ON THE NEW METHOD OF DETERMINING THE LONGITUDE BY THE CULMINATION OF THE MOON AND STARS:

Being a Paper read before the Astronomical Society of London.

TO WHICH ARE NOW ADDED

AN APPENDIX,

AND

A List of Stars, applicable to the purpose, for the year 1825.

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P A P E R S.

I. *On the Method of determining the Difference of Meridians, by the Culmination of the Moon.* By Francis Baily, Esq. F.R.S. & L.S.

Read April 9 and May 14, 1824.

1. THE mode of determining the difference of longitude between two given points on the surface of the earth, has long engaged the attention of various astronomers and mathematicians; and has been executed with more or less accuracy, according to the means employed for that purpose. I shall pass by those methods which have been expressly invented and proposed for the purposes of *navigation*, where minute accuracy is frequently obliged to be sacrificed to convenience; and shall confine my observations, in the present paper, to those which may be conveniently practised *by land*, and with instruments which are in the hands of every practical astronomer.

2. If the distance between two observatories be not very great, their difference of meridian may be determined with sufficient accuracy, by means of chronometers conveyed from one observatory to the other, or by means of signals previously agreed on. This has been practised very successfully on many recent occasions. But, where this is impracticable, we must have recourse to the observation of certain celestial phænomena for the solution of the problem. For this purpose, five several and distinct methods have been

proposed : 1° the eclipses of Jupiter's satellites : 2° eclipses of the moon : 3° eclipses of the sun : 4° occultations of the fixed stars : 5° the meridional transits of the moon.

3. The results deduced from the observations of the eclipses of Jupiter's satellites are, for obvious reasons, very unsatisfactory. The phænomena will, in fact, appear to take place at different moments of time, with different instruments and to different observers. Moreover, they are visible only in certain positions of the planet in its orbit ; a circumstance which very much circumscribes the utility of the method.

The eclipses of the moon afford a still more unsatisfactory result : they occur but seldom in the course of a year, and the phænomena attending them cannot (on account of the indistinctness of the border of the earth's shadow) be observed with that degree of accuracy which the present state of astronomy requires for such purposes.

Eclipses of the sun are more certain in their deductions : but, they so rarely occur, and are at the same time so limited in extent, that they can seldom be brought in aid of the general solution of the problem. From September 1820 to November 1826, there is only one solar eclipse that will be visible in this country.

4. There remain therefore only the two other methods, on which the practical astronomer can safely and constantly depend. Of these, I am aware that occultations of the fixed stars by the moon have been long considered as affording the best means of determining the difference of longitude between two places : and, assuredly, the results deduced from them have agreed with each other to a greater degree of accuracy, than those deduced by any of the preceding methods.

There are, however, many circumstances, attending the practical solution of the problem by this method, which tend to destroy the confidence which is reposed in the correctness of the theory. In the first place, it is necessary to know the apparent right ascension and declination of the star very exactly, on the day of observation ; which, if the star is of inferior magnitude (and such being the most numerous, are the most likely to be occulted), may not be readily determined : for, we may not be able to find it in any catalogue ; and, when found, we have to compute its precession, aberration, and nutation expressly for this purpose. In the second place, we have to calculate the parallax of the moon in right-ascension and declination (or in longitude and latitude) for the given moment of observation : and in this computation we must assume a given quantity for the compression of the earth; respecting which, astronomers are by no means agreed, and which will consequently give rise to various results, according to the view which each astronomer may take of the subject. Thirdly, this method is dependent on the accuracy of the lunar tables, not only as to the position of the moon and her horary motion, but also as to her horizontal parallax and semidiameter: and in the latter of these quantities we shall sometimes find a difference of four seconds between the tables of M. Burg and those of M. Burckhardt. Fourthly, the method is, in a great measure, dependent on a correct knowledge of the longitude and latitude of the place of observation. And lastly, the apparent border of the moon is so uneven (consisting of projecting mountains and hollow valleys) that we cannot always depend on the immersion or emersion having taken place at the exact distance from the moon's centre, as computed from the lunar tables *.

