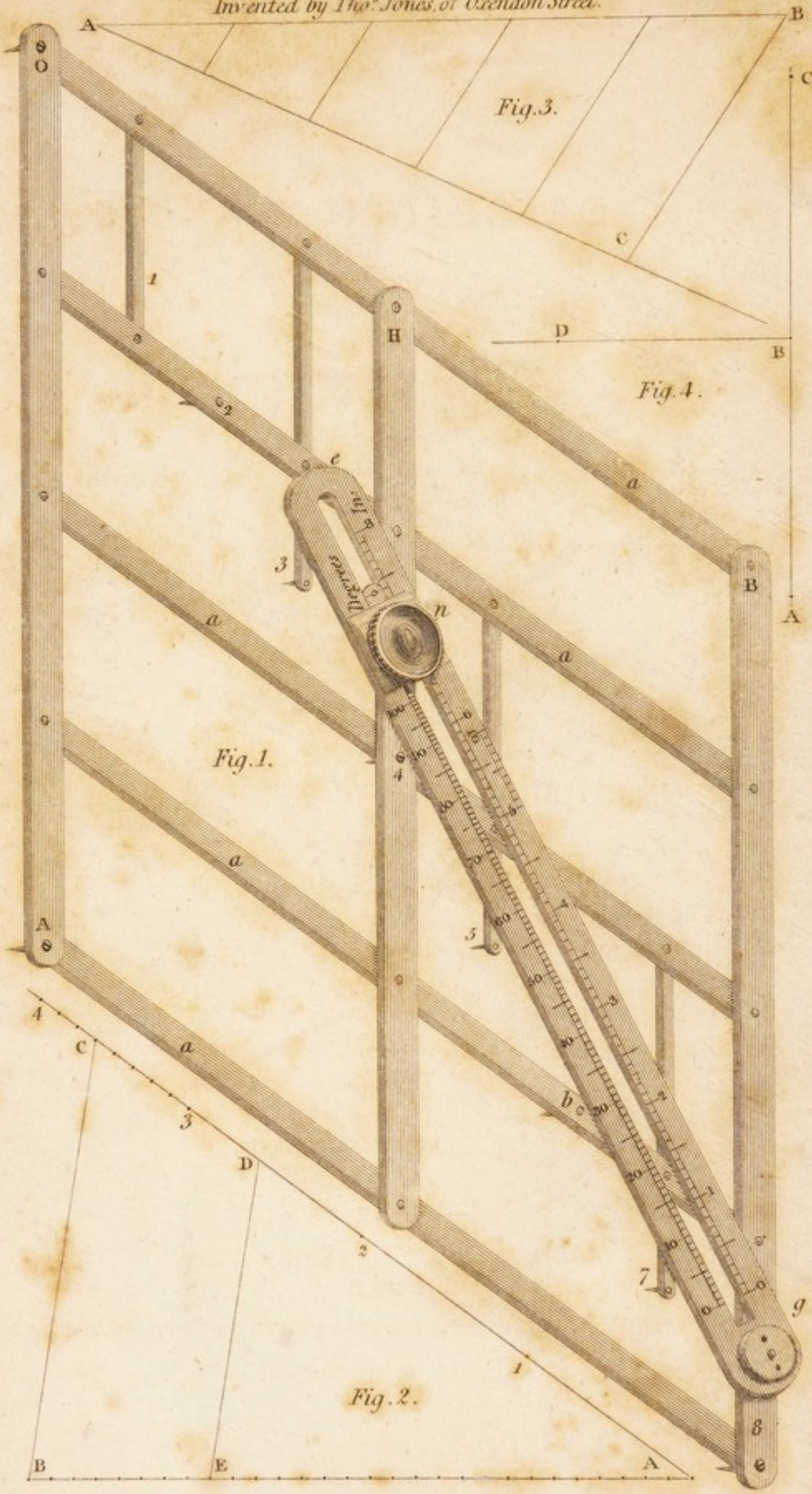
Description of a new transit instrument / improved by Sir H.C. Englefield ... and made and sold by T. Jones.

Sectograph.

Invented by Thos. Jones of Ozendon Street.



