon A, is 5.773 upon B, the area in gallons.

For Malt or Corn.

Set 2737.47 upon A, to 41.2 upon B; then against 41.2 upon A, is .627 upon B, the area in bushels.

For

For Tallow Grofs.

Set 38.55 upon A, to 41.2 upon B; then against 41.2 upon A, is 44.032 upon B, the area in pounds.

For Tallow Neat.

Set 39.98 upon A, to 41.2 upon B; then against 41.2 upon A, is 42.457 upon B, the area in pounds.

For Hard Soap.

Set 34.56 upon A, to 41.2 upon B; then against 41.2 upon A, is 49.115 upon B, the area in pounds.

For Green Soft Soap.

Set 32.68 upon A, to 41.2 upon B; then against 41.2 upon A, is 51.941 upon B, the area in pounds.

For White Soft Soap.

Set 32.54 upon A, to 41.2 upon B; then against 41.2 upon A is 52.164 upon B, the area in pounds.

For Green or Raw Starch.

Set 44.32 upon A, to 41.2 upon B; then against 41.2 upon A, is 38.299 upon B, the area in pounds.

Note, You may find the area of a circle in all these denominations at one set of the rule, by the lines C and D, thus,

First, put the sliding-piece C the reverse way into its place, then set the diameter of the circle upon D, to 1 upon C, and against the several gauge-points for circles (as mentioned in the table at page 83) upon D, you have the area upon C.

*To gauge a Semi-circle.**Definition.*

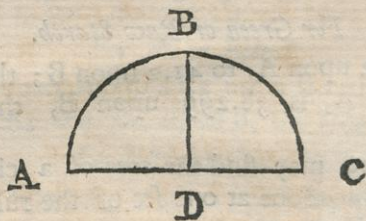
A Semi-circle is bounded by the diameter A C, and half the circumference A B C.

Rule.

Multiply half the circumference A B C, by one fourth part of the diameter, the product is the area in square inches, which divide by 282 for ale gallons, 231 for wine, 2150 for malt bushels.

Example.

Suppose the diameter A C, be equal to 16 inches; and the half circumference A B C be equal to 25.13 inches; what is the area of the semi-circle in ale and wine gallons and malt bushels?

*Operation.*

First 25.13 (half the circumference) multiplied by 4, (one fourth of the diameter) the product is 100.52, the area in square inches; then,

For

For Ale or Beer.

282) 100.520 (.356 area in gallons.

For Wine or Cyder.

231) 100.520 (.435 area in gallons.

For Malt or Corn.

2150) 100.520 (.046 area in bushels.

By the Sliding-Rule.

Set the divisor (for right-lined figures) upon A, to half the circumference upon B; then against one fourth part of the diameter upon A, you will have the areas upon B.

Operation.

For Ale or Beer.

Set 282 upon A, to 25.13 upon B; then against 4 upon A, you have .356 upon B, the area in gallons.

For Wine or Cyder.

Set 231 upon A, to 25.13 upon B; then against 4 upon A you have .435 upon B, the area in gallons.

For Malt or Corn.

Set 2150 upon A, to 25.13 upon B; then against 4 upon A, you have .046 upon B, the area in bushels.

Another way to find the area of a Semi-circle.

Rule.

Divide half the square of the diameter by the circular divisors, and the quotients will be the areas as above.

To

To gauge a Quarter of a Circle.

Definition.

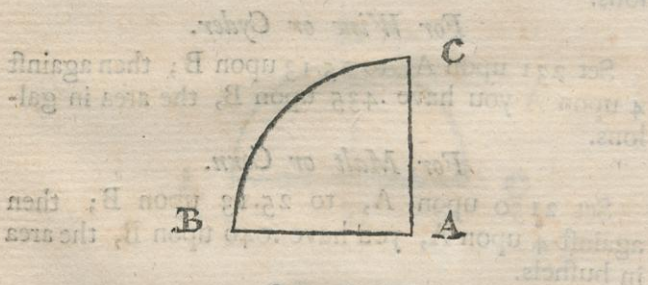
A Quarter of a Circle is bounded by two radius's, or legs, meeting in the center, and cutting each at right angles at A, on which the arch B C is drawn.

Rule.

Multiply half the arch by the radius (or leg) or half the leg by the whole arch; either of which gives the area in square inches; which divide by 282 for ale gallons, 231 for wine, 2150 for malt bushels.

Example.

Suppose the radius, or leg, A B, be 8 inches, and the arch B C be 12.566 inches, what is the area in ale and wine gallons, and malt bushels?



Operation.

First 12.566 (the arch) multiplied by 4 (half the leg) the product is 50.264, the area in square inches; then,

For

For Ale or Beer.

282) 50.264 (.178 area in gallons.)

For Wine or Cyder.

231) 50.264 (.217 area in gallons.)

For Malt or Corn.

2150) 50.264 (.023 area in bushels.)

By the Sliding-Rule.

Set the above divisors upon A, to the length of the arch upon B; then against half the radius, or leg, upon A, you will find the area's upon B.

*Operation.**For Ale or Beer.*

Set 282 upon A, to 12.566 upon B; then against 4 upon A, is .178 upon B, the area in gallons.

For Wine or Cyder.

Set 231 upon A, to 12.566 upon B; then against 4 upon A, is .217 upon B, the area in gallons.

For Malt or Corn.

Set 2150 upon A, to 12.566 upon B; then against 4 upon A, is .023 upon B, the area in bushels.

*To gauge a Sector of a Circle,**Definition.*

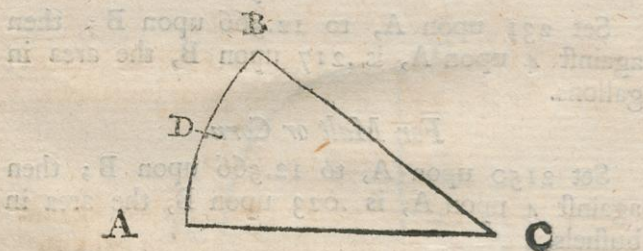
A Sector of a Circle is a figure bounded by two (radius's) or femidiameters of the circle, having some part of the circumference for its base.

Rule.

Multiply the (radius) or femidiameter by half the arch of the sector, and the product is the area in square inches: which divide by 282 for ale gallons, 231 for wine, and 2150 for malt bushels.

Example.

Suppose A B C D, be a sector of a circle, whose radius A C equal to B C, is 41.2 inches, and the arch A B, is 32 inches; what is the area in ale and wine gallons, and malt bushels?

*Operation.*

First, the radius A C=41.2 inches, multiplied by A D (the half of A B)=16 inches, is 659.2, which is the area in square inches; then,

For

For Ale or Beer.

282) 659.200 (2.337 area in gallons.

For Wine or Cyder.

231) 659.200 (3.009 area in gallons.

For Malt or Corn.

2150) 659.200 (.323 area in bushels.

By the Sliding-Rule.

Set the divisor upon A, to the semidiameter upon B; then against half the length of the arch upon A, you have the area upon B.

Operation.

For Ale or Beer.

Set 282 upon A, to 41.2 upon B; then against 16 upon A, is 2.337 upon B, the area in gallons.

For Wine or Cyder.

Set 231 upon A, to 41.2 upon B; then against 16 upon A, is 3.009 upon B, the area in gallons.

For Malt or Corn.

Set 2150 upon A, to 41.2 upon B, then against 16 upon A, is 323 upon B, the area in bushels.

To

*To gauge a Segment of a Circle.**Definition.*

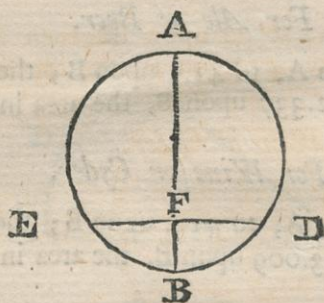
A Segment of a Circle, is a part cut off, by a right-line (less than the diameter) drawn within the circle, as E D, so that E B D is a segment less than a semicircle, and E A D is greater than a semicircle.

Rule.

Multiply the chord line E D, by two thirds of the height F B, and the product is the area in square inches; which divide by 282 for ale gallons, 231 for wine, and 2150 for malt bushels.

Example.

Suppose E B D, be a segment of a circle, whose chord line E D, is 24 inches, and the height F B is 9 inches; what is the area in ale and wine gallons, and malt bushels?

*Operation.*

First, the chord line 24, multiplied by 6 (equal $\frac{2}{3}$ of 9) is 144, the area in square inches; then,

For

For Ale or Beer.

282) 144.000 (.51 area in gallons.

For Wine or Cyder.

231) 144.000 (.623 area in gallons.

For Malt or Corn.

2150) 144.000 (.066 area in bushels.

By the Sliding-Rule.

Set the divisor upon A; to the length of the chord line upon B; then against two thirds of the height upon A, is the area upon B.

Operation.

For Ale or Beer.

Set 282 upon A, to 24 upon B; then against 6 upon A, you have .51 upon B, the area in gallons.

For Wine or Cyder.

Set 231 upon A, to 24 upon B; then against 6 upon A, you have .623 upon B, the area in gallons.

For Malt or Corn.

Set 2150 upon A, to 24 upon B; then against 6 upon A, you have .066 upon B, the area in bushels.

*To gauge an Oval.**Definition.*

An Oval, or ellipsis, is a circular figure, as A B C D, having two unequal diameters, as A C, which is called the Transverse, and B D the conjugate diameter, and is a mean proportional between two circles whose diameters are equal to the transverse, and conjugate diameters of the ellipsis.