5. The *meridional transits* of the moon, agreeably to the method about to be described in this paper, are free from all these objections: the observations are made with the greatest facility; the opportunities are of frequent occurrence; the absolute time is of no material consequence; the computations are by no means intricate or troublesome; and the results are (I believe) more to be relied on than by any of the preceding methods. But, prior to

* See the account of the singular phænomenon noticed by M. Koch at Dantzic, when observing the occultation of *Aldebaran* on March 7, 1794. *Con. des Tems* An. vi. page 253. "He "was looking out for the immersion of the star, near the upper crescent of the moon. It disap- "peared at first; but 10″ afterwards it re-appeared suddenly in all its brilliancy. It was soon "afterwards hid a *second time*. It re-appeared however again; but presently after, it disappeared "for the *third time*." In Baron Zach's *Correspondance Astronomique*, vol. iii. page 584, there is an account of the occultation of a star of the 7th magnitude, observed by M. Rumker on February 19, 1820. He made use of a very high magnifying power, which showed very distinctly the mountains in the moon. "The star appeared to run with great velocity along the summits "of these mountains, by which it was *occasionally eclipsed*. This magnificent spectacle lasted "nearly ten minutes." The Baron likewise states, in the same work, page 591, that he himself was, on September 8, 1786, witness to an immersion of λ *Piscium*, which entered behind the moon, in a valley between two high mountains. The late Sir W. Herschel also, in a solar eclipse (recorded in *Phil. Trans.* for 1794) remarked that the first impression on the sun's disc was made by the projection of two high mountains of the moon, having the appearance of horns; which were distinctly visible on the sun's disc before the body of the moon appeared. The same appearance presented itself to M. Mechain, when observing the commencement of this eclipse at Barcelona. See *Con. des Tems*, for 1795-6, page 192.

my entering on this part of the subject, it may be proper to say a word or two on the *old* mode of making these observations; in order that they may be carefully distinguished from the newly proposed mode which I am about to explain.

6. The *old method* appears to have been first mentioned in Purchas's *Pilgrims*, in his account of one of the voyages for the discovery of Greenland. But the example there given is a proof that the correct principles of the subject were not understood. It was afterwards explained in Carpenter's *Geography*, printed at Oxford in 1635. The Marquis De Chabert employed it with success, in his travels in 1753; determining by it the longitude of Carthagena: and in the *Mémoires de l'Acad. Roy. des Sciences* for 1766, he has described a simple method of fixing and verifying a transit instrument, in order to facilitate this mode of observation. Dr. Maskelyne also proposed it in the Appendix to the *Nautical Almanac* for 1769; restricting the comparison, however, to "the principal stars of the first and second magnitude lying "nearest the equator." M. Jean Bernoulli, likewise, has alluded to the method in his *Recueil pour les Astronomes*: and it was made the subject of a distinct publication by the Abbé Toaldo in 1784*. Lastly Mr. Pigott, without knowing what his predecessors had thus done, suggested the same method in the *Phil. Trans.* for 1786 and 1790. But in all these cases, the comparisons have been made between the moon's *centre, reduced to the meridian,* and stars passing the meridian about the same time, observed in *any* parallel of declination. A practice which has evidently led to the failure of the measure. For, although Mr. Pigott states that such stars as are nearest to the moon, in right-ascension and declination, are the most proper on these occasions (a remark that has been repeated by almost every subsequent writer), yet, in practice, this important consideration does not appear to have been attended to: and it has been left to the present day to improve upon the method. Meridional observations of this kind were, therefore, liable to nearly all the objections that have been alluded to in the case of occultations; since both the moon and the stars require to be *reduced* to their apparent places at the moment of observation. The method, therefore, has been seldom followed; and when adopted, has seldom led to any satisfactory results. A remarkable instance of this kind occurs in the list of 665 observations com-

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* For this historical sketch I am indebted to the kindness of Dr. Gregory, Professor of Mathematics at the Royal Military Academy at Woolwich.

puted and compared by M. Bouvard, in the *Con. des Tems* for 1825, page 344, for determining the difference between the meridians of Greenwich and Paris: and where the errors amount sometimes to nearly 37 seconds in time*.

7. The *newly proposed method* consists in merely observing, with a transit instrument, the *differences* of right-ascension between the *border* of the moon, and certain fixed stars previously agreed on; restricting the observations to *such stars as differ very little from the moon in declination*. It is evident that this method is quite independent of the errors of the lunar tables, except as far as the horary motion of the moon (in right-ascension) is concerned; and which, in the present case, may be depended on with sufficient confidence: that it does not involve any question as to the compression of the earth: that a knowledge of the correct position of the star is not at all required: and finally, that an error, even of several seconds, in the state of the clock, is of no consequence. Consequently, a vast mass of troublesome and unsatisfactory computation is avoided. Moreover, it is the only method that is *universal*, or, that may be adopted, at one and the same time, by persons in every habitable part of the globe: for, it is applicable to situations distant 180° in longitude from each other; and even *beyond* that distance, as I shall show by one of the subsequent examples.

