A

METHOD

OF

CLEARING LUNAR DISTANCES

FROM THE

EFFECTS OF PARALLAX AND REFRACTION.

THE following is a method for clearing lunar distances from the effects of parallax and refraction by projection, which is the same as by Kelly's, except that in place of a long calculation of multiplication and division in that method, I have introduced proportional logarithms, and consequently rendered it much easier and shorter. If the corrections are taken off the scale with care, it will give the true distance to a degree of exactness that one unacquainted with it would scarcely imagine. If the scale was enlarged and made of ivory, it would be very convenient. This method may serve as a corrector, that is to compare it with distances cleared by other methods.

DRAW a vertical line at pleasure, which call the lunar line, as AB fig. 40, plate XXXI, to the right of which draw another line, making an angle with the former equal to the apparent distance (taken off the line of chords) AC, and let that be called the solar line; from the angular point A, lay off the sines of the sun and moon's apparent altitudes, or moon and star's altitude, on their respective lines, and mark the points ☽ and ✳, or ☽ and ☉ to which they extend. Through each of those points ☽ and ✳ or ☽ and ☉ draw perpendicular lines, lunar and solar, and mark where these two lines intersect in D. Then the distance D ☽ from this point to the place ☽ will give the first correction measured on the line of chords, reckoning each degree of the scale a mile, and let this be called the line of correction. When the line of correction falls on the right of the lunar line as in fig. 40, it is subtractive; but when it falls on the left as in figure 41, it is additive. From the line of correction, to find the true correction, multiply the given correction by the given horizontal parallax, and divide the product by 62 when the question is subtractive, but divide by 53 when the correction is additive, and it will give the true correction which is either additive or subtractive, according to the direction herein mentioned.

Example 1. *Fig.* 40.

Given the Moons apparent altitude	56° 20′
Stars apparent altitude	49° 48′
Apparent distance	72° 36′ 13″
Moon's horizontal parallax	59′ 9″

To find the true distance by projection, draw the lunar line at pleasure AB, and draw the line AC to make an angle with the former equal to the apparent distance; from the point A lay off the sign of the moon's apparent altitude AC, and that of the stars equal to A✳ the star's apparent altitude.

Through the point ☽ and ✳ draw perpendicular lines, which will intersect in D; the line D☽ is the first correction, which being measured on the line of chords, and calling each degree a mile, will be found equal to 32′, and this being on the solar or star side of the lunar line, is subtractive; multiply it by the given horizontal parallax, and the product divide by 62, which gives 30′ 32″, which subtract from the apparent distance, viz.

Apparent distance	72° 36′ 13″
Second correction subtract	30′ 32″
True distance	72° 5′ 41″

As logarithms are constructed to facilitate the calculation of multiplication and division, so that by them multiplication is performed by addition, and division by substraction.

EXAMPLE.

The first correction 32′ prop. log.	7501
Moon's horizontal parallax 59′ 9″ prop. log.	4833
	1.2334
The divisor 62′ prop. log. subtract	4629
Prop. log. of the difference gives 30′ 32″	0.7705

The same as above.

Example 2. *Fig.* 41.

Given moon's apparent altitude	40° 00′
Stars apparent altitude	20° 00′
Apparent distance	30° 00′
Moon's horizontal parallax	60′

Plate XXXI

Fig: 40.

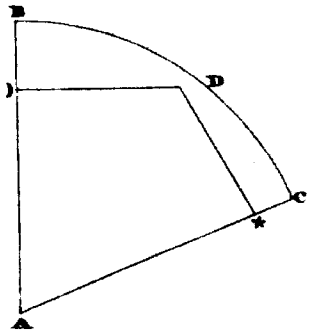


Fig: 41.

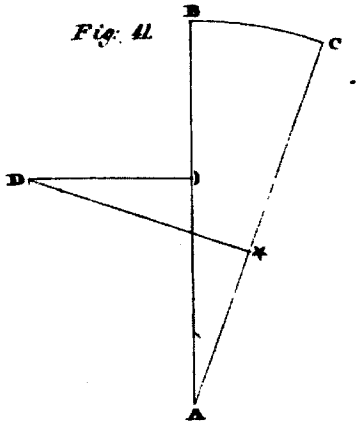


Fig: 42.

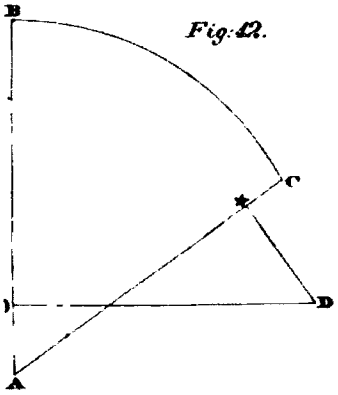


Fig: 43.

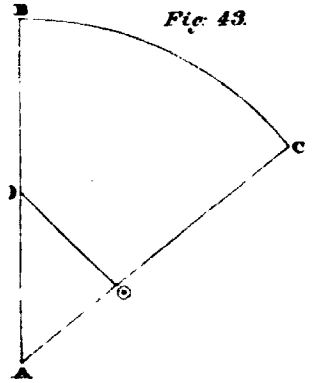


Fig: 44.

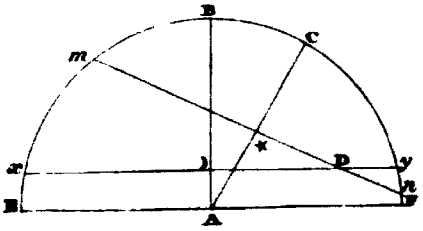
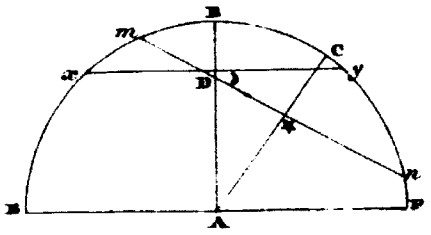


Fig: 45.