Rule.

Multiply the transverse diameter by the conjugate diameter, and the product is the area in circular inches; which product divide by 359 for ale gallons, 294 for wine, and 2737.47 for malt bushels.*

Example.

Suppose A B C D be an oval, or ellipsis, whose transverse diameter is 68.5 inches, and the conjugate diameter B D, is 51.5 inches; what is the area in ale and wine gallons, and malt bushels?



* Or multiply the transverse and conjugate diameters together, and that product multiply by .7854, this last product will be the area in square inches.

Operation.

First, multiply 68.5 inches (the transverse diameter) by 51.5 inches (the conjugate diameter) and the product is 3527.75 the area in circular inches, then,

For Ale or Beer.

359) 3527.750 (9.826 area in gallons.

For Wine or Cyder.

294) 3527.750 (11.999 area in gallons.

For Malt or Corn.

2737.47) 3527.75000 (1.288 area in bushels.

By the Sliding-Rule.

Set the divisor upon A, to the transverse diameter on B, then against the conjugate diameter on A, you have the area upon B.

Operation.

For Ale or Beer.

Set 359 upon A, to 68.5 upon B; then against 51.5 upon A, you have 9.826 upon B, the area in gallons.

For Wine or Cyder.

Set 294 upon A, to 68.5 upon B; then against 51.5 upon A, you have 11.999 upon B, the area in gallons.

For Malt or Corn.

Set 2737.47 upon A, to 68.5 upon B; then against 51.5 upon A, you have 1.288 upon B, the area in Bushels.

*A New and Complete
To gauge a Parabola.*

Definition.

A Parabola is one of the conic sections, and is generated by cutting a cone through, with a plain parallel to the side thereof.

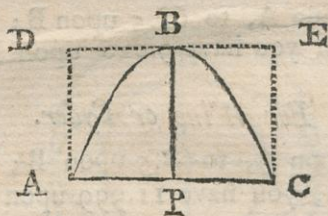
Note. Every parabola is two thirds of its circumscribing parallelogram; (*i. e.*) $A B C$ is $\frac{2}{3}$ of $A D E C$, whence this

Rule.

Multiply the base $A C$, by two thirds of the perpendicular height $B P$, and the product is the area in square inches; which divide by 282 for ale gallons, 231 for wine, and 2150 for malt bushels.

Example.

Suppose $A B C$ be a parabola, whose base $A C$ is 15 inches, and perpendicular height $B P$, is 12 inches, what is the area, in ale and wine gallons and malt bushels?



Operation.

First, the base $A C = 15$ multiplied by 8 (equal $\frac{2}{3}$ of the height $B P$) is 120, the area in square inches, then,

For

For Ale or Beer.

282) 120.000 (.425 area in gallons.

For Wine or Cyder.

131) 120.000 (.519 area in gallons.

For Malt or Corn.

2150) 120.000 (.055 area in bushels.

By the Sliding-Rule.

Set the divisor upon A, to the base upon B, then against two thirds of the height upon A, you will find the area upon B.

Operation.

For Ale or Beer.

Set 282 upon A, to 15 upon B; then against 8 upon A, you will find .425 upon B, the area in gallons.

For Wine or Cyder.

Set 231 upon A, to 15 upon B; then against 8 upon A, you will find .519 upon B, the area in gallons.

For Malt or Corn.

Set 2150 upon A, to 15 upon B; then against 8 upon A, you will find .055 upon B, the area in bushels.

To gauge an Hyperbola.

Definition.

An Hyperbola is also one of the conic sections, and is generated by cutting the cone with a plain parallel to the axis.

The area of an hyperbola, cannot be perfectly found by any certain or settled rules, as those of the ellipsis and parabola have been.

But here *note*, that a certain ingenious author hath asserted, that every conical hyperbola is greater than half, and less than three fourths of its circumscribing parallelogram: if so, it will be near enough to take all hyperbola's at a mean, thus,—say every hyperbola is five eighths of its circumscribing parallelogram, wherefore this

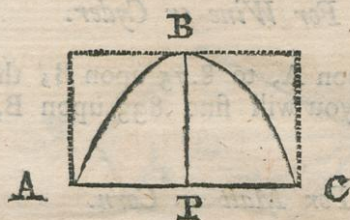
Rule.

Multiply the base by the height, and that product again by 5, which last product divide by 8, and the quotient will be (nearly) the area in square inches, then divide by 282 for ale gallons, 231 for wine, and 2150 for malt bushels.

Example.

Suppose ABC be an hyperbola, whose base AC, is 22 inches, and the height BP, is 14 inches, what is the area in ale and wine gallons and malt bushels?

Dpe

*Operation.*

First, the base, 22, multiplied by the height 14, is 308, which multiplied by 5, is 1540; then 1540 divided by 8, is 192.5, the area in square inches; then,

For Ale or Beer.

282) 192.500 (.682, area in gallons.

For Wine or Cyder.

231) 192.500 (.833, area in gallons.

For Malt or Corn.

2150) 192.500 (.089, area in bushels.

By the Sliding-Rule.

First, find $\frac{5}{8}$ of the height, thus; set the denominator 8, upon A, to the numerator 5, upon B; then against the height 14 upon A, you have 8.75 upon B; which is $\frac{5}{8}$ of 14. Then, set the divisor upon A, to $\frac{5}{8}$ of the height upon B; and against the base upon A, you will have the area upon B.

Operation.

For Ale or Beer.

Set 282 upon A, to 8.75 upon B; then against 22 upon A, you will find .682 upon B, the area in gallons.

For Wine or Cyder.

Set 231 upon A, to 8.75 upon B; then against 22 upon A, you will find .833 upon B, the area in gallons.

For Malt or Corn.

Set 2150 upon A, to 8.75 upon B; then against 22 upon A, you will have .089 upon B, the area in bushels.

*To gauge an Irregular figure.**Definition.*

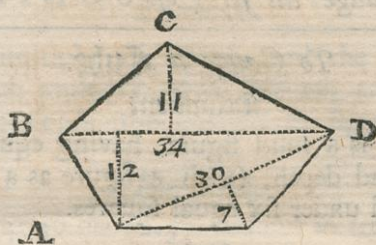
All figures that have above four sides, and those unequal, are called Irregular Figures, or Polygons.

Rule.

Divide the figure by diagonals, &c. into trapeziums, triangles, &c. which being done, find the areas of the trapeziums, triangles, &c. severally, in inches, and add the several areas together, so will the sum be the area of the figure; then divide by 282 for ale gallons, 231 for wine, and 2150 for malt bushels.

Example.

Suppose A B C D E, be an irregular figure, whose dimensions are as in the figure; what is the area in ale and wine gallons, and malt bushels?



Operation.

First, having divided the figure, as you see, into one trapezium, and one triangle, or rather into three triangles, find their areas as you did that of a triangle, which will be as under,

The area of the triangle BCD is	187	} inches.
The area of the triangle ABD is	204	
The area of the triangle ADE is	105	

Their sum is - - - - - 496. Then,

For Ale or Beer.

282) 496.000 (1.758 area in gallons.

For Wine or Cyder.

231) 496.000 (2.147 area in gallons.

For Malt or Corn.

2150) 496.000 (.2306 area in bushels.

Note, The contents of all tuns, whose sides are straight, and whose bases are equal, (being any of the foregoing figures) are found by multiplying the area of the bases by the depth.

*To gauge all sorts of SOLIDS.**To Gauge a Cube.**Definition.*

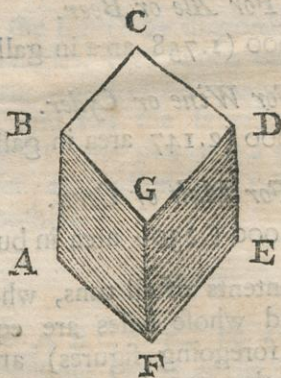
A Cube is a solid figure, having equal length, breadth, and depth, (such a figure as a dye) and is contained under six equal squares.

Rule.

Take your dimensions in inches, and multiply the length, breadth, and depth, into one another, and the product is the solidity in square inches, which divide by 1728 for feet, 282 for ale gallons, 231 for wine, 2150 for malt, 30.28 for pounds of tallow grofs, &c. as in the table.

Example.

Suppose ABCDEFG be a cube, whose side is 16 inches, what is the content in ale and wine gallons, malt bushels, pounds of tallow, &c. &c.



Opera-

Operation.

First, multiply 16 by 16, and the product is 256, which multiply again by 16, and the last product is 4096, the content in square inches; then;

For Feet.

1728) 4096.00 (2.37 content in feet.

For Ale or Beer.

282) 4096.00 (14.52 content in gallons.

For Wine or Cyder.

231) 4096.00 (17.73 content in gallons.

For Malt or Corn.

2150) 4096.00 (1.9 content in bushels.

For Tallow Grofs.

30.28) 4096.0000 (135.27 content in pounds.

For Tallow Neat.

31.4) 4096.000 (130.44 content in pounds.

For Hard Soap.

27.14) 4096.0000 (150.92 content in pounds.

For Green Soft Soap.

25.67) 4096.0000 (159.17 content in pounds.

For White Soft Soap.

25.56) 4096.0000 (160.25 content in pounds.

For Green or Raw Starch.