8. This method was first successfully practised by M. Nicolai, a distinguished astronomer and mathematician at Manheim; who, in the very first number of Professor Schumacher's *Astronomische Nachrichten*, has drawn the public attention to this point. With a view to show the advantage and convenience of the method, he inserted a list of all the stars (selected from the catalogue of M. Piazzi) that would be favourably situated for such comparisons in the ensuing lunation, and invited astronomers to make corresponding observations. These stars he calls, by way of distinction, *moon-culminating* stars; on account of their culminating about the same time as the moon. The plan was speedily adopted: stars were selected for succeeding lunations, and published all over the continent: and already, at several observatories, the observers have been enabled to determine their difference of meridian, in a few months, with as much accuracy as they formerly could in as many years. It might indeed, at first sight, appear that the same results would be obtained, if we merely observed the correct *time* of the moon's transit, without any re-

* In the *printing* of the formula, by which that list was computed, there appears to be some error, which has escaped the learned author.

ference to the contiguous stars: but, a moment's reflection will convince us that, by referring the moon's border to the adjacent stars, we obviate all errors not only of the clock, but also in the position of the transit instrument.

9. Professor Schumacher, who enters so readily and with so much zeal into every subject connected with the advancement of astronomy, has, ever since, continued to publish, for each lunation, lists of these selected stars; and has recently adopted the plan of publishing them two years in advance, in order that observers situated in distant parts of the world may take advantage of the method, and compare their observations with those made in Europe. The utility of this measure is so obvious, that it will probably be soon adopted in all ephemerides, as affording one of the most ready means of determining the longitude by land. It is with a view of diffusing a more general knowledge of this plan, and of promoting its adoption, that I now take the liberty of intruding on the time and attention of the Society, by attempting a more minute detail of the method, requisite to be pursued in order to deduce the proper solution of the problem, than has been hitherto given in any astronomical work in this country. In doing this, I must necessarily advert to the valuable labours of M. Nicolai; who, in various papers in M. Schumacher's work above alluded to*, has entered into the discussion of this subject with all that talent and accuracy for which he is so distinguished.

10. Let the difference between the time of the transit of the moon's *limb*, and of the fixed star previously agreed on, at the observatory situated most westerly, be denoted by t; and, at the observatory situated most easterly, by τ. These values will consequently be *positive* when the right-ascension of the moon exceeds that of the star (that is, when the transit of the star precedes that of the moon): but, on the contrary, they will be *negative*. Then will $(t - \tau)$ denote the true difference of the right-ascension of the moon's *limb*, for the time elapsed between the observations.

But, the true difference of the right-ascension of the moon's *centre* will (if the two observatories differ considerably in longitude) be somewhat different from this: inasmuch as the time of the moon's semidiameter passing the meridian will have varied in the interval of the observations, partly from a variation in the semidiameter itself, and partly from a change in the moon's declination. Let us denote, for the apparent time of the moon's culmination at the western observatory, her *true* radius, or semidiameter, as seen from the

* *Astronomische Nachrichten*, No. 1. 26. 37. 52.

earth, by r; her *true* declination by d: and let these quantities, at the time of the moon's culmination at the eastern observatory, be respectively denoted by ϱ and δ. Then will

$$(t-\tau) \pm \frac{1}{15}\left(\frac{r}{\cos d} - \frac{\varrho}{\cos \delta}\right) = \Delta \qquad \text{(A)}$$

be the true difference of the right ascension of the moon's *centre*, for the two moments of observation: where the upper sign is to be taken when the first (or western) border of the moon is observed; and the lower sign, when the second (or eastern) border is observed. But, in all cases, where the difference of meridians between the two places is not very great, we may neglect this correction, depending on the variation in the semidiameter and declination of the moon; and the formula will be simply $(t-\tau) = \Delta$.

11. The *true* semidiameter and declination of the moon, above alluded to, are such as they are supposed to be if *seen from the centre of the earth;* in opposition to the *apparent* semidiameter and declination, which some persons have erroneously imagined ought to be adopted. The words *true* and *apparent* are frequently used by astronomers as synonymous terms; which, however, is not the case. The *true* place of the sun, for instance, can *never* correspond with its *apparent* place: neither can the *true* places of the fixed stars correspond with their *apparent* places, except in those cases when the aberration is $= 0$. But, with respect to the planets, and more especially the moon, the *true* place will seldom or never, on account of parallax, agree with the *apparent* place. It is, therefore, desirable that in *all* cases we should carefully distinguish between the *mean*, the *true*, and the *apparent* places. In the present instance it is absolutely necessary, in order to avoid ambiguity and confusion. The augmentation of the moon's semidiameter, on account of her altitude, does not affect the duration of her passage in the transit instrument: neither is her motion in the field of the telescope affected by any apparent deviation from her true declination *. A correction, however, on account of parallax, becomes necessary if the border of the moon has been observed only at the *side* wires of the transit instrument, in the manner hereafter alluded to.

