

XIV. *Description and Use of a new constructed Equatorial Telescope or portable Observatory, made by Mr. Edward Nairne, London.*

Read Feb. 7, 1771. **T**HE Instrument consists of the following parts (see the annexed Plate, TAB. IV.) a mahogany triangular Stand A A A, and three adjusting screws B B B; a moveable azimuth Circle C, which is divided into degrees, and by a vernier index to every 6 minutes; above this azimuth Circle is the horizontal plate D, to the under part of which is fastened the vertical conical axis E; on the middle of the upper surface of the horizontal plate, is placed a ground glass Level F, by which the plate D is set parallel, and the pillar E perpendicular to the horizon; from this plate rise perpendicularly two quadrants G G, one of which is divided for the latitude into half degrees, and has a vernier index to 3 minutes; the equatorial plate H, with its hour circle, is supported by the two quadrants G G; its axis of motion (which is placed near the hours XII. XII.) passes through the centers of the quadrants, and carries the index I, pointing to the divided quadrant; the equatorial plate is divided into half degrees, and has a vernier index shewing every 3 minutes of right ascension or 12 seconds of time; it is figured to shew

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both degrees and time; to prevent misapprehension, it may be right to remark that the hours XII. XII. ought properly to have been placed according to the meridian line; they are here placed otherwise, for the convenience of better seeing the meridian distance shewn by the vernier; On the upper part of the equatorial plate is the plate K; upon this plate K, are fixed the two supporters MM, which support the axis N, under which is fastened the semicircle of declination O, divided into half degrees, and has a vernier index subdividing it to 3 minutes; on the upper part of this axis, is fixed an achromatic Telescope P, which magnifies about 50 times; to the eye End of this Telescope, is applied a small reflecting speculum making an angle of  $45^\circ$  with the axis of the telescope, whereby objects that are in the zenith or any other altitude may be observed, without putting the body in any inconvenient position; to the under part of the axis N, is fastened a brass arm carrying the weight Q, which counterbalances the telescope, and the brass work annexed to it; whilst the weights R R counterbalance in like manner the whole of the instrument that is moveable on the equatorial axis, so that whatever position the instrument is put in, it will there remain, being perfectly balanced; the four motions of this instrument may, when required, be moved extremely slow, by means of the indented edges of the circle and semicircles, and the screws or worms to which the handles are fixed, *viz.* that for the horizontal motion marked S, called the horizontal handle, that marked T the handle of latitude, V the equatorial handle, and W the declination handle.

To adjust the instrument for observation, the first thing to be done is to make the horizontal plate D level, by means of the spirit level, and the three adjusting screws at the bottom of the stand; this being done, move the equatorial plate either with or without the latitude handle, until the index on the quadrant points to the latitude of the place; and then the equatorial plate will be raised, to the elevation of the equator of the place, which is equal to the complement of the latitude (and which, if not known, may likewise be found by this instrument, as will appear hereafter); and thus the instrument is ready for observation. The manner of using this instrument for the following observations, I shall borrow in part from the words of the late ingenious Mr. Short, in his description of his equatorial telescope\*, which, however, differs essentially in construction from this.

*To find the Hour of the Day, and the Meridian of the Place.*

First, find from astronomical Tables, the Sun's declination for the day; and for that particular time of the day; then set the declination femicircle to the declination of the Sun, taking particular notice whether it is North, or South; and set the declination femicircle accordingly, you then turn about both the horizontal handle and equatorial handle, until you find the Sun precisely concentrical with the field of the telescope; if you have a clock or watch at hand, mark that instant of time, and by looking upon the equatorial plate and vernier index, you will find

\* Vide Phil. Transf. Vol. XL. p. 242.

the exact apparent time of the day, which, comparing with the time shewn by the clock or watch, shews how much either of them differ from apparent time; in this manner you find the hour of the day.

*To find the Meridian of the Place.*

[The instrument remaining as in the last observation.]

You first move the plate K until the vernier on it cuts the 12 o'clock hour, and, discharging the screw to which the declination handle is fixed, turn the telescope down to the horizon, and observe the point which is then in the middle of the field of the telescope, or cut by the intersection of the cross wires, and a supposed line drawn from the center of this field, to that point in the horizon, is your meridian line, where a mark may be set up in order to preserve it; you may likewise preserve this line, by the azimuth circle, which being made moveable, should be turned so as to bring the 0 of the azimuth plate to agree with its vernier, when the telescope is pointed to the meridian; this motion in the azimuth plate will be found very convenient, since you may thus recover the meridian line by it, and it will shew the exact azimuth of any object the telescope is directed to, without disturbing any other part of the instrument: the best time of the day for making this observation for finding your meridian, is about three hours before noon, or as much after noon; the meridian of the place may be found by this method very nearly, and, if proper allowance be made for refraction,

fraction, it may be found to great exactness ; this line once settled will save trouble afterwards, and is indeed the foundation of all astronomical observations.