34.8) 4096.000 (117.7 content in pounds.

By the Sliding-Rule.

First, to perform questions of this nature, there are marked upon the line D, certain gauge-points, which gauge-points are the square roots of the foregoing divisors; their use is thus,

Set the proper gauge-point upon D, to the side of the cube upon C; then against the side of the cube upon D, you have the content upon C.

*Operation.**For Feet.*

Set 41.6, the gauge-point, upon D, to 16 upon C; then against 16 upon D, is 2.37 upon C, the content in feet.

For Ale or Beer.

Set 16.79 upon D, to 16 upon C; then against 16 upon D, is 14.52 upon C, the content in gallons.

For Wine or Cyder.

Set 15.19 upon D, to 16 upon C; then against 16 upon D, is 17.73 upon C, the content in gallons.

For Malt or Corn.

Set 46.36 upon D, to 16 upon C; then against 16 upon D, is 1.9 upon C, the content in bushels.

For Tallow Grofs.

Set 5.5 upon D, to 16 upon C; then against 16 upon D, is 135.27 upon C, the content in pounds grofs.

For Tallow Neat.

Set 5.6 upon D, to 16 upon C; then against 16 upon D, is 130.44 upon C, the content in pounds neat,

For

For Hard Soap.

Set 5.2 upon D, to 16 upon C; then against 16 upon D, is 150.92 upon C, the content in pounds.

For Green Soft Soap.

Set 5.06 upon D, to 16 upon C; then against 16 upon D, is 159.17 upon C, the content in pounds.

For White Soft Soap.

Set 5.05 upon D, to 16 upon C; then against 16 upon D, is 160.25 upon C, the content in pounds.

For Green or Raw Starch.

Set 5.9 upon D, to 16 upon C; then against 16 upon D, is 117.7 upon C, the content in pounds.

Here note, That you may find the content of the cube in all these denominations, at one set of the rule, thus,

First, put the sliding-piece C, the reverse way into its place, then

Set the side of the cube upon D, to the side of the cube upon C; then against the several gauge-points upon D, you have the several contents (as before) upon C.

*To gauge a Parallelepipedon.**Definition.*

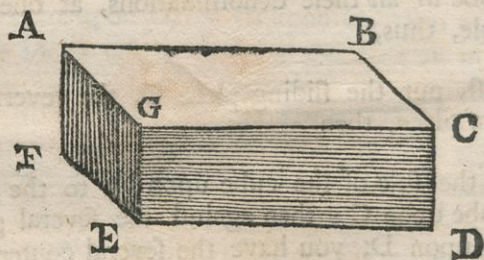
A Parallelepipedon is a solid figure contained under (or included between) six parallelograms, the opposite sides of which are parallel and equal.

Rule.

Multiply the length by the breadth, and the product by the depth; this last product is the content in square inches, which divide by 282 for ale gallons, 231 for wine, and 2150 for malt bushels, &c.

Example.

Suppose ABCDEFG be a parallelepipedon, whose length AB is 42 inches, the breadth BC is 24 inches, and depth CD is 16 inches, what is the content in ale and wine gallons, and malt bushels?

*Operation.*

First, multiply 42 (the length) by 24 (the breadth) and the product is 1008, which multiply by 16 (the depth) and that product is 16128, which is the content in square inches; then,

For

For Ale or Beer.

282) 16128.00 (57.19 content in gallons.

For Wine or Cyder.

231) 16128.00 (69.81 content in gallons.

For Malt or Corn.

2150 (16128.00 (7.5 the content in bushels.

By the Sliding-Rule.

First, find a mean proportional between the length $AB=42$, and the breadth $BC=24$ (as before directed) which you will find to be 31.749; then set the proper gauge-point upon D, to the depth upon C, then against the mean (between the length and breadth) upon D, you have the content upon C.

*Operation.**For Ale or Beer.*

Set 16.79, the gauge-point, upon D, to 16 upon C; then against 31.749 upon D, is 57.19 upon C, the content in gallons.

For Wine or Cyder,

Set 15.19 upon D, to 16 upon C; then against 31.479 upon D, is 69.81 upon C, the content in gallons.

For Malt or Corn.

Set 46.36 upon D, to 16 upon C; then against 31.479 upon D, is 7.5 upon C, the content in bushels.

*To gauge a Prism.**Definition.*

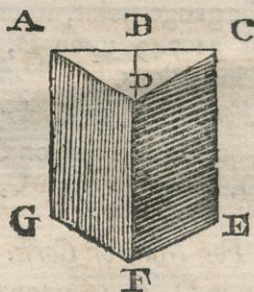
A Prism is a solid figure, the opposite ends of which are equal, alike, and parallel (most commonly triangular) and all other sides are parallelograms.

Rule.

Find the area of the base or end, as before, then multiply that area by the depth, and the product is the content in square inches, which divide by 282 for ale gallons, 231 for wine, and 2150 for malt bushels.

Example.

Suppose ABCDEFG be a triangular prism, that is, whose base $=$ ABCD is a triangle, the side AC is 42 inches, the height BD is 20 inches, and the depth CE is 50 inches, what is the content in ale and wine gallons, and malt bushels?

*Operation.*

First, multiply $42 = AC$, by 10 (the half of BD) and the product is 420, which multiply by
50

50 (the depth) and that product is 21000, which is the content in square inches; then,

For Ale or Beer.

282) 21000.00 (74.45 content in gallons.

For Wine or Cyder.

231) 21000.00 (90.9 content in gallons.

For Malt or Corn.

2150) 21000.00 (9.76 content in bushels.

By the Sliding-Rule.

First find a mean proportional between the base $AC=42$, and half the height $BD=10$; (as before directed) which you will find to be 20.49; then,

Set the gauge-point upon D, to the depth upon C; then against the mean proportional upon D, is the content upon C.

Operation.

For Ale or Beer.

Set the gauge point 16.79 upon D, to 50 upon C; then against 20.49 upon D, is 74.45 upon C, the content in gallons.

For Wine or Cyder.

Set 15.19 upon D, to 50 upon C; then against 20.49 upon D, is 90.9 upon C, the content in gallons.

For Malt or Corn.

Set 46.36 upon D, to 50 upon C; then against 20.49 upon D, is 9.76 upon C, the content in bushels.

*To gauge a Pyramid.**Definition.*

A Pyramid is a solid figure whose sides are plain triangles, having for its base a square, or any other regular polygon, and meeting in a point at the top.

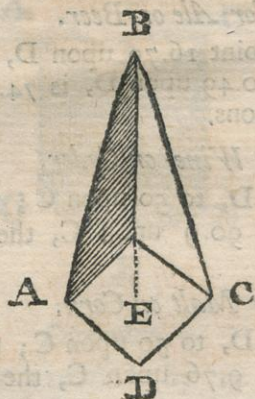
Every pyramid is one third part of a prism, of the same base, and of the same height; whence this

Rule.

Multiply the area of the base, by one third part of the height, and the product will be the content in square inches, which divide by 282 for ale gallons, 231 for wine, and 2150 for malt bushels.

Example.

Suppose ABCD be a square pyramid, the side of whose base is $AD=DC=36$ inches, and height $BE=48$ inches, what is the content in ale and wine gallons, and malt bushels?



Opera-

Operation.

First, multiply 36 by itself, and the product is 1296, which multiplied by 16 ($=\frac{1}{3}$ of the height) the product is 20736, the content of the pyramid in square inches; then,

For Ale or Beer.

282) 20736.00 (73.53 content in gallons.

For Wine or Cyder.

231) 20736.00 (89.76 content in gallons.

For Malt or Corn.

2150) 20736.00 (9.64 content in bushels.

By the Sliding-Rule.

Set the proper gauge-point upon D, to one third of the height upon C; then against the side of the base upon D, you have the content upon C.

Operation.

For Ale or Beer.

Set 16.79 upon D, to 16 upon C; then against 36 upon D, is 73.53 upon C, the content in gallons.

For Wine or Cyder.

Set 15.19 upon D, to 16 upon C; then against 36 upon D, is 89.76 upon C, the content in gallons.

For Malt or Corn.

Set 46.36 upon D, to 16 upon C; then against 36 upon D, is 9.64 upon C, the content in bushels.

*To gauge a Cylinder.**Definition.*

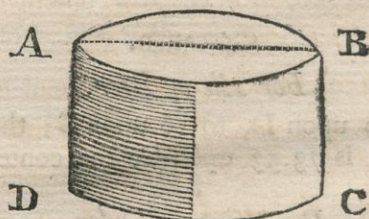
A Cylinder is only a round prism, having its bases or ends equal circles, and is in all places of an equal diameter.

Rule.

Multiply the square of the diameter by the depth, and the product is the content in circular inches, which divide by 359 for ale gallons, 294 for wine, and 2737.47 for malt, &c. as in the table.

Example.

Suppose ABCD be a cylinder, whose diameter AB is 42 inches, and the depth AD is 36 inches, what is the content in feet, ale gallons, wine gallons, malt bushels, tallow pounds, &c?

*Operation.*

First, 42 (the diameter) being squared in 1764, and that multiplied by 36 (the depth) the product is 63504, the content in circular inches; then,

For

For Feet.

2200.15) 63504.0000 (28.86 content in feet.

For Ale or Beer.

359) 63504.00 (176.89 content in gallons.

For Wine or Cyder.

294) 63504.00 (216 content in gallons.

For Malt or Corn.