12. This being premised, let us revert to the formula (A); and endeavour

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* See Lalande's *Astronomie*, vol. 2, page 204; and Delambre's *Abrégé d'Astronomie*, page 314.

to deduce therefrom, the difference of meridians between two observatories. In all cases of this kind it is taken for granted, that that difference is *approximately* known; at least to the nearest minute of time. This approximate value I shall denote by χ. Now, in order to deduce, from Δ, the *correct* difference of meridians, which I shall denote by x, we require only one element from the lunar tables: viz. the moon's *horary* motion in right-ascension; or, more properly, the true increase of the moon's right-ascension between the two apparent times of culmination. Let the apparent time (as shown at Greenwich or Paris, or any other meridian for which the ephemeris is computed from which the calculations are made) of the culmination of the moon at the western observatory, be denoted by c; and let a be the true right-ascension of the moon at that time: further, let the apparent time (shown as above) of the moon's culmination at the eastern observatory be denoted by $\varkappa$; and let α be true right-ascension of the moon at that time. Then, knowing the increase of the moon's true right-ascension ($= a - \alpha$), in the given interval of time ($= c - \varkappa$), we have the following proportion; $(a - \alpha)$ is to $(c - \varkappa)$, as Δ is to the angle in time described by the western meridian in the interval of the observations: that is, equal to the difference of longitude added to Δ. Whence the true difference of longitude will be $\frac{c-\varkappa}{a-\alpha}\Delta - \Delta$: and consequently we have

$$x = \left(\frac{c-\varkappa}{a-\alpha} - 1\right)\Delta \qquad \text{(B)}$$

But the motion of the moon in right-ascension being expressed (in the ephemerides) in *arc* and not in *time*, it will be necessary to divide $(a - \alpha)$ by 15: or, which is the same thing, to multiply $(c - \varkappa)$ by that quantity. Consequently we shall have

$$x = \left(15\frac{c-\varkappa}{a-\alpha} - 1\right)\Delta$$

13. There is, however, another modification of this formula to be made, in order to adapt it to general use. The value of $(c - \varkappa)$ is expressed in *apparent* time; which will consequently vary, from day to day, according to the position of the sun in its orbit: and as all the computations are made in sidereal time, the value of $(c - \varkappa)$ must be multiplied by the ratio of the true solar time (on the day of observation) to sidereal time. The value of a true solar day, expressed in sidereal time, is always equal to 24^h added to the sun's daily increase in right-ascension. This value of the true solar day, which

may be taken from any ephemeris*, I shall denote by s ; and our formula will then become

$$x = \left(\frac{s}{24^h} \times 15 \times \frac{c - \varkappa}{a - \alpha} - 1 \right) \Delta$$

But, as it is more convenient that all these values should be expressed in seconds of time, this equation may be finally reduced to

$$x = \left(\frac{s}{86400} \times 15 \times \frac{c - \varkappa}{a - \alpha} - 1 \right) \Delta \qquad \text{(C)}$$

14. In order to bring into one view the final equation, for the practical solution of the problem, let us resume

$$(t - \tau) \pm \frac{1}{15} \left(\frac{r}{\cos d} - \frac{\varrho}{\cos \delta} \right) = \Delta \qquad \text{(A)}$$

and let us make

$$\frac{s}{5760} \times \frac{c - \varkappa}{a - \alpha} - 1 = n \qquad \text{(D)}$$

then will the correct difference of longitudes be †,

$$x = \Delta n = \left[(t - \tau) \pm \frac{1}{15} \left(\frac{r}{\cos d} - \frac{\varrho}{\cos \delta} \right) \right] \times \left[\frac{s}{5760} \cdot \frac{c - \varkappa}{a - \alpha} - 1 \right] \qquad \text{(E)}$$

And here it may be remarked, that when more stars than one have been observed on any given night, $(t - \tau)$ must be taken equal to the *mean* of *all* the comparisons made at the same culmination of the moon.

15. The values of t and τ are determined by immediate observation : and those of c and $\varkappa$ might be easily deduced therefrom, if observers would record their observations *entire* ; since, the sidereal time of the transits being given, we might easily compute the apparent time to the nearest minute, which will be quite sufficient. The values of r, ϱ, d, and δ may be taken from an ephemeris, and computed for the *apparent* times of observation *as shown at the meridian for which such ephemeris is calculated.* The values of a and α may also be computed from the same ephemeris, for the same apparent times as those above alluded to, by the help of second differences. And here, it may be useful to know that it is not necessary to determine with strict accuracy, the *absolute* value of the moon's semidiameter and declination at *both* the obser-

* In the *Con. des Tems* the daily increase of the sun's right-ascension, for every day in the year, is given in a collateral column.