*To find a known Star or Planet at any proposed instant of time, whether in the day or night.*

The instrument remaining rectified as in the last observation ; set the declination semicircle to the declination of the planet, at the proposed instant, and bring the index of the equatorial plate, to point to the meridian distance of the star or planet, at the proposed instant if westward, or to the complement of the meridian distance if eastward of the meridian. (This distance is found by adding together the right ascension of the Sun in time, and the apparent time of the day, and taking the difference between the sum and the star's right ascension in time ; when the star's right ascension in time is greater than the above sum, the meridian distance will be East ; when the star's right ascension is less than the sum, the meridian distance is West.) Having thus set the Instrument, look through the telescope, you will see the star or planet ; and if it should afterwards get out of the field, you will easily recover it, by moving the equatorial handle only, provided the star is above the horizon, because the diurnal motion of a star is parallel to the equator.

By this instrument most of the stars of the first and second magnitude may be seen even at midday, and the Sun shining bright, as also Mercury, Venus, and Jupiter ; Saturn and Mars are not so easy to be seen, in the day time, upon account of the faintness of  
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their light, except when the Sun is but a few degrees above the horizon ; in the same manner in the night time, when you can see a star or planet, or any new phenomenon, such as a comet, you may find its declination and meridian distance or complement thereof, by turning about the equatorial handle and declination handle, untill you see the star, planet, or new phenomenon ; and looking upon the equatorial plate, you find its meridian distance or complement thereto, and upon the declination semicircle its declination. In order to have the other uses of this instrument, you must set it to the hour XII on the equatorial plate, and to 0 on the semicircle of declination, and set the axis E perpendicular to the horizon, and then this instrument becomes an Equal Altitude Instrument, a Transit Instrument, a Theodolite, a Quadrant, an Azimuth Instrument, and a Level ; the manner of applying it to these different purposes is obvious.

*The following is one Example of its Uses in finding the Altitude of any Object.*

Set 0 of the semicircle of declination, to agree with 0 of its vernier index, and fasten it there ; fix likewise the vernier of the equatorial plate to 12 o'clock, or 0 degrees ; then, having set the axis E perpendicular, by means of the level F, turn the instrument about horizontally upon the axis E, and vertically upon the axis of motion of the equatorial plate, until the object appears in the middle of the field ; and the index I will point out upon the quadrant  
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G, the zenith distance of the object, the complement of which to  $90^\circ$  is its altitude; hence the greatest or meridian altitude may be found, from which the latitude of the place may be deduced in the usual manner.