2737.47) 63504.0000 (23.19 content in bushels.

For Tallow Grofs.

38.55) 63504.0000 (647.31 content in pounds.

For Tallow Neat.

39.98) 63504.0000 (1588.39 content in pounds.

For Hard Soap.

34.56) 63504.0000 (1837.5 content in pounds.

For Green Soft Soap.

32.68) 63504.0000 (1943.2 content in pounds.

For White Soft Soap.

32.54) 63504.0000 (1951.56 content in pounds.

For Green or Raw Starch.

44.32) 63504.0000 (1432.85 content in pounds.

By the Sliding-Rule.

First, To perform questions of this nature, there are marked upon the line D, certain gauge-points, which gauge-points are the square roots of the foregoing divisors ; their use is thus,

K 3

Set

Set the proper gauge-point upon D, to the depth upon C; then against the diameter upon D, you have the content upon C.

Operation.

For Feet.

Set 46.9 upon D, to 36 upon C; then against 42 upon D, is 28.86 upon C, the content in feet.

For Ale or Beer.

Set 18.94 upon D, to 36 upon C; then against 42 upon D, is 176.89 upon C, the content in gallons.

For Wine or Cyder.

Set 17.14 upon D, to 36 upon C; then against 42 upon D, is 216 upon C, the content in gallons.

For Malt or Corn.

Set 52.32 upon D, to 36 upon C; then against 42 upon D, is 23.19 upon C, the content in bushels.

For Tallow Grofs.

Set 6.2 upon D, to 36 upon C; then against 42 upon D, is 1647.31 upon C, the content in pounds.

For Tallow Neat.

Set 6.3 upon D, to 36 upon C; then against 42 upon D, is 588.39 upon C, the content in pounds.

For Hard Soap.

Set 5.9 upon D, to 36 upon C; then against 42 upon D, is 1837.5 upon C, the content in pounds.

For

For Green Soft Soap.

Set 5.71 upon D, to 36 upon C; then against 42 upon D, is 1943.2 upon C, the content in pounds.

For White Soft Soap.

Set 5.7 upon D, to 36 upon C; then against 42 upon D, is 1951.56 upon C, the content in pounds.

For Green or Raw Starch.

Set 6.66 upon D, to 36 upon C; then against 42 upon D, is 1432.85 upon C, the content in pounds.

Note, You may find the content of a cylinder in all these denominations, at one set of the rule; thus,

First put the sliding-piece C, the reverse way into its place; then

Set the diameter upon D, to the depth upon C; then against the several gauge-points upon D, you have the several contents (as before) upon C.

*To gauge a Cone.**Definition.*

A cone is only a round pyramid, whose base is a circle, or ellipsis, and the other end a point, the intermediate parts decreasing thereto.

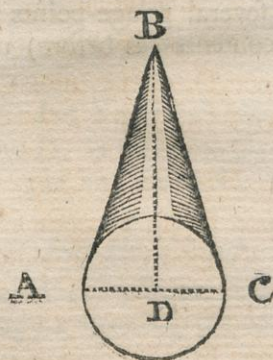
Every cone is one third part of its circumscribing cylinder; whence this

Rule.

Multiply the square of the diameter of its base, by one third part of the perpendicular height, and the product is the content in circular inches, which divide by 359 for ale gallons, 294 for wine, and 2737.47 for malt bushels.

Example.

Suppose ABCD be a cone, the diameter of whose base AC is 28 inches, and the perpendicular height BD is 45 inches, what is the content in ale and wine gallons and malt bushels?



Operation.

First, square 28 (the diameter) which makes 784, and that multiplied by 15 (a third part of the height) the product is 11760, which is the content in circular inches; then,

For Ale or Beer.

359) 11760.00 (32.75 content in gallons.

For Wine or Cyder.

294) 11760.00 (40 content in gallons.

For Malt or Corn.

2737.47) 11760.0000 (4.29 content in bushels.

By the Sliding-Rule.

Set the gauge-point upon D, to one third of the height upon C; then against the diameter of the base upon D, you will have the content upon C.

Operation.

For Ale or Beer.

Set 18.94 upon D, to 15 upon C; then against 28 upon D, is 32.75 upon C, the content in gallons.

For Wine or Cyder.

Set 17.14 upon D, to 15 upon C; then against 28 upon D, is 40 upon C, the content in gallons.

For Malt or Corn.

Set 52.32 upon D, to 15 upon C; then against 28 upon D, is 4.29 upon C, the content in bushels.

To

*To gauge a Globe.**Definition.*

A Sphere, or Globe, is a round solid, every part of whose surface is equally distant from a point within, called its Center; and therefore its length, breadth, and depth are equal.

Every globe is two thirds of its circumscribing cylinder; whence this

Rule.

Multiply the square of the diameter by two thirds of the diameter, and the product is the content in circular inches; which divide by 359 for ale gallons, 294 for wine gallons, 2737.47 for malt bushels*.

Example.

Suppose ABCD be a globe, whose diameter AC or BD is 36 inches, what is the content in ale and wine gallons and malt bushels?



* Or thus; cube the globe's diameter, then multiply it by this decimal .5236, and the product will be the content in square inches.

Operation.

First, square 36 (the globe's diameter) and it makes 1296, and that multiplied by 24 (two thirds of the diameter) the product is 31104, which is the content in circular inches, then,

For Ale or Beer.

359) 31104.00 (86.64 content in gallons.

For Wine or Cyder.

294) 31104.00 (105.79 content in gallons.

For Malt or Corn.

2737.47) 31104.0000 (11.36 content in bushels.

By the Sliding-Rule.

Set the gauge-points for circles upon D, to two thirds of the diameter upon C; then against the diameter upon D, you will have the contents upon C.

Operation.

For Ale or Beer.

Set 18.94 upon D, to 24 upon C; then against 36 upon D, is 86.64 upon C, the content in gallons.

For Wine or Cyder.

Set 17.14 upon D, to 24 upon C; then against 36 upon D, is 105.79 upon C, the content in gallons.

For Malt or Corn.

Set 52.32 upon D, to 24 upon C; then against 36 upon D is 11.36 upon C, the content in bushels.

To

*A New and Complete
To guage a Spheroid.*

Definition.

A Spheroid is a solid figure in the form of an egg; being longer than it is broad; and is made by the rotation of a semi-ellipsis.

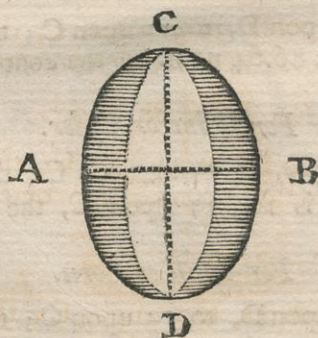
Every Spheroid is two thirds of its circumscribing cylinder; wherefore this

Rule.

Multiply the square of the shortest diameter *AB* by two thirds of the longest diameter *CD*, and the product is the content in circular inches; which divide by 359 for ale gallons, 294 for wine, and 2737.47 for malt bushels.

Example.

Suppose *ABCD* be a spheroid, whose longest diameter *CD* is 48 inches, and the shortest diameter *AB* is 30 inches; what is the content in ale and wine gallons and malt bushels?



Operation.

First, square 30 (the shortest diameter) and it makes 900, and that multiplied by 32 (two thirds of the longest diameter) the product is 28800, which is the content in circular inches; then,

For Ale or Beer.

359) 28800.00 (80.22 content in gallons.

For Wine or Cyder.

294) 28800.00 (97.95 content in gallons.

For Malt or Corn.

2737.47) 28800.000 (.105 content in bushels.

By the Sliding-Rule.

Set the proper gauge-point upon D, to two thirds of the longest diameter upon C; then against the shortest diameter upon D, you will find the content upon C.

Operation.

For Ale or Beer.

Set 18.94 upon D, to 32 upon C; then against 30 upon D, is 80.22 upon C, the content in gallons.

For Wine or Cyder.

Set 17.14 upon D, to 32 upon C; then against 30 upon D, is 97.95 upon C, the content in gallons.

For Malt or Corn.

Set 52.32 upon D, to 32 upon C; then against 30 upon D, is .105 upon C, the content in bushels.

To

*To gauge a Parabolic Conoid**Definition.*

A Parabolic Conoid is a solid formed by the rotation of a semiparabola about its axis.

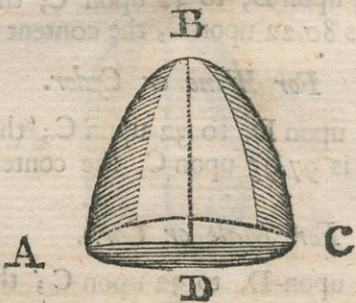
Every Parabolic Conoid is equal to half its circumscribing cylinder; wherefore this

Rule.

Multiply the square of the diameter of the base by half the height, and the product is the content in circular inches, which divide by 359 for ale gallons, 294 for wine, and 2737.47 for malt bushels.

Example.

Suppose *ABCD* be a parabolic conoid, whose diameter *AC* is 20 inches, and height *BD* is 12 inches; what is the content thereof in ale and wine gallons and malt bushels?



Operation.

First, 20 (the diameter) squared, is 400, and that multiplied by 6 (half the height) the product is 2400, which is the content in circular inches; then,

For Ale or Beer.

359) 2400.00 (6.68 content in gallons.

For Wine or Cyder.

294) 2400.00 (8.16 content in gallons.