† In this formula, t and τ will be *positive* when the star precedes the moon : on the contrary, they will be *negative*. And the *upper* sign must be taken when the *first* border of the moon is observed. See § 10.

vatories; for, the values may be computed in whole seconds only for one observatory, and the correct *differences* in the given interval added thereto, in order to determine the values for the other observatory. The same remark will apply to the values of c and $\varkappa$, which may be taken to the nearest minute only, provided the corresponding values of a and α be correctly determined. These points will be more fully illustrated in some of the ensuing examples.

15. If the value of c and $\varkappa$ cannot be deduced from the recorded observation, we must compute them from the ephemeris. For instance, the apparent time of the moon's culmination at Greenwich is given in the Nautical Almanac; and the apparent time, *as shown at Greenwich*, of her culmination on any other meridian, may be deduced therefrom by proportion as follows. Twenty-four hours are to the assumed difference of meridians, as the difference in the apparent time of culmination from the given day to the next preceding or following (as the case may be) is to a value which must be *subtracted* from the time of the moon's culmination at Greenwich, if the proposed place is situated to the *east* (or *added*, if to the *west*): from the difference in the former case we must subtract (or to the sum, in the latter case, we must add) the assumed difference of longitude: and the resulting value will give the apparent time, *as shown at Greenwich*, of the moon's culmination at the other meridian. But, when the apparent time of the moon's culmination at one meridian is known, we may deduce the apparent time at the other meridian by a much shorter formula, which will be adverted to in the sequel. See § 32.

It should be understood that it is the time of the culmination of the moon's *centre* which is given in the ephemeris; and this is the value which I have adopted in the ensuing pages. But, strictly speaking, it is the time of the culmination of the observed *border* of the moon, which ought to be adopted: and which will generally differ from the preceding value above a minute in time, either *minus* or *plus*, according as the first or second border is enlightened. The error will be imperceptible if we compute for the *same* point of the moon, at both observatories: and it is for this reason that I have thought it unnecessary to perplex the subject by the introduction of any additional rules. If observers, however, would give the correct time of the transit, it would remove the possibility of any error from this source.

16. I have already remarked that these formulæ are adapted to *sidereal* time only: if therefore the clock, by which any of the comparisons are made, should be adjusted to *mean solar* time, the observed interval, denoted by t or τ,

must be multiplied by 1.0027379. It will not be of any consequence if the clock should not *exactly* show the correct time; as it is the *difference* only, between two given moments, that is required. All that is necessary therefore is, that the clock should go correctly during the short interval of the transits. In fact, the whole method is a method of differences only; and it is to these *differences* that the principal attention must be paid.

17. Since the mean value of s, in the equation (D), is equal to $86636^s,55$; and the mean value of $\frac{c-x}{a-\alpha}$ is equal to 1·8214; it follows that the mean value of n is equal to 26·4: whence it appears, that an error in the observations will, on an average, cause an error of upwards of 26 times that amount in the difference of longitude. This, however, is by no means peculiar to the present method; since it applies always with equal, and mostly with greater force, to every other method of determining the longitude, depending on the motion of the moon.

18. By means of the general formula (E), we shall be enabled to deduce the difference of meridians, when the observations have been complete; that is, when the border of the moon has been observed at all the wires of the transit instrument, or at an equal number equally distant from the centre wire. I shall, in a subsequent part, allude to those cases where the lunar observation has been incomplete, or where only a certain number of wires, not equally distant from the centre, have been used in observing the transit of the moon. In the mean time, I shall proceed to show the application of the above formula by some examples; which, although the same as those given by M. Nicolai in M. Schumacher's *Astron. Nach.* No. 26 and 52, will be solved by means of the formula given in this paper.

19. M. Nicolai at Manheim, and M. Struve at Dorpat, observed the culmination of the first border of the moon on the 3d, 4th, and 5th of March, 1822; and noted down the difference between the time of her passage, and the passage of the following stars, which had been previously announced in M. Schumacher's *Astron. Nach.* The result (after the correction of an error in some of the figures representing the *minutes*, in M. Struve's list) is given in the following table.

1822.	Stars.	Manheim. $t =$	Dorpat. $\tau =$	Differ. $(t - \tau) =$
March 3	309 Mayer	$+ 13^m\ 18^s,30$	$+ 10^m\ 17^s,56$	$+ 3^m\ 0^s,74$
	82 Gemin.	+ 8 9 ,43	+ 5 8 ,55	+ 3 0 ,88
	μ' Cancri	− 9 41 ,11	− 12 41 ,89	+ 3 0 ,78
			mean =	+ 3 0 ,80
March 4	351 Mayer	+ 15 38 ,66	+ 12 51 ,40	+ 2 47 ,26
	44 Cancri	+ 10 12 ,39	+ 7 24 ,99	+ 2 47 ,40
			mean =	+ 2 47 ,33
March 5	410 Mayer	+ 10 49 ,74	+ 8 14 ,08	+ 2 35 ,66
	413 Mayer	+ 6 32 ,41	+ 3 56 ,83	+ 2 35 ,58
			mean =	+ 2 35 ,62

