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GEOMETRICAL

AND

GRAPHICAL ESSAYS,

CONTAINING,

A GENERAL DESCRIPTION

OF THE

MATHEMATICAL INSTRUMENTS

USED IN

GEOMETRY, CIVIL AND MILITARY SURVEYING, LEVELLING, AND PERSPECTIVE;

WITH MANY NEW

PRACTICAL PROBLEMS.

ILLUSTRATED BY THIRTY-FOUR COPPER PLATES.

BY THE LATE

GEORGE ADAMS,

MATHEMATICAL INSTRUMENT MAKER TO HIS MAJESTY, &c.

THE SECOND EDITION,

CORRECTED AND ENLARGED BY

WILLIAM JONES,

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may at any moment, without the trouble of getting out, see the number of the revolutions of the wheel. If the instrument is to be always applied to one wheel, a table may easily be constructed to shew the distance in miles and its parts by inspection only.

The *pedometer* is exactly the same kind of instrument as the way-wiser. The box containing the wheels is made of the size of a watch case, and goes into the fob, or breeches pocket; and, by means of a string and hook fastened to the waistband or at the knee, the number of steps a man takes in his regular paces are registered, from the action of the string upon the internal wheel-work, at every step, to the amount of 30,000. It is necessary to ascertain the distance walked, that the average length of one pace be previously known, and that multiplied by the number of steps registered on the dial plate.

OF THE SURVEYING CROSS, *fig.* 2, *plate* 14.

The cross consists of two pair of sights, placed at right angles to each other: these sights are sometimes pierced out in the circumference of a thick tube of brass about 2½ inches diameter, see *fig.* 3, *plate* 14. Sometimes it consists of four sights strongly fixed upon a brass cross; this is, when in use, screwed on a staff having a sharp point at the bottom to stick in the ground; one of this kind is represented at *fig.* 2, *plate* 14. The four sights screw off to make the instrument convenient for the pocket, and the staff which is about 4½ or five feet in length (for both the crosses) unscrews into three parts to go into a portmanteau, &c.

The surveying cross is a very useful instrument for placing of offsets, or even for measuring small pieces of ground; its accuracy depends on the sights being exactly at right angles to each other. It may be proved by looking at one object through two of the sights, and observing at the same time, without moving the instrument, another object through the other two sights; then turning the cross upon the staff, look at the same objects through the opposite sights; if they are accurately in the direction of the sights, the instrument is correct.*

It is usual, in order to ascertain a crooked line by offsets, first to measure a base or station line in the longest direction of the piece of ground, and while measuring, to find by the cross the places where perpendiculars would fall from the several corners and bends of the boundary; this is done by trials, fixing the instrument so, that by one pair of sights both ends of the line may be seen; and by the other pair, the corresponding bend or corner; then measuring the length of the said perpendicular. To be more particular, let A, h, i, k, l, m, *fig*. 35, *plate* 9, be a crooked hedge or river; measure a strait line, as AB, along the side of the foregoing line, and while measuring, observe when you are opposite to any bend or corner of the hedge, as at c, d, e; from thence measure the perpendicular offsets, as at c h, d i, &c. with the offset staff, if they are not too long; if so, with the chain. The situation of the offsets are readily found, as above directed, by the cross, or *King*'s

* I have made some additions to the box cross staff, which have been found useful and convenient for the pocket, where great accuracy is not required. See *fig*. 6. A compass and needle at the top A to give the bearings, aud a moveable graduated base at B, by rack-work and pinion C, to give an angle to 5′ of a degree by the nonius divided on the box above. Thus the surveyor may have a small theodolite, circumferentor, and cross staff all in one instrument. EDIT.

surveying quadrant; they are to be registered in the field-book.