For Malt or Corn.

2737.47) 2400.0000 (.87 content in bushels.

By the Sliding-Rule.

Set the proper gauge-point upon D, to half the height upon C; then against the diameter upon D, you will find the content upon C.

Operation.

For Ale or Beer.

Set 18.94 upon D, to 6 upon C; then against 20 upon D, is 6.68 upon C, the content in gallons.

For Wine or Cyder.

Set 17.14 upon D, to 6 upon C; then against 20 upon D, is 8.16 upon C, the content in gallons.

For Malt or Corn.

Set 52.32 upon D, to 6 upon C; then against 20 upon D, is .87 upon C, the content in bushels.

To

*To gauge an Hyperbolic Conoid.**Definition.*

An Hyperbolic Conoid, is a solid formed by the rotation of a semi-hyperbola about its axis.

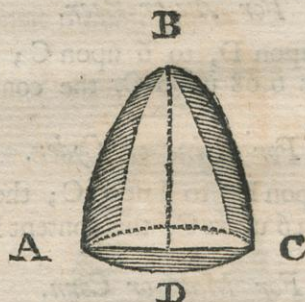
Every Hyperbolic Conoid is (nearly) equal to five twelfths of its circumscribing cylinder; whence this

Rule.

Multiply the square of the diameter of the base by $\frac{5}{12}$ of the height *, and the product is the content in circular inches; which divide by 359 for ale gallons, 294 for wine, and 2737.47 for malt bushels?

Example.

Suppose ABCD, be an hyperbolic conoid, whose diameter AC is 26 inches, and height BD is 48 inches; what is the content in ale and wine gallons, and malt bushels?



* Note, Multiply the height by 5, and divide the product by 12, the quotient will be equal to $\frac{5}{12}$ of the height.

Operation.

First, 26 (the diameter) squared is 676, and that multiplied by 20, (five twelfths of the height) the product is 13520, the content in circular inches; then,

For Ale or Beer.

359) 13520.00 (37.66 content in gallons.

For Wine or Cyder.

294) 13520.00 (45.98 content in gallons.

For Malt or Corn.

2737.47) 13520.0000 (4.93 content in bushels.

By the Sliding-Rule.

First, find $\frac{5}{12}$ of the height, thus;

Set the denominator 12 upon A, to the numerator 5 upon B; then against 48, the height upon A, you will find 20 upon B; which is $\frac{5}{12}$ of 48; then,

Set the proper gauge-point upon D, to five-twelfths of the height upon C, and against the diameter upon D, you will have the content upon C.

Operation.

For Ale or Beer.

Set 18.94 upon D, to 20 upon C; then against 26 upon D, is 37.66 upon C, the content in gallons.

For Wine or Cyder.

Set 17.14 upon D, to 20 upon C; then against 26 upon D, is 45.98 upon C, the content in gallons.

For Malt or Corn.

Set 52.32 upon D, to 20 upon C; then against 26 upon D, is 4.93 upon C, the content in bushels.

*To gauge a Parabolic Spindle.**Definition.*

A Parabolic Spindle is a solid, formed by the rotation of a parabola about its ordinate.

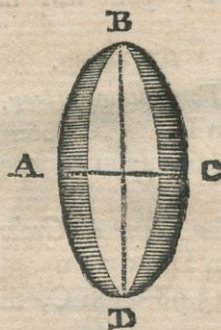
Every Parabolic Spindle is eight fifteenths of its circumscribing cylinder; wherefore this

Rule.

Multiply the square of the diameter (in the middle) by $\frac{8}{15}$ of the length *, and the product is the content in circular inches, which divide by 359 for ale gallons, 294 for wine, and 2737.47 for malt bushels.

Example.

Suppose ABCD be a parabolic spindle; whose diameter AC, is 15 inches, and length BD is 24 inches; what is the content in ale and wine gallons, and malt bushels?



* *Note,* Multiply the length by 8, and divide the product by 15, the quotient will be equal to $\frac{8}{15}$ of the length.

Operation.

First, 15 (the diameter in the middle) squared, is 225, and that multiplied by 12.8 (eight fifteenths of the length) the product is 2880.0 the content in circular inches, then,

For Ale or Beer.

359) 2880.00 (8.02 content in gallons.

For Wine or Cyder.

294) 2880.00 (9.79 content in gallons.

For Malt or Corn.

2737.47) 2880.0000 (1.05 content in bushels.

By the Sliding-Rule.

First, find $\frac{8}{15}$ of the length, thus;

Set the denominator, 15, upon A, to the numerator, 8, upon B; then against 24 (the length) upon A, you will find 12.8 upon B; which is $\frac{8}{15}$ of 24; then,

Set the proper guage-point upon D, to eight fifteenths of the length upon C; and against the diameter upon D, you will have the content upon C.

Operation.

For Ale or Beer.

Set 18.94 upon D, to 12.8 upon C; then against 15 upon D, is 8.02 upon C, the content in gallons.

For Wine or Cyder.

Set 17.14 upon D, to 12.8 upon C; then against 15 upon D, is 9.79 upon C, the content in gallons.

For Malt or Corn.

Set 52.32 upon D, to 12.8 upon C; then against 15 upon D, is 1.05 upon C, the content in bushels.

*To gauge the frustum of a Pyramid or Cone.**Definition.*

If a Pyramid or Cone be cut by a plane parallel to the base, that which remains below is called the Frustum of a Pyramid or Cone.

Rule.

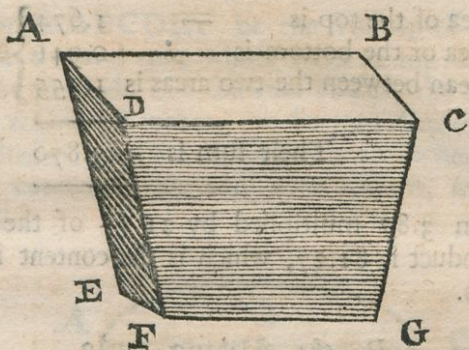
Find the area of the greater base, and the area of the lesser, and then find a geometrical mean between those two areas; the sum of these three, multiplied by one third part of the depth, gives the content.

Note, This is a general rule for the frustum of any pyramid or cone, whose bases are parallel, whether they are square, triangular, circular, or elliptical, &c.

Example.

Suppose A B C D E F G be the frustum of a pyramid, whose bases are rectangular parallelograms, unequal, but parallel, and the sides straight; the length A B of the greater base is 72 inches, the breadth B C is 50 inches, and the length F G of the lesser base is 54 inches, the breadth E F is 37.5 inches, and the depth 63 inches; what is the content in ale and wine gallons, and malt bushels?

Oper.



Operation.

For Ale or Beer.

The area of the top is — — 12.765
 The area of the bottom is — — 7.18
 The mean between the two areas is 9.573 } gallons.

Their sum is 29.518

Then 29.518 multiplied by 21 ($\frac{1}{3}$ of the depth) the product is 619.878, which is the content in ale gallons.

For Wine or Cyder.

The area of the top is — — 15.584
 The area of the bottom is — — 8.766
 The mean between the two areas is 11.688 } gallons.

Their sum is 36.038

Then 36.038 multiplied by 21, ($\frac{1}{3}$ of the depth) the product is 756.798, which is the content in wine gallons;

For Malt or Corn.

The area of the top is	—	1.674	} bushels.
The area of the bottom is	—	0.941	
The mean between the two areas is		1.255	
Their sum is		<u>3.870</u>	

Then 3.87 multiplied by 21 ($\frac{1}{3}$ of the depth) the product is 81.27, which is the content in malt bushels.

By the Sliding-Rule.

1. Set 282 upon A, to 50 upon B; then against 72 upon A, is 12.765 (the area of the top) upon B.

2. Set 282 upon A, to 37.5 upon B; then against 54 upon A, is 7.18 (the area of the bottom) upon B.

3. Set 12.765 (the area of the top) upon C, to 12.765 upon D; then against 7.18 (the area of the bottom) upon C, is 9.573 (the mean area) upon D.

Then add the areas and the mean together, and their sum is 29.518; then,

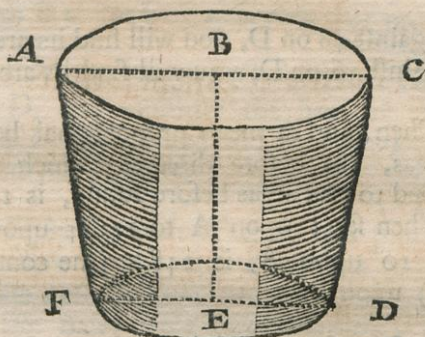
4. Set 1 upon A, to 21 ($\frac{1}{3}$ of the depth) upon B; then against 29.518 upon A, is 619.878 (the content) upon B.

Note, The same must be done for wine, and malt, only instead of 282, you must make use of 231 for wine, and 2150 for malt.

Example

Example II.

Suppose ABCDEF be the frustum of a cone; that is, a round tun, whose bases at top and bottom are parallel, but unequal circles, the top diameter AC is 48 inches, the bottom diameter FD, is 36 inches, and the depth BE is 30 inches; what is the content in ale and wine gallons, and malt bushels?



Operation.

For Ale or Beer.

The area of the top is	- - -	6.417	} gallons.
The area of the bottom is	- - -	3.61	
The mean between the two areas is		4.813	

Their sum is 14.840

Then 14.84 multiplied by 10 ($\frac{1}{3}$ of the depth) the product is 148.4, which is the content in ale gallons.