20. As the times of the moon's culmination are not here given, we must deduce them from some ephemeris. By a reference to the *Con. des Tems*, it will be seen that the moon passed the meridian of Paris, on those days, at $8^h\ 51^m$, $9^h\ 45^m$, and $10^h\ 34^m$ apparent time, respectively. Consequently the *Paris* apparent time of her culmination at Manheim (situated by estimation in $0^h\ 24^m\ 31^s$ east longitude from Paris), and at Dorpat (situated by estimation in $1^h\ 37^m\ 28^s$ east longitude from Paris) will, by the rule in § 15, be respectively, to the nearest minute of time, as under: viz.

1822.	Manheim. $c =$	Dorpat. $x =$	Differ. $(c - x) =$
March 3	$8^h\ 26^m$	$7^h\ 10^m$	$1^h\ 16^m$
4	9 19	8 4	1 15
5	10 8	8 53	1 15

The true semidiameter and declination of the moon at Manheim and Dorpat, at those respective hours (Paris time) will be as under: viz.

March 3 $r = 15'\ 44'',4$ $\varrho = 15'\ 44'',8$
$d = 23°\ 51'\ 42''$ $\delta = 24°\ 2'\ 18''$

March 4 $r = 15'\ 36'',6$ $\varrho = 15'\ 37'',0$
$d = 19°\ 40'\ 0''$ $\delta = 19°\ 54'\ 0''$

March 5 $r = 15'\ 28'',5$ $\varrho = 15'\ 28'',8$
$d = 14°\ 30'\ 30''$ $\delta = 14°\ 46'\ 48''$

And consequently the value of $\frac{1}{15}\left(\frac{r}{\cos d} - \frac{\varrho}{\cos \delta}\right)$ will be respectively $-0^s,123$ $-0^s,125$ and $-0^s,100$. Whence we deduce

$$\text{March } 3 \quad \Delta = +180^s,80 - 0^s,123 = 180^s,677$$
$$4 \quad \Delta = +167,33 - 0,125 = 167,205$$
$$5 \quad \Delta = +155,62 - 0,100 = 155,520$$

21. In order to obtain the values of a and α, we must compute, by means of second differences, the true right-ascension of the moon for the apparent times denoted by c and $\varkappa$: the difference of which will be the increase in the true right-ascension of the moon, or her true motion in the interval denoted by $(c-\varkappa)$. The following are the true values, as deduced from the *Con. des Tems*: viz.

March 3	$c = 8^h\ 26^m$	$a = 116°\ 49'\ 24'',4$
	$\varkappa = 7\ \ 10$	$\alpha = 116\ \ 4\ \ 7,6$
	$(c-\varkappa) = 1\ \ 16$	$(a-\alpha) = 45\ \ 16,8$
	$\frac{c-\varkappa}{a-\alpha} = 1,67845$	
March 4	$c = 9\ \ 19$	$a = 131\ \ 5\ \ 44,3$
	$\varkappa = 8\ \ 4$	$\alpha = 130\ \ 24\ \ 13,1$
	$(c-\varkappa) = 1\ \ 15$	$(a-\alpha) = 41\ \ 31,2$
	$\frac{c-\varkappa}{a-\alpha} = 1{\cdot}80636$	
March 5	$c = 10\ \ 8$	$a = 144\ \ 19\ \ 9,3$
	$\varkappa = 8\ \ 53$	$\alpha = 143\ \ 40\ \ 30,7$
	$(c-\varkappa) = 1\ \ 15$	$(a-\alpha) = 38\ \ 38,6$
	$\frac{c-\varkappa}{a-\alpha} = 1{\cdot}94083$	

The length of the true solar day, or the value of s, was on each of those days, as under: viz.*

March 3	$s = 24^h\ 3^m\ 43^s,4 = 86623^s,4$
4	$s = 24\ \ 3\ \ 42,9 = 86622,9$
5	$s = 24\ \ 3\ \ 42,5 = 86622,5$

* M. Nicolai states that the value of s may be assumed as a constant quantity $(= 86623^s)$ for the three days. This, however, will alter the fractional part of the second in each result: and, as very little is gained by such an assumption, I have carried on the operation with the *correct* values.