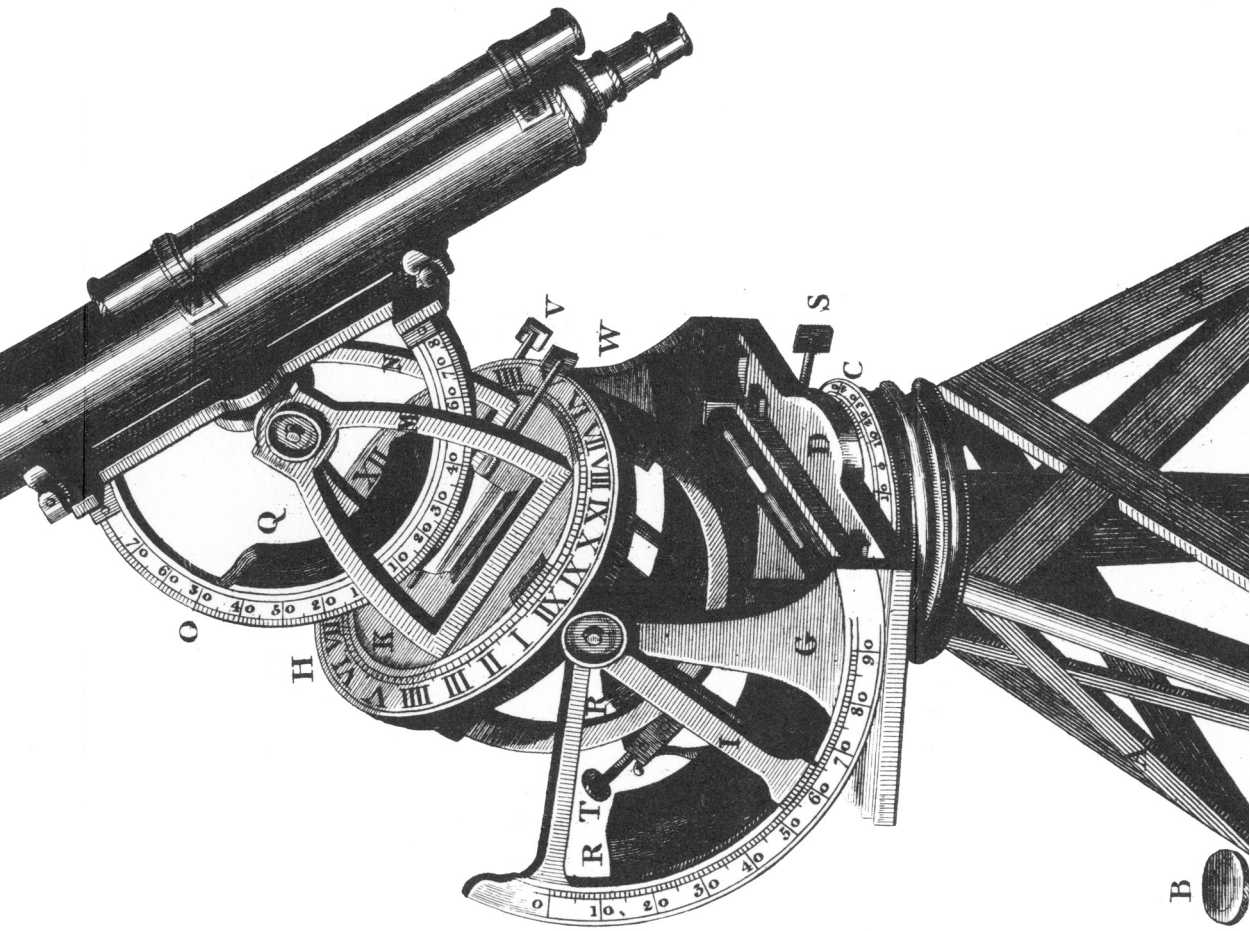
*The Equatorial Telescope.*



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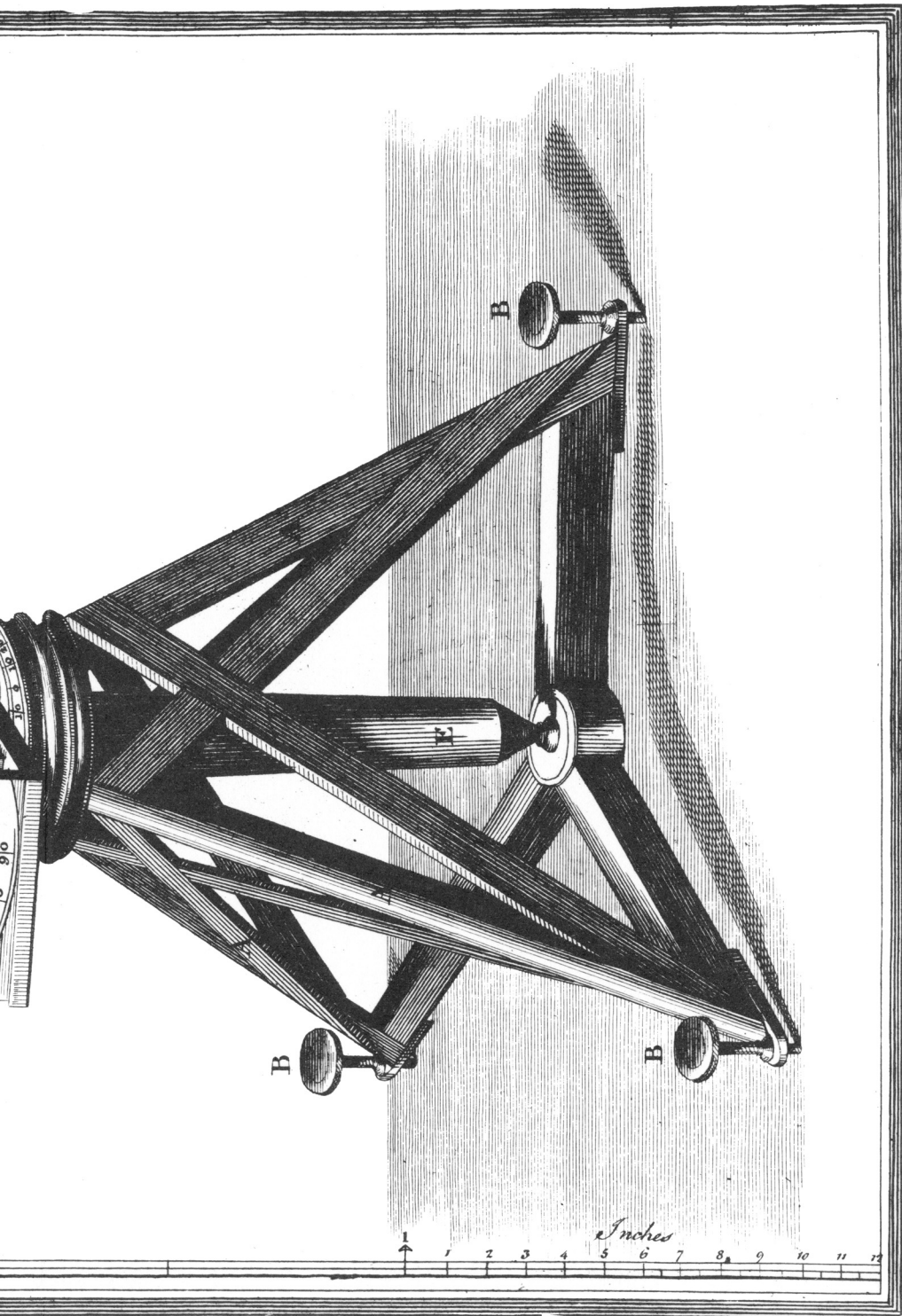
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