L 4

Note,

Note, After the same manner may the content in wine gallons and malt bushels be found.

By the Sliding-Rule.

For Ale or Beer.

1. Set 18.94 (the ale gauge-point for a circle) upon D, to 1 upon C; then against any diameters upon D, is the area upon C.

Thus against 48 on D, you will find its area 6.417 }
And against 36 on D, you will find its area 3.61 }

2. Then find a mean proportional between the two areas, (as before directed) which is 4.813; this added to the areas before found, is 14.84.

3. Then set 1 upon A to 14.84 upon B; and against 10 upon A, is 148.4 (the content in ale gallons) upon B.

Note, The same must be observed for wine and malt, only instead of 18.94, (the ale gauge-point) you must make use of 17.14 (the wine gauge-point) for wine, and 52.32 (the malt gauge-point) for malt.

Note also, That an elliptical frustum of a cone, is gauged all one as the frustum of a circular cone, only having regard to find the areas, as you were taught in the ellipsis, and 'tis done.

To find the content of any Tun, whose sides are straight, and bases, parallelograms, or ellipsis's another way.

Rule.

1. To the greater length CD , add half the lesser length FG , and multiply the sum by the greater breadth BC (or bc) reserving that product.

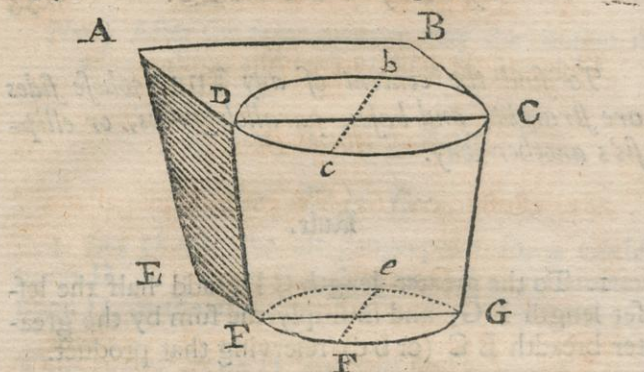
2. To the lesser length FG , add half the greater length CD , and multiply the sum by the lesser breadth EF (or ef) and add this product to the former reserved product.

3. Multiply the sum of these two products by $\frac{1}{3}$ of the tun's depth, and divide the product by 282 for ale gallons, 231 for wine, and 2150 for malt, if the bases were parallelograms: but by 359 for ale gallons, 294 for wine, and 2737.47 for malt bushels, if they were ellipsis's.

Example.

Suppose $ABCDEFG$, be a tun whose bases are parallel and sides straight; the length $AB = CD$ of the greater base is 70 inches, and the breadth BC (bc) is 60 inches; the length FG of the lesser base is 56 inches; and the breadth EF (ef) is 40 inches, and the depth 57 inches; what is the content in ale and wine gallons and malt bushels?

Ans.



Operation.

The greater length D C is	— — —	70
Half the lesser length F G is	— — —	28
Their sum is	— — —	98
The greater breadth B C (b c) is	— — —	60
The product to be reserved is	— — —	5880
The lesser length F G is	— — —	56
Half the greater length D C is	— — —	35
Their sum is	— — —	91
The lesser breadth E F (e f) is	— — —	40
The product is	— — —	3640
The product above reserved	— — —	5880
Their sum is	— — —	9520
One third of the depth is	— — —	19
		85680
		9520
The product is	— — —	180880
Then,		

Then, if the bases are parallelograms,

For Ale or Beer.

282) 180880.00 (641.41 content in gallons.

For Wine or Cyder.

231) 180880.00 (783.03 content in gallons.

For Malt or Corn.

2150) 180880.00 (84.13 content in bushels.

If the bases are ellipsis's, then

For Ale or Beer.

359) 180880.00 (503.84 content in gallons.

For Wine or Cyder.

294) 180880.00 (615.23 content in gallons.

For Malt or Corn.

2737.47) 180880.0000 (66.07 content in bushels.

*To guage the Frustum of a Globe.**Definition.*

The Frustum of a Globe, is any piece cut off from the whole globe.

Rule.

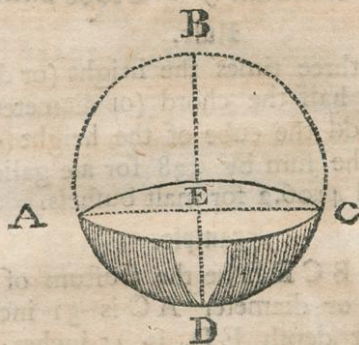
To the area of the frustum's diameter, add the area of the depth more one third of the same; multiply the sum by half the depth, and the product will be the content of the frustum.

Or,

To the square of the frustum's diameter, add the square of the depth more one third of the same, and multiply the sum by half the depth; the product will be the content in circular inches, which divide by 359 for ale gallons, 294 for wine, and 2737.47 for malt bushels.

Example.

Suppose $AECD$ be the frustum of a globe whose diameter AC is 40 inches, and depth ED is 18 inches, what is the content in ale and wine gallons and malt bushels?



Operation.

The square of the diameter $AC=40$ is 1600

The square of the depth $ED=18$ is 324

One third of the square of the depth is 18

Their sum is 1942

Half the depth is — — — 9

Product is the content in circular inches 17478, then

For Ale or Beer.

359) 17478.00 (48.68 content in gallons.

For Wine or Cyder.

294) 17478.00 (59.44 content in gallons.

For Malt or Corn.

2737.47) 17478.0000 (6.38 content in bushels.

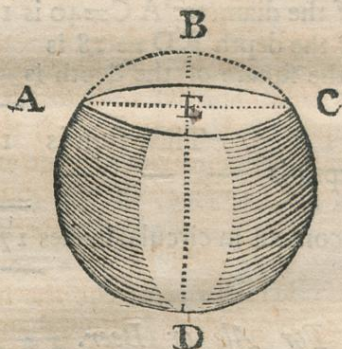
To gauge the Frustum of a Globe another way.

Rule.

Multiply three times the height (or depth) by the square of half the chord (or diameter) and to the product add the cube of the height (or depth) then divide the sum by 538 for ale gallons, 441 for wine, and 4106.2 for malt bushels.

Example.

Suppose A B C D E be the frustum of a globe whose chord or diameter A C is 31 inches, and the height or depth E D, is 35 inches; what is the content in ale and wine gallons and malt bushels?



Operation.

First, three times the height D E is	105
The square of half the chord A C is	240.25
The product is	25226.25
Add the cube of the height E D is	42875
The sum is	68101.25

Then

For

For Ale or Beer.

538) 68101.25 (126.58 content in gallons.

For Wine or Cyder.

441) 68101.25 (154.42 content in gallons.

For Malt or Corn.

4106.2) 68101.250 (16.58 content in bushels.

To gauge the lower frustum of a Parabolic Conoid, cut parallel to the base.

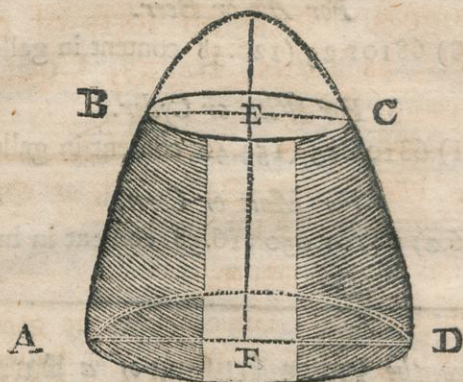
Rule.

To the square of the bottom diameter, add the square of the top diameter; multiply the sum by half the depth, and the product is the content in circular inches, which divide by 359 for ale gallons, 294 for wine, 2737.47 for malt bushels.

Exampler.

Suppose ABCDEFG represent the frustum of of a parabolic conoid, whose bottom diameter is 30 inches, the top diameter 20 inches, and the depth 40 inches, what is the content in ale and wine gallons, and malt bushels?

Opera-



Operation.

The square of the bottom diameters is 900

The square of the top diameter is - 400

The sum of the squares is — 1300

Multiply by half the depth — 20

The product is — — 26000 the

content in circular inches ; then,

For Ale or Beer.

359) 26000.00 (72.42 content in gallons.

For Wine or Cyder.

294) 26000.00 (88.09 content in gallons.

For Malt or Corn.

2737.47) 26000.0000 (9.49 content in bushels.

To

To gauge and inch all sorts of open vessels, as TUNS, BACKS, COOLERS, COPPERS, &c.

To gauge and inch a Mash-Tun, or Guile-Tun.

Definition.

Mash-Tuns, and Guile-Tuns, are generally the frustums of a cone, and it matters not whether they stand upon the greater or lesser base, for the method of gauging them is all one.

Rule.

Divide or part the tun into several frustums; each of 10 inches deep; and find the content of every single frustum by taking the diameters in the middle of every one of those 10 inches; that is, the first diameter at 5 inches from the top; the second diameter 15 inches from the top; the third diameter 25 inches from the top; &c. and multiply their respective areas by 10, (which is done by removing the separating point one place forward to the right-hand) then the sum of all those frustums will be the whole content of the tun.

Note. When the depth of the tun is not even 10 inches, then you must add together as many areas as are taken in the middle of every 10 inches; and the other part of the depth which is not even 10 inches, as suppose 4, 5, 6, &c. must be multiplied by the bottom area, which product, added to the sum of the other areas, gives the content.