Consequently we shall have the value of x, on those days, as under:

$$\text{March 3} \quad x = 180^s{,}677 \left(\frac{86623{\cdot}4}{5760} \times 1{\cdot}67845 - 1\right) = 1^h\ 12^m\ 59^s{,}45$$

$$4 \quad x = 167{,}205 \left(\frac{86622{\cdot}9}{5760} \times 1{\cdot}80636 - 1\right) = 1\ \ 12\ \ 54{,}95$$

$$5 \quad x = 155{,}520 \left(\frac{86622{\cdot}5}{5760} \times 1{\cdot}94083 - 1\right) = 1\ \ 13\ \ \ 3{,}71$$

$$\text{mean} = 1\ \ 12\ \ 59{,}70$$

22. The difference of longitude therefore, between Manheim and Dorpat, is, by the observations of these three days only, equal to $1^h\ 12^m\ 59^s{,}7$ which agrees very nearly with the mean result ($= 1^h\ 12^m\ 57^s$) of *all* the observations hitherto made, as given in the table of geographical positions in the *Con. des Tems* for 1826.

23. In these calculations, in which the sexagesimal notation is so much involved, the computer will find considerable assistance in the use of Callet's *Tables Portatives de Logarithmes*. By a happy arrangement of the natural numbers, and by the help of the two collateral columns there given, the computation of any quantities composed of *sexagesimals* becomes, without any reduction, as easy and familiar as those which are formed according to the *decimal* notation. This great improvement (which was at first attacked by the critics) was originally suggested by M. De Parcieux. See Lalande's *Bibliographie Astronomique*, page 415. It is much to be regretted that a similar plan has not yet been pursued in expressing the logarithms of the *circular* functions in *time*, as well as in *arc*: which would frequently save a vast deal of time and trouble to the computer, and prevent many errors that now occur in converting them from one to the other. I do not, however, despair of still seeing this plan carried into execution by some public-spirited individual.

24. In the method laid down by preceding writers, for the solution of the question which forms the subject of this paper, they have assumed that, in the equation (B), the value of $(c-x)$ should denote *one hour*, and that $(a-\alpha)$ should represent the moon's *horary* motion in right-ascension: or, in other words, that $\frac{c-x}{a-\alpha}$ should in all cases be denoted by $\frac{1^h}{h}$; where h denotes the *horary* motion of the moon in right-ascension, deduced from half an hour before and half an hour after that point of time which is the *mean* of the two observations. This, however, is not strictly correct, when the difference of meridians is

very small, as between Altona and Göttingen, or between Greenwich and Paris: nor where it amounts to several hours, as between observatories situated in different hemispheres. It is true that the *horary* motion may be safely employed when the difference of longitudes is nearly *one hour*, or even when it extends to two or three hours (which will comprise the greater part of the observatories in Europe): but in every other instance, it is evident that an incorrect allowance is, in such case, made for the *second differences* in the moon's motion during the given interval. And it happens that the error, occasioned by this assumption, is the greatest about the time of the full moon, when comparisons of this kind are most frequent. As nothing therefore is gained by such an assumption, it will be better in all cases to adopt the true interval (to the nearest minute), and compute the true difference in the moon's right-ascension for that period; in the manner already proposed in this paper. I would remark, however, for the information of those who wish to retain the mode of solution by means of the moon's *horary* motion, that MM. Bessel, Hansen, Nicolai, and Mollweide have, in Nos. 33, 37, and 40 of M. Schumacher's *Astron. Nach.*, given various formulæ and tables for determining such horary motion; which will be found very useful and convenient to those who choose to retain this mode of computation.

25. I shall now give another example of the application of the formulæ above mentioned. On May 30, 1822, M. Nicolai observed the difference of time between the culmination of the first border of the moon, and the culmination of *α Virginis* at Manheim. The difference was likewise observed at Paris, by M. Bouvard: and on the *following* day (according to the civil reckoning) by M. Rumker at Paramatta, in New South Wales*. This latter circumstance will not prevent us from connecting the three observations together: since we have only to assume Paramatta as the most *westerly* position, in comparing it with the observatory at Paris; and then take the *complement* of the resulting value, for its *eastern* longitude. The differences observed were as follow, viz.

Manheim.	Paris.	Paramatta.
$-33^m\ 7^s,74$	$32^m\ 21^s,86$	$-5^m\ 41^s,81$

I shall first deduce the difference of meridians between Manheim and Paris: for this purpose we have $t = -32^m\ 21^s,86$, and $\tau = -33^m\ 7^s,74$; whence $(t-\tau) = +45^s,88$. The apparent time of the moon's culmination at Paris

* See Schumacher's *Astron. Nach.* No. 29, 42, and 52.