DESCRIPTION AND USE

OF

"The Sectograph,"

PRINCIPALLY INTENDED FOR THE PURPOSE OF

DIVIDING RIGHT LINES INTO EQUAL PARTS,

MEASURING, LAYING DOWN,

OR

DIVIDING ANGLES,

AND

INSCRIBING POLYGONS IN THE CIRCLE, &c.

INVENTED AND MADE BY

THOMAS JONES,

Astronomical and Mathematical Instrument Maker, &c.
No. 21, *Oxendon-Street.*

London:

PRINTED BY RICHARD AND ARTHUR TAYLOR, SHOE-LANE.

M.DCCC.XIV.

DESCRIPTION,

&c.

SEVERAL years have now elapsed since I first thought of the arrangement for this instrument; but though I obtained a patent for it about two years ago, I have till now been prevented from submitting it to the public by various professional duties which I could not lay aside; being obliged, like every man who tries to attain excellence in his profession, to finish the greater and most particular parts of my instruments with my own hands.

The sectograph will, I hope, effect the purposes intended; namely, a considerable saving of time, and a degree of accuracy applicable to the various purposes of drawing. The instrument is very simple in its construction, and easy in its use; requiring only one setting or adjustment for dividing, laying down, or measuring any space or angle; and with a facility calculated to lessen the laborious part of these processes, and to render them light and pleasant to the careful and elegant draughtsman.

The common size of the sectograph is about eight inches long, and measures to the extent of that distance. The instrument is packed in a morocco case (with a printed description inside) the exterior of which is about nine inches long, and three quarters of an inch square*.

Description of the Instrument.

The bars of metal (or other substance) (Pl.VI.) A,H,B, are of equal dimensions, the bars *a*, *a*, *a*, *a*, *a*, are likewise equal to each other. The whole of the eight bars are of the same length, and are pinned and screwed together at the dots and small circles, where the ends of the smaller bars join the larger; each joint giving an easy and pleasant motion. 1, 3, 5, and 7 are small short pieces placed across, and pinned to the others. 0, 1, 2, 3, 4, 5, 6, 7 and 8 are the places where the steel points are fixed into the bars. *e*, *g*, is a scale with a slit in the middle, which receives the clamp and fixing screw *n*, for holding the points at any required di-

* The price of the eight-inch is two guineas, that of others in proportion to their lengths, &c. as they are made to any size, with any number of points, or without the clamp and scale, if required.

stance,

stance. This scale has degrees on one side of the surface, and inches and parts of inches on the other.

Directions for using the Sectograph.

The letters and figures referred to in the following directions are marked on the instrument.

Open the instrument by pulling A and B asunder, until the exterior nearly forms a square. Hold it in the hand, or place it on paper, with A next to you: the points will then appear in line, and numbered from left to right 0, 2, 4, &c. and may be made to recede from or advance to each other at pleasure. For dividing *lines*, place 0 on the beginning, and the 2d, 3d, 4th, &c. on the other point or distance to be divided, and press down the intermediate points, or as many as may be required. When a transfer or copy is to be taken, take care to clamp the instrument by the milled head as soon as it is set. For measuring *distances*, place 0 on one point, and the point of the opposite corner on the other: the scale on the side where the divisions are marked 1, 2, 3, 4, &c. (indicating inches) will give, at the clamp, the inches and parts of the required distance. For laying down *angles*, (the other side of the scale marked 10, 20, 30, &c. are the degrees, the point A the angular point, and the other two points 0 and 8 form with A the sides of the angle,) set the division of the clamp to the number of degrees, clamp the instrument, and apply the points to the paper, or other surface. For measuring *angles*, place the point A in the angle, and the other points to the sides respectively, clamp the instrument, and the scale will give the number of degrees. For angles of one degree, &c. set the instrument to ninety degrees, and clamp it; then place A, 8, on one side of the angle and let fall the point 0, press gently the points A and 0, loosen the clamp, lift the point 8, and move the required number of degrees, either for measuring or laying down angles. By the scale of inches the points are placed one inch, one-half, one-quarter, one-eighth, or one-sixteenth, from each other. The intermediate distances may be had by the scale of inches. In order to get the hundredth part of an *inch*, set the clamp to 5 inches, beyond which are ten divisions; then place the 7th point in the dot where you want the hundreds to commence; let fall the 8th point, on which place the second finger of the right hand firmly; with the other hand hold the end 0, letting the fingers touch the paper; then raise the 7th point, still keeping the 8th down, and move the points towards each other until you come to the first of the