M

But

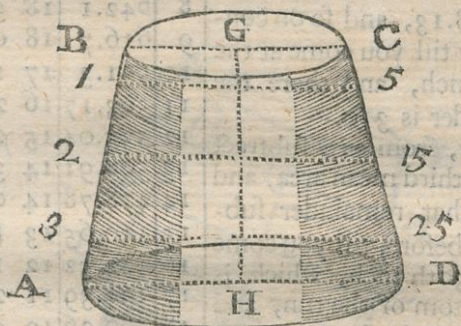
But to find what the tun will hold upon every inch (which is called Inching the tun) as is requisite in large tuns used by brewers, proceed thus;

From the whole content of the tun subtract the mean area of the first frustum continually, till you come at the tenth inch of the tun's depth, and from that remainder subtract the mean area of the second frustum continually, till you come at the 20th inch of the tun's depth, and from that remainder subtract the mean area of the third frustum, &c. and if your work be right, there will be no remainder at the last inch or bottom of the tun.

Note. All tuns whose sides are straight may be inched by this method; whether their bases are circular, square, &c. all the difference being to find the area of the different figures given as bases.

Example.

Suppose $ABCD$, be a tun, whose bottom diameter AD is 108 inches, the top diameter BC , is 93 inches, and the depth GH , is 30 inches, (what is the content) and how many ale gallons will this tun contain upon every inch of the depth.



Operation.

First, take the diameters at 5, 15, 25 inches depth severally, which suppose to be as under, viz. 95.5 inches the first, 100.5 the second, and 105.5 the third; then the areas, either by the pen or sliding-rule, are found to be 25.4 the first, 28.13 the second, and 31. the third; and their contents at 10 inches deep will be 254 gallons the first, 281.3 gallons the second, and 310 gallons the third; and these added together, their sum is 845.3 gallons, the whole content of the tun.

Then from 845.3 subtract 25.4 (the first mean area) and from that remainder subtract 25.4 again, and so on till you come at the 10th inch, and there the remainder will be 591.3

Then from 591.3 subtract 28.13 (the second mean area) and from that remainder subtract 28.13, and so on continually till you come at the 20th inch, and there the remainder is 310.

Lastly, from 310 subtract 31 (the third mean area) and from that remainder subtract as before, till you come to the 30th inch, which is the bottom of the tun, and the remainder is 0.

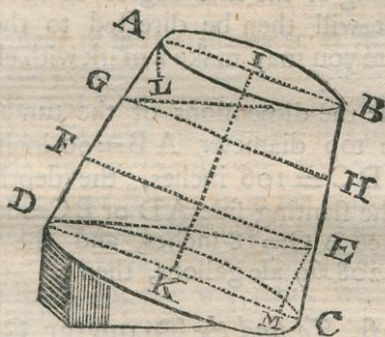
The use of this table is plain to the meanest capacity, for if you come to this tun and find 6 inches of the depth dry, the quantity of liquor then in the tun is 692.9 gallons; if 14 inches be dry, there remains in the tun 478.78 gallons, or 14 barrels, 0 firkins, and 2.78 gallons.

Depth	Content in ale gallons.	Content in B. F. G.		
0	845.3	24	3	3.8
1	819.9	24	0	3.9
2	794.5	23	1	4.0
3	769.1	22	2	4.1
4	743.7	21	3	4.2
5	718.3	21	0	4.3
6	692.9	20	1	4.4
7	667.5	19	2	4.5
8	642.1	18	3	4.6
9	616.7	18	0	4.7
10	591.3	17	1	4.8
11	563.17	16	2	2.17
12	535.04	15	2	8.04
13	506.91	14	3	5.41
14	478.78	14	0	2.78
15	450.65	13	1	0.15
16	422.52	12	1	6.02
17	394.39	11	2	3.39
18	366.26	10	3	0.76
19	338.13	9	3	6.63
20	310.	9	0	4.0
21	279.	8	0	7.0
22	248.	7	1	1.5
23	217.	6	1	4.5
24	186.	5	1	7.5
25	155.	4	2	2.0
26	124.	3	2	5.0
27	93.	2	2	8.0
28	62.	1	3	2.5
29	31.	0	3	5.5
30	0.	0	0	0.0

To find the Drip or fall of a Tun.

Definition.

The Drip or Fall of a Tun, is when it is set a little sloping on one side, for conveniency of cleansing; so that when the bottom (of the tun ABCD) is just covered at D, the other side EC is 20.14 inches wet.



First draw the line EF parallel to the bottom CD, and then it is plain, that when the tun stands in this oblique position, the quantity of wort equal to CDE is more than half of CDEF, because the tun stands upon its greater base: but if it had stood upon the lesser base, the quantity would have been less than half CDEF: and if the tun had been a cylinder, the two quantities, viz. CDE and DEF would be exactly equal.

Now if liquor be poured into the tun until it touches the top diameter at the edge B, the surface of that liquor may be represented by the line BG,

M 3

by

by which it is plain, that the part of the tun A B G A, will be empty, and so the tun will want so much of its whole content, which subtracted from the content, the remainder will be the quantity of liquor that will fill up the tun to B.

Note, If the tun is empty, you may find the point G, that is where the surface of the liquor would cut, if it were filled up, to B, by the help of a quadrant, for looking through the sights at B, and the thread falling at the beginning of the first degree in the limb, your sight will then be directed to the point G, where you may make a mark with chalk : now,

Suppose the dimensions of the tun A B C D be first ; the top diameter A B = 90 inches, bottom diameter D C = 106 inches, the depth I K = 60 inches, the slanting side A D or B C = 60.53 inches, the distance A G = 18 inches, and the content of the tun 1208.69 ale gallons, then ;

1st. *To find the Diameter G H.*

Rule.

Say, as the slanting side A D = 60.53 is to half the difference of the diameters A B and C D = 8 ; so is the slanting side A G = 18 to half the difference of the diameters A B and G H = 2.37, which doubled and added to the diameter A B = 90, will be 94.74, the diameter G H required.

2^d. *To*

2d. To find the depth AL of the frustum
 $ABGH$.

Rule.

Say, as the slanting side $AD=60.53$ is to the depth of the whole tun $IK=60$, so is the slanting side $AG=18$, to its proper part of the depth, viz. $AL=17.84$ required.

3d. To find what the part $ABGA$ will hold.

Rule.

To the square of the top diameter $AB=90$, add one half of the product of the top and bottom diameters (AB and GH) multiply the sum by the depth $AL=17.84$, and the product is 220561.272 , which divide by 1077 , quotes 204.792 for the content of the part $ABGA$ in ale gallons, which subtract from 1208.69 gallons, the whole content of the tun; the remainder 1003.898 gallons is the quantity of liquor the tun will hold, when filled up to the edge B .

To find what quantity of Liquor must be poured into the tun (as it now stands) to cover the bottom CD .

1st. To find CE , this is the

Rule.

Say, As $GH=94.74$ is to $DC=106$; so is $BH=18$, to $CE=20.14$, and so much of the side BC will be wet, when the liquor comes to touch at E .

M 4

2d. To

2d. *To find the diameter E F.*

Rule.

Say, as the slanting side $AD=60.53$, is to half the difference of the diameters (AB and DC) $=8$; so is the slanting part $AF=40.39$ to half the difference of the diameters (AB and FE) $=5.34$; which doubled, and added to AB , the top diameter $=90$, gives 100.68 for the diameter EF required.

3d. *To find the depth E M of the frustum F E D C.*

Rule.

Say, as $BC=60.53$ is to the depth of the tun $IK=60$; so is $EC=20.14$, to $EM=19.96$, then,

4th. *To find what the part F E D will hold.*

Rule.

To the square of the top diameter $FE=100.68$, add one half of the product of the diameter FE multiplied by the diameter DC ; multiply that sum by the depth $EM=19.96$, and the product is 308831.147904 , which divide by 1077 quotes 286.7516 , the content of the part FEC in ale gallons.

Lastly,

Lastly, To find how much Liquor will cover the Bottom, viz. the part DEC.

Rule.

To the square of the bottom diameter $CD=106$, add half the product of the diameter CD , multiplied by the diameter FE ; multiply the sum by the depth $EM=19.96$, and the product is 330777.9184 , which divide by 1077 , and the quotient is 307.1289 , the content of the part DEC in ale gallons.

Note, But the practical way of finding the drip or fall of a tun, &c. is to measure into the tun (when it is dry) so much liquor as will just cover its bottom, by which means you not only find the true fall, but also the true level plane over the bottom of the tun; from which, if the nearest distance from the top of the tun to the surface of the liquor, be set off upon every one of its sides, you will then have a parallel plane at the top of the tun to that of the liquor.

Then having found, as before, so much of the tun's content as is betwixt those two planes, add it to the tun's drip or fall, and that sum will be the whole content of the tun.

And if so much of the tun's content as is between those two planes, be inched as is before directed, and 1, 2, 3, 4, or any number of those areas accounted from the bottom, be added to the fall, that sum will shew the quantity of liquor that is in the tun.

To

To gauge a Back or Cooler.

Definition.

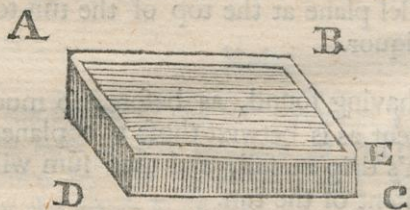
A Back or Cooler is square or oblong, made of wood, &c. about 6, 8, or 10 inches deep, into which the boiling wort is let out of the copper, for more expedition in cooling.