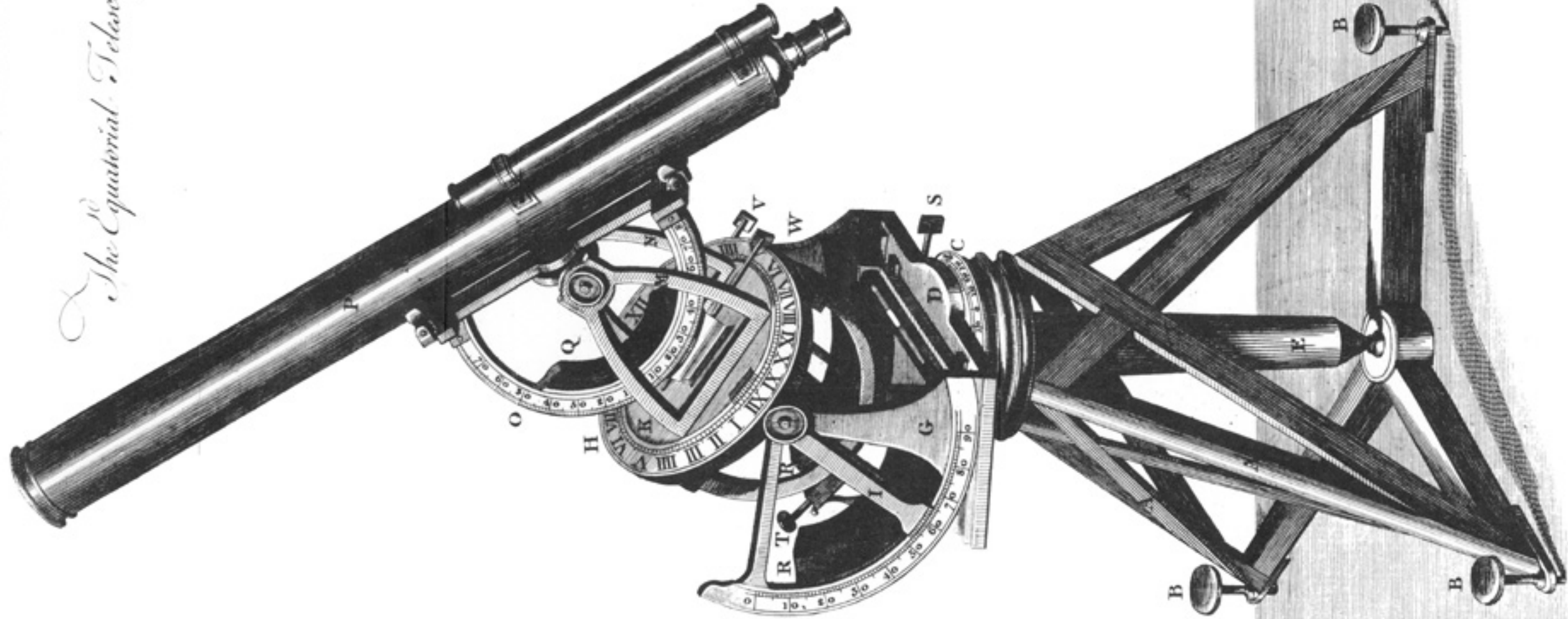
*L. N. B. Paris 1811 et 1812.*

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Inches



*The Equatorial Telescope.*



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Inches