Of surveying with the chain and cross. What has been denominated by many writers, surveying by the *chain only*, is in fact surveying by the cross and chain; for it is necessary to use the cross, or optical square, for determining their perpendicular lines, so that all that has been said, even by these men, in favour of the *chain alone*, is founded in fallacy. To survey the triangular field A B C, *fig.* 22, *plate* 9, by the chain and cross: 1. Set up marks at the corners of the field. 2. Beginning, suppose at A, measure on in a right line till you are arrived near the point D, where a perpendicular will fall from the angle, let the chain lie in the direction or line AB. 3. Fix the cross over AB, so as to see through one pair of sights the mark at A or B, and through the other, the mark at C; if it does not coincide at C with the mark, the cross must be moved backwards or forwards, till by trials one pair of the sights exactly coincide with the mark at C, and the other with A or B. 4. Observe how many chains and links the point D is from A, suppose 3.0.3. which must be entered in the field-book. 5. Measure the perpendicular D C, 643. 7. finish the measure of the base line, and the work is done. *This mode is used at present by many surveyors, probably because there is no check whereby to discover their errors, which must be very great, if the survey is of any extent.*

To plot this, make AB equal 11.41. AD equal to 3.0.3. on the point D erect the perpendicular D C, and make it equal 6.43. then draw AC, B C, and the triangle is formed.

Fig. 1.

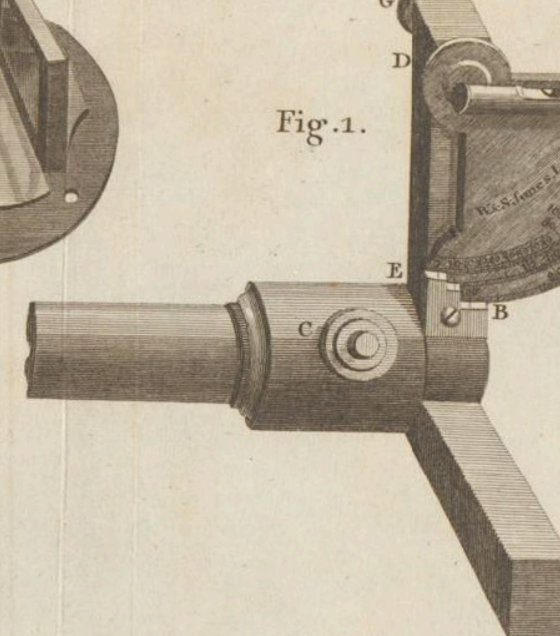


Fig. 2.

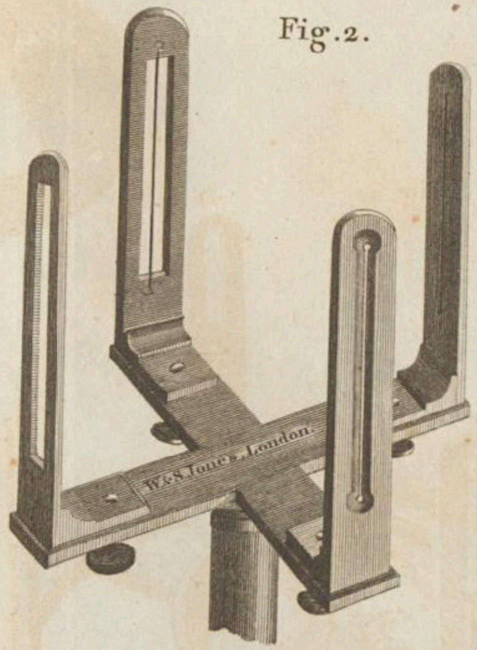


Fig. 3.

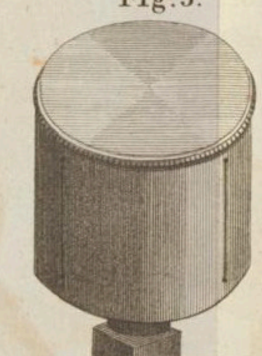
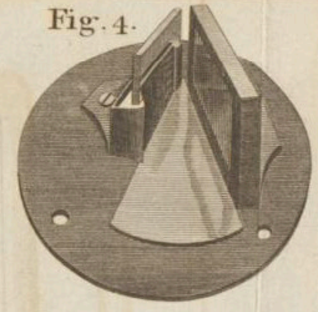


Fig. 4.