ten

ten divisions; then with the first finger of the right hand make a dot with the 7th point, (which may easily be done without marking with the other points,) which distance will be one-hundredth of an inch; then raise the 7th point, move to another division, dot, &c. &c. By using every second division you will have the fiftieth of an inch, &c. Fractional parts of distance may be measured by the same means.

The Sectograph and Scale for dividing Circles, Angles, Lines, &c.

This sectograph is exactly the same as the former, except that of its not having the graduated scale *e*, *g*; instead of which it is accompanied by a scale, the size of the instrument when opened to its greatest extent, that is, about eight inches and a half long and five-eighths of an inch wide. Both being of the same dimensions, are neatly packed in one case.

The ivory scale has on one side a diagonal scale of inches; on the other, polygons, sines, tangents, semi-tangents, and chords;—the whole constructed expressly for the instrument.

The Use of the Sectograph and Scale.

The first (0) and last point (8) on the line of points are called the extremes; the single point (at A or B) the central point.

To divide any line, AB, fig. 1. into a given number of equal parts, each less than the greatest, but greater than the smallest division that can be made by the instrument.

Rule.

1. Draw AC (fig. 1.) making any angle with AB.
2. Take any distance as A 1 between the extreme points, and repeat it as often as necessary along AC; as from A to 1, 1 to 2, 2 to 3, &c.
3. Press down the points in the last division, as from 3 to 4, and let C be the required point.
4. With the same extent of the sectograph and one extreme in C, let the other fall in D.
5. Join CB, and parallel thereto draw DE; then BE is one extent of the sectograph on the line AB, to which apply it and finish the division.

Example. Let it be required to divide the line AB into twenty-nine equal parts with an instrument of eight divisions, or nine points.

Proceed

Proceed as above, and press down the points in the 4th grand division, and C will fall against the 5th point, from which draw a line to B. Then make CD equal to A1, and draw DE parallel to CB, and BE will be the length of eight divisions on the line AB, to which apply the instrument and finish the division.

When the division can be made with one remove of the instrument, it may be easily done by trial without drawing an additional line.

To divide any line AB into a given number of equal parts, each greater than 1, but less than 2, of the greatest divisions that can be made by the instrument.

Rule.

1. Draw AC (fig. 2.) making any angle with AB.
2. With the instrument drawn to its greatest extent, make the required number of divisions along AC, the last point being at C.
3. Join CB, and parallel thereto draw lines from all the points to AB; or, without drawing the lines, make marks in AB, which will then be divided as required.

Let the greatest division that can be made by the instrument be called D.

Then, to divide AB into any number of equal parts, each greater than 2 D, but less than 3 D,

Rule.—Mark AC with twice the required number of divisions, each equal to D, and having joined CB, draw parallels from every 2d point in AC to AB, or make marks therein.

If the divisions to be made on AB are greater than 3 D, but less than 4 D,

Mark AC with three times the required number of divisions, each equal to D, and draw parallels from every 3d point, &c.

N.B. When the divisions on AC are nearly equal to those on AB, the angle at A may be small; but it will be best to make it larger as the difference is greater.

The length of a line being given in inches, to divide it into a given number of equal parts by the lines of $\frac{1}{2}$ and $\frac{1}{4}$ inches on the scale.

Rule.

Multiply the number of inches by 2 or 4, to bring them into half or quarter inches. Then say,

As the number of parts given: to the number of parts in the sectograph: so is the length of the line given to the length of one extent of the sectograph. Take

Take this extent between the extreme points from the line of half or quarter inches (as the case may be), and this extent applied to the given line will divide it as required.

Examples.

1. Let it be required to divide a line of 5 inches long into 17 equal parts?

Here $5 \times 2 = 10$ half inches. Then

As 17 : 8 : : 10 : 4·706 nearly. Take this number between the extreme points of the sectograph from the line of half inches. Then apply it to the given line, and it will divide it as required.