En by J Warr Jr Philad^a

To find the true distance, draw the lines ABC as before, making the angle A equal to 30° 00′ the apparent distance, lay off A ☽ and A ✳ equal to the signs of their apparent altitude. Then, through ✳ and ☽ draw perpendicular lines, which will intersect in D, then is the line D ☽ equal to 24° 14′ on the line of chords, which call 24′ 14″ the first correction, and being on the contrary side of the star that is on the left side of the lunar line, it is additive; then 24′ 14″ being multiplied by 60′ the given horizontal parallax, and divided by 53′ will give 27′ 27″, the second correction being added to 30° 00′ the apparent distance will give the true distance, 30° 27′ 27″.

Or by prop. logarithms:

First correction 24′ 14″ prop. log.	8706
Moon's horizontal parallax 60′ prop. log.	4771
	1.3477
53 prop. log.	5310
Prop. log. of second correction 27′ 27″	0.8167

Which being added to the apparent distance, gives the true distance.

Example 3. *Fig.* 42.

Given in the moon's apparent altitude	10° 00′
Star's apparent altitude	70° 00′
Apparent distance	60° 00′
Moon's horizontal parallax,	60′

Let ABC be described to an angle at A equal to 60° the apparent distance, and lay off from the line of sines A ☽ and A ✳ equal to the moon and star's apparent altitudes respectively. Through ☽ and ✳ draw perpendicular lines which will meet in D, then is D ☽ equal to 56° 00′ on the line of chords, calling each degree on the scale a mile, which is the first correction, then 56 × 60 ÷ 62 is equal to 54′ 12″, the second correction which is subtractive from the apparent distance being on the right side of the lunar line will give the true distance.

Example by Proportional Logarithms.

Prop. Log. of first correction 56′ 00′		5071
Prop. Log. of moon's Hor. Par.		4771
	Sum	9842
Prop. Log. 62′		4629
Difference gives prop. log. of second correction 54′ 12″		5213

Apparent distance	60 00 00
Second correction	54 12
True distance	59 05 48

Example 4. *Fig.* 43.

Given the moon's apparent altitude	24° 00′
Sun's apparent altitude	18° 00′
Apparent distance	44° 00′
Moon's horizontal parallax	56′ 30″

To find the correction and apparent distance,

Describe ABC as before, making an angle at A equal to the apparent distance, lay off A ☽ and A ⊙ equal to the sine of the sun and moon's apparent altitudes respectively; through ☽ and ⊙ draw perpendicular lines, which in this case will meet in ☽, therefore it appears there is no correction to be made, so that the apparent distance will be the true distance.

Example 5. *Fig.* 44.

The following example in projection may be performed with equal facility and accuracy, by the scale of chords only, when the apparent distance is not more than 90°.

Given the moon's zenith distance	80° 00′
Star's zenith distance	60° 00′
Apparent distance	24° 00′
Moon's horizontal parallax	60′

To find the true distance:

With the chord of 60° describe the semicircle EBF, make EB the lunar line, and make AC equal to an angle of 24° to equal the apparent distance; lay off 80° the moon's zenith distances, (measured on the line of chords,) both ways from B to X and Y, and draw the line XY, then lay off the star's zenith distance 60° both ways, from C to M and MN; observe where MNXY intersect in D, and D ☽ is the line of correction, which falling on the right side of the lunar line it is subtractive, then multiply the first correction by the given horizontal parallax 60′ anddivide by 62 gives the second correction, or by proportional logarithms, as in the preceding rules.

1st Cor.	48′ 45″	Prop. Log.	5673
Hor. Par.	60′	Prop. Log.	4771
			1.0444
Prop. Log. of 62′			0.4629
Prop. Log. of Second Correction	47′ 11″		0.8515

Ap. Dist.	24° 00′ 00″
Second Cor.	47′ 11″
True distance	23° 12′ 49″

Example 6. *Fig.* 45.

Given the moon's zenith distance	30° 26′ 0
Star's zenith distance	42° 50′ 0
Apparent distance	27° 29′ 43″
Moon's horizontal parallax	54′ 43″

The correction from ☽ to D measured on the line of chords, will reach 4°, calling each degree a mile, will be four miles, which multiply by the given horizontal parallax, and as the first correction falls on the left side of the lunar line, divide by 53, which will give 14′ 14″ for the second correction, falling on the left side of the lunar line, it is additive to apparent distance, or by proportional logarithms.

First correction 4′ prop. log.	1.6532
Moon's hor. par. 54′ 43″ prop. log.	5172
Sum	2.1704
The dividend 53′ prop. log. subt. gives 4′ 8″	5310
Prop. log.	1.6394

Apparent distance	27°	29°	43″
Second correction		4	8
True distance	27	33	51

N. B. The apparent zenith distances, are found by subtracting the apparent altitudes from 90°.

On taking a Lunar Observation when there is only one Observer.

A lunar observation may be obtained by only one observer in the following manner:

Suppose the angular distance between the sun and moon to be increasing, lap them sufficiently, so as to allow time to read off the angular distance, and to set it down on the slate, then observe when their limbs are in contact, and as soon as that is done, take the altitude of the sun, with the same sextant, and by having a quadrant at hand, lay down the sextant, and with the quadrant take the altitude of the moon. This operation may be performed in so short a time, that little or no allowance need be made.

N. B. If the distance be decreasing, it may be performed by separating the objects, and waiting till they come in contact.

Since my remarks on the Andes, page 132, went to press, I have ascertained from Mr. Darby, at his lecture-room, Philadelphia, that the Hymmalaya Mountains are the highest in the