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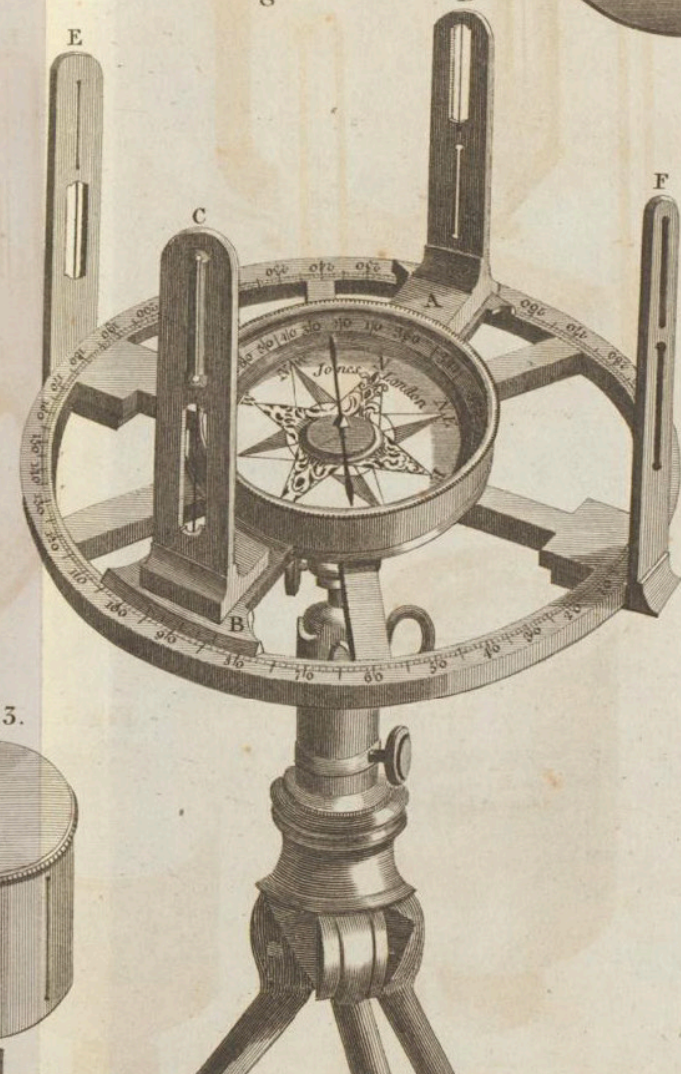


Fig. 6.

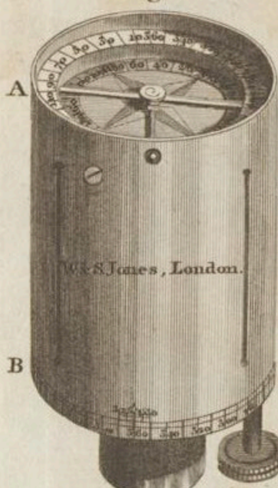
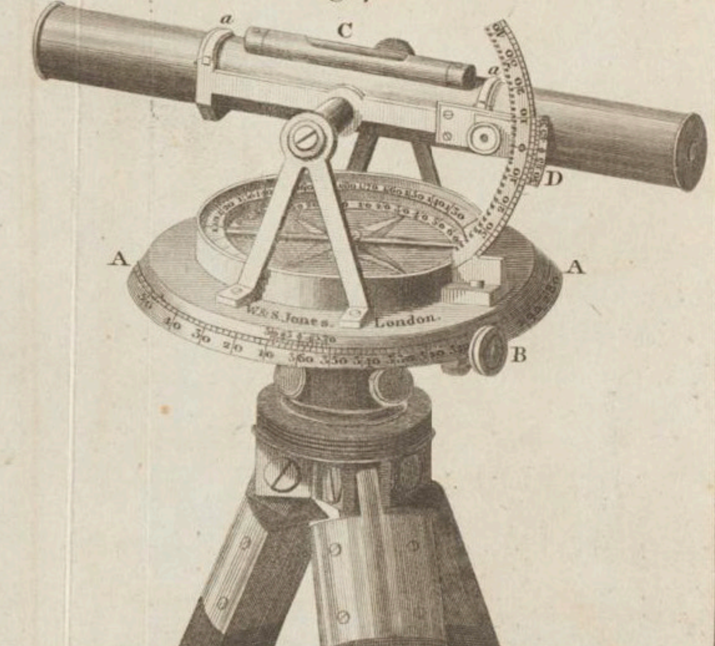


Fig. 7.



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