2. To divide a line of $6\frac{1}{2}$ inches long into 37 equal parts?

Here $6\frac{1}{2} \times 2 = 13$ half inches.

Then, as 37 : 8 : : 13 : 2·811 nearly, to be taken from the line of half inches, as in the last example.

3. To divide a line of $14\frac{3}{4}$ inches long into 23 equal parts?

Here $14\frac{3}{4} \times 4 = 59$ quarter inches. Then

As 23 : 8 : : 59 : 20·522 nearly, to be taken from the line of quarter inches.

4. To divide a line of $25\frac{7}{8}$ inches long into 31 equal parts?

Here $25\frac{7}{8} \times 4 = 103\frac{1}{2}$ quarter inches. Then

As 31 : 8 : : 103·5 : 26·71 nearly, to be taken from the line of quarter inches.

5. To divide a line of 48·35 inches long into 100 equal parts?

Here $48{\cdot}35 \times 4 = 193{\cdot}4$ quarter inches. Then

As 100 : 8 : : 193·4 : 15·472 to be taken from the line of quarter inches.

If the length of the line to be divided is not given in inches, it may easily be found by measuring, and then divided by this method, which in some cases will be found to be preferable to the other.

Use of the Lines on the Scale.

The several lines on the scale, which belong to the circle, are adapted to the radius of the instrument, which is the distance between the central point and one extreme point.

1. *Of the Line of Chords.*

To raise a perpendicular, or make an angle of 90 degrees.

Rule.—Fix the middle point (fig. 3.) of the instrument in the point B, or that from which the perpendicular is to be drawn,

drawn, and extend the extremes to any distance along the line, as from A to C; then the central point will fall in the perpendicular line at D.

To find the measure of an angle.

Rule.—Fix the central point in the intersection of the lines, or angular point, and bring the extreme points to the containing lines. Then this extent or distance of the extremes applied to the line of chords, will show the measure of the angle required.

To make an angle of any number of degrees less than 90.

Rule.—Apply the extreme points to the line of chords, and take between them the measure of the angle. Then fix the central point in the angular point, and the extremes will fall in the lines to be drawn from that point.

N.B. If it be required to make an angle less than can be taken between the extreme points of the instrument,—draw a perpendicular or angle of 90°, and then lay down the complement of the required angle.

2. *Of the Sines, Tangents, and Semi-Tangents.*

The lines of tangents and semi-tangents are particularly useful in the projection of the sphere, and the line of sines in drawing the parabola by points. No further explanation seems to be necessary here, as that is given in every treatise where their use is required.

3. *Of the Line of Polygons.*

This line is numbered the contrary way, because the lengths of the sides increase as their numbers decrease: it is regularly divided from 3 to 24, and numbered; but the numbers 11, 13, 15, 17, 19, 21 and 22 are left out for want of room.

When a polygon of several sides is inscribed in a circle, by continuing the division with one side only taken from the scale, the error (if any) will increase with the number; and will consequently at last be very considerable. It will therefore be necessary to divide the circle into parts of 2, 3, or more sides each; and then take one side between the extremes from the line of polygons, and finish the polygon by subdivisions. This may be done very correctly for composite numbers.

Thus the number 21 is composed of 3 and 7: therefore, divide the circle first into 3 parts, and then take the side of 21 from the line, and subdivide each division into 7.

Again,

Again, 20 is composed of 4 and 5: therefore divide the circle into 4 parts, and then by the side of 20 subdivide each division into 5.

For the prime numbers take one side from the line of polygons, and with it mark 3 divisions as exactly as possible. Take these 3 divisions between the extremes, and divide the circle into as many divisions of 3 sides each, as are necessary; then with one side between the extremes trisect the divisions.

N. B. On the line of sines, the sine of 53 degrees is equal to the chord of three sides of a polygon of 23 sides nearly.

For the purpose of very readily measuring degrees, bisecting angles and lines, the sectograph (if required) may be made to consist of three points only in the line, besides the central point.

Printed by R. and A. Taylor, Shoe-Lane, London.