

XXIII. *An Account of an Apparatus applied to the equatorial Instrument for correcting the Errors arising from the Refraction in Altitude. By Mr. Peter Dollond, Optician; communicated by the Astronomer Royal.*

Read March 4, 1779.

THE refraction of the atmosphere occasions the stars or planets to appear higher above the horizon than they really are; therefore, a correction for this refraction should be made in a vertical direction to the horizon.

The equatorial instrument is so constructed, that the correction cannot be made by the arches or circles which compose it when the star, &c. is in any other vertical arch except that of the meridian, because the declination arch is never in a vertical position but when the telescope is in the plane of the meridian.

To correct this error, a method of moving the eye-tube which contains the wires of the telescope in a vertical direction to the horizon has been practised; but as the eye-tube is obliged to be turned round in order to  
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move it in that direction, in the different oblique positions of the instrument, the wires are thereby put out of their proper situation in every other position of the instrument, except when it is in the plane of the meridian; for the equatorial wire should always be parallel to the equator, that the star in passing over the field of the telescope may move along with it, otherwise one cannot judge whether the telescope be set to the proper declination, except at the instant the star is brought to the intersection of the wires, which is only a momentary observation.

The method I have now put in practice for correcting the refraction of the atmosphere is by applying two lenses before the object-glass of the telescope; one of them convex, and the other concave; both ground on spheres of the same radius, which in those I have made is thirty feet. The convex lens is round, of the same diameter as the object-glass of the telescope, and fixed into a brass frame or apparatus, which fits on to the end of the telescope. The concave lens is of the same width, but nearly two inches longer than it is wide, and is fixed in an oblong frame, which is made to slide on the frame the other lens is fixed into, and close to it. These two lenses being wrought on spheres of the same radius, the refraction of the one will be exactly destroyed by that of

the other, and the focal length of the object-glass will not be altered by their being applied before it; and if the centers of these two lenses coincide with each other, and also with that of the object-glass, the image of any object formed in the telescope will not be moved or suffer any change in its position. But if one of the lenses be moved on the other, in the direction of a vertical arch, so as to separate its center from that of the other lens, it will occasion a refraction, and the image will change its altitude in the telescope. The quantity of the refraction will be always in proportion to the motion of the lens, so that by a scale of equal parts applied to the brass frame, the lens may be set to occasion a refraction equal to the refraction of the atmosphere in any altitude. If the concave lens be moved downwards, that is, towards the horizon, its refraction will then be in a contrary direction to that of the atmosphere, and the star will appear in the telescope as if no refraction had taken place.

There is a small circular spirit level fixed on one side the apparatus, which serves to set it in such a position, that the centers of the two lenses may be in the plane of a vertical arch. This level is also used for adjusting a small quadrant, which is fixed to it, and divided into degrees, to shew the elevation of the telescope when directed to the star; then the quantity of refraction an-

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fwering to that altitude may be found by the common tables, and the concave lens set accordingly, by means of the scale at the side, which is divided into half minutes, and, if required, by using a nonius, may be divided into seconds.

It must be observed, that when a star or planet is but a few degrees above the horizon, the refraction of the atmosphere occasions it to be considerably coloured. The refraction of the lens acting in a contrary direction would exactly correct that colour, if the dissipation of the rays of light were the same in glass as in air; but as it is greater in glass than in air, the colours occasioned by the refraction of the atmosphere will be rather more than corrected by those occasioned by the refraction of the lens.

A drawing of the refraction apparatus is added, which may serve to give a more clear idea of it. See plate IV.

EXPLANATION OF THE PLATE.

AA, The circular brass tube, which fits on to the end of the telescope.

BB, The oblong concave lens in its frame, which slides over the fixed convex lens.

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- C, The circular spirit level, which shews when the oblong lens is in a vertical arch.
- D, The quadrant to which the spirit level is fixed, for shewing the angular elevation of the telescope.
- E, The milled head fixed to a pinion, by which the whole apparatus is turned round on the end of the telescope, in order to set the oblong lens in a vertical arch.
- F, Another pinion for setting the quadrant to the angular elevation of the telescope. By means of these two pinions the air bubble must be brought to the middle of the level.
- aa, Is the scale, with divisions answering to minutes and half minutes of the refraction occasioned by the concave lens.