Rule.

Multiply the length by the breadth, and divide the product by 282, and the quotient is the area or number of ale gallons, that the back will hold at 1 inch deep; which multiplied by the depth, gives the whole content.

Example.

Suppose ABCD represent a back or cooler, whose length AB is 112 inches, breadth BE is 78 inches, and depth EC is 8 inches, what is the content in ale gallons.



Operation.

First, 112 multiplied by 78, is 8736, (the area in inches) which divided by 282, is 30.978, the area in ale gallons, or what the back holds at 1 inch deep.

Then

Then 30.978 (the area) multiplied by 8 (the depth) produceth 247.824 ale gallons, the whole content of the back.

Note, You may take one tenth of the area, and reduce it into barrels, firkins, &c. which add continually, gives what the back holds upon every 10th of the first inch deep, and thus you may proceed for the next inch deep, and so on for the whole depth, &c.

To find the true Dip of the Backs.

Because backs are not placed level, but sloping, for conveniency of drawing off the wort; besides, when they have been a little time used, do generally warp, and become more uneven as they grow older; therefore, if you should dip in too deep a place, you would wrong the subject; and if in too shallow a place, you would wrong the king: to remedy which,

1. When the bottom of the back is covered all over (of any depth) with liquor, then dip it in eight or ten several places, as remote and equally distant one from another as you can, noting down the wet inches, and decimal parts of every dip.

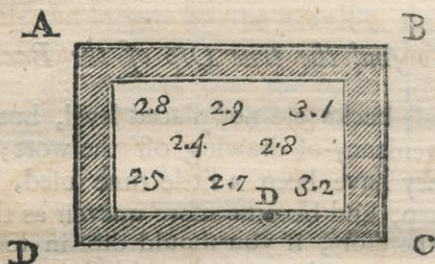
2. Then divide the sum of all those dips, or wet inches, by the number of places you dipped in, and the quotient will be the mean wet of all those dips.

3. Find

3. Find out such a place by the side of the back, that just wets the same with that mean dip, (as suppose at D in the following figure) and make a mark there for the true and constant dipping-place of that back.

Example.

Suppose I take as many dips as you see in the figure;



and add them together, the sum will be 22.4, which divided by 8, (the number of dips) quotes 2.8 for a mean depth, and I find the dip that answers it, to be exactly at D.

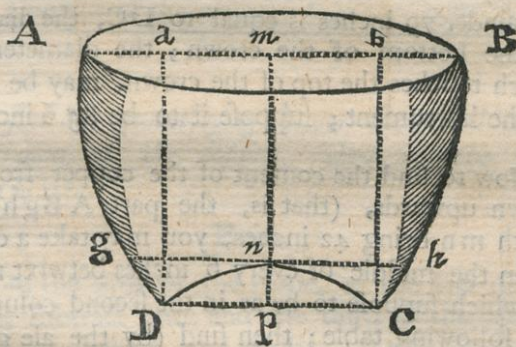
Then if any quantity of worts which cover the whole back, be dipped or gauged at that place, and the wet inches so taken be multiplied into the area of the back in gallons, the product will shew how many gallons of wort are in that back at that time.

To gauge a Copper with a Rising Crown.

In London the common brewers coppers are all made with rising crowns, which they tell you are made so, that the liquor and wort may boil the sooner.

How to take the Dimensions.

Suppose A B C D be a copper to be gauged, the dimensions may be taken, and the content found as under.



Take a small cord or thread, and fasten it at A, and extend the other end to the opposite side of the copper at B, where fasten it, or cause some person to hold it straight; then set one end of your instrument at D, and move it towards A or B, till you find the nearest distance to the thread, as at a; this distance Da, is the depth of the copper; suppose it be 50 inches.

In

In like manner set one end of your instrument upon the top of the crown at n , and take the nearest distance to the thread; as nm , suppose it be 42 inches, which subtract from $Da=50$ inches, the remainder is 8, which is the height of the crown.

Then measure AB , the diameter at the top, which suppose is 110 inches, and hold a thread so as a plummet, at the end thereof, may hang just over D , which it will do when at a ; then measure Aa , which is equal to Bb ; suppose each be 15.5 inches: add these together, and the sum is 31 inches, which subtract from $AB=110$ inches, the remainder 79 inches is equal to DC , the diameter at the bottom of the crown; the diameter gh , which touches the top of the crown, may be found by the instrument; suppose it to be 85.6 inches.

Now to find the content of the copper from the crown upwards, (that is, the part $ABgh$) the depth mn being 42 inches, you may take a diameter in the middle of every 6 inches betwixt m and n , which suppose to be as in the second column of the following table; then find (by the ale gauge-point upon the sliding rule) the areas of those several diameters, and set them against their proper diameters in the third column; having so done, the fourth column is made by multiplying each area by 6, which gives the content at every 6 inches of the depth mn , which, added together, makes 32 barrels, 3 firkins, 7.21 gallons.

Parts of the depth.	Diameters.	Areas of those Diameters.	Content of every 6 Inches reduced to		
			Bar.	Fir.	Gal.
6	108.9	33.03	5	3	2.65
6	105.1	30.76	5	1	6.05
6	101.2	28.52	5	0	1.08
6	97.3	26.37	4	2	5.2
6	93.4	24.29	4	1	1.22
6	90.6	22.86	4	0	1.15
6	86.8	20.98	3	2	6.86
42	Sum is		32	3	7.21
To cover the crown			2	1	4.1
Content of the copper			35	1	2.81

To find the quantity of liquor that will cover the crown of the copper (that is, the part g D n Ch).

Rule.

From the area of the plane, at the top of the crown, subtract once and one third of the area of the crown's height, and multiply the remainder by half the height of the crown, the product is the number of gallons that will cover the crown.

By the diameter $gh=85.6$ inches, the area of the plane of the top of the crown is found to be 20.41 gallons; and by the diameter $np=8$ inches, the area of the crown's height is found to be .178 gallons; once and one third of which, subtracted from 20.41 gallons, the remainder is 20.173, and this multiplied by 4, (half the height of the crown) the product is 80.692, which is the content of the part $gDnCn$, and so much liquor the crown will take to cover it, which is 2 barrels, 1 firkin, 4.1 gallons.

Add the content of the part $ABgh$, viz. 32 barrels, 3 firkins, 7.21 gallons, to the content last found, and the sum will be the whole content of the copper $ABCnD$, viz. 35 barrels, 1 firkin, 2.81 gallons.

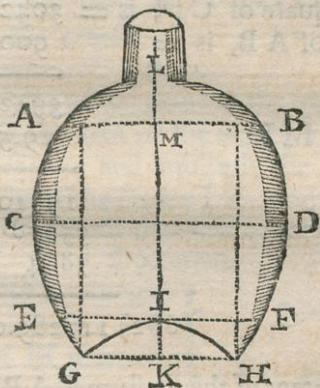
Note, The more curved the sides of any copper are, the more mean circles you ought to take; (*i. e.*) in the middle of every 6, 5, or 4 inches, &c.

A copper is inched by the same method as is before shewn for inching of tuns.

To Gauge a Still.

Stills are generally made with rising crowns, as the coppers are, and must be divided into such figures as (according to your judgment) you think they make the nearest approaches to ;

So in the Still following; the part ALB must be gauged as the segment of a globe; the middle part EABF, as the middle frustum of a spheroid; and the lower part (as in the copper) GEFH, as a parabolic conoid.

*Example.*

Suppose	{	AB = 30	}	Inches,
	EF = 30			
	AG = 35			
	LM = 7			
	MI = 29.5			
	IK = 5.5			
	GH = 23			
	[	CD = 39	]	

How many wine gallons will this Still hold.

N

1st. For

1st. For the middle frustum $EABF$, as the middle frustum of a spheroid.

Rule.

To twice the square of CD , add once the square of AB ; multiply the sum by MI , and divide the product by 882, and the quotient is the content of that part in wine gallons.

Operation.

Twice the square of CD , is = 3042

The square of AB , is = 900

The sum is 3942

Multiply by MI 29.5

19710

35478

7884

882) 116289.000 (131.858

So the content of the frustum $EABF$ is 131.858 wine gallons.

2d. For $ALMB$, as the segment of a globe.

Rule.

Multiply three times the height LM , by the square of half the chord AB , and to the product add the cube of the height LM ; then divide the sum by 441, and the quotient is the content of the segment in wine gallons.

Three

Operation.

Three times the height LM is 21

The square of half the chord AB is 225

105

42

42

The product is

4725

Add the cube of the height LM is 343

441)5068.000(11.492

So the content of the segment ABLM is 11.492 wine gallons.

3d. For the part EIFHIG, viz. what will cover the crown.

Rule.

From the area of the plane at the top of the crown EF, subtract the area of the height IK, more one third of the same; and multiply the remainder by half the height of the crown IK, and the product is the number of gallons that will cover the crown.

Operation.

The area of EF in wine gallons, is ———— } 3.061

The area of IK more one third of the same, is — } 136

Remains 2.925

Multiply by half the height IK ———— } 2.75

14625

20475

5850

Will cover the crown 8.04375

Add the part ECABDF 131.858

Add the part ALMB 11.492

The whole content of the still is ———— } 151.39375 wine gal.