(as shown by the *Con. des Tems*) was $8^h\ 16^m$: whence we deduce the apparent (Paris) time of her culmination at Manheim, to be $7^h\ 51^m$. Consequently we have

$$c = 8^h\ 16^m \qquad \varkappa = 7^h\ 51^m \qquad (c-\varkappa) = 25^m$$

The true semidiameter and declination of the moon, at Paris and Manheim, at those hours respectively will be

Paris.	Manheim.
$r = 14'\ 52'',93$	$\varrho = 14'\ 53'',09$
$d = 9^\circ\ 16'\ 6''$	$\delta = 9^\circ\ 10'\ 37''$

Consequently the value of Δ, in the equation (A), will be $+\ 45^s,88 + 0^s,005 = 45^s,885$. The true right-ascension of the moon, for the apparent times above mentioned, will be respectively

$$c = 8^h\ 16^m \qquad a = 191^\circ\ 8'\ 7'',1$$
$$\varkappa = 7\ \ 51 \qquad \alpha = 190\ \ 56\ 41\ ,5$$
$$(c-\varkappa) = 0\ \ 25 \qquad (a-\alpha) = \ \ 11\ 25\ ,6$$

$$\frac{c-\varkappa}{a-\alpha} = 2\ 18786$$

The value of s, on that day, being $86644^s,6$ we shall have for the final equation

$$x = 45^s,885\left(\frac{86644,6}{5760} \times 2\cdot18786 - 1\right) = 24^m\ 24^s,23$$

26. Let us now deduce the difference of longitude between Paramatta and Paris: for this purpose we have $t = -\ 5^m\ 41^s,81$ and $\tau = -\ 32^m\ 21^s,86$; whence $(t-\tau) = +\ 26^m\ 40^s,05$. The apparent (Paris) time of the moon's culmination at Paramatta (considered as being situated by estimation in $14^h\ 5^m\ 30^s$ *west* longitude from Paris, on account of the culmination there happening *after* the culmination at Paris) may be deduced, from the rule in § 15, to be, to the nearest minute of time, equal to May 30, $22^h\ 46^m$, apparent Paris time. Consequently we have

$$c = 22^h\ 46^m \qquad \varkappa = 8^h\ 16^m \qquad (c-\varkappa) = 14^h\ 30^m$$

The true semidiameter and declination of the moon at Paramatta and Paris, at those hours respectively, will be

Paramatta.	Paris.
$r = 14'\ 49'',31$	$\varrho = 14'\ 52'',93$
$d = 12^\circ\ 22'\ 29''$	$\delta = 9^\circ\ 16'\ 6''$

Consequently the value of Δ, in the equation (A), will be $+\ 26^m\ 40^s,05$

$+0^s,381 = 26^m\,40^s,431$. The true right ascension of the moon, for the apparent times above mentioned, will be respectively

$$\begin{array}{rl} c = & 22^h\ 46^m \\ \varkappa = & \ \ 8\ \ 16 \\ \hline (c-\varkappa) = & 14\ \ 30 \end{array} \qquad \begin{array}{rl} a = & 197^\circ\ 48'\ 18'',4 \\ \alpha = & 191\ \ \ 8\ \ \ 7\ ,1 \\ \hline (a-\alpha) = & \ \ \ 6\ \ 40\ \ 11,3 \end{array}$$

$$\frac{c-\varkappa}{a-\alpha} = 2\cdot17398$$

Whence the final equal equation will be

$$x = 26^m\ 40^s,431\left(\frac{86644,6}{5760} \times 2\cdot17398 - 1\right) = 14^h\ 5^m\ 36^s,83$$

which is the longitude of Paramatta *west* of Paris: and this, being subtracted from 24^h, will give $9^h\ 54^m\ 23^s,17$ for the longitude *east*. If from this value we deduct the difference of meridians between Paris and Manheim, found as above, we shall have $(9^h\ 54^m\ 23^s,17 - 24^m\ 24^s,23) = 9^h\ 29^m\ 58^s,94$ for the difference of meridians between Manheim and Paramatta.

27. Hitherto the observations have been confined to the *western* border only of the moon: but, it would evidently add much to the accuracy of the results if the transits of the stars were compared also with the *eastern* border. This suggestion has been attended to by M. Schumacher; and it is his intention in future to extend his list of stars through a greater portion of each lunation, in order that observers may make comparisons with *each* border of the moon. The method of computation will be precisely the same; attention being paid to the double sign in the formula (A). Whether any advantage could be gained by observing particular *spots* on the moon, must be left to future trial. Owing to the difficulty of identifying such spots, as well as to their constant change of position (arising from the libration of the moon) such a plan would be impracticable at observatories very distant from each other; and ought not to be adopted, even in those situated near each other, without considerable caution.

28. I would also remark that it was, at first, the practice of astronomers, in recording observations of this kind, to state merely the *differences* observed. But, they have since adopted the more satisfactory method of recording the *exact* time of each observation (in the order in which they occur); corrected for the error of the clock and the deviation of the instrument: to which are usually annexed (for the reasons hereafter to be mentioned) the number of *wires* at which each observation has been made. It would be a still further improvement of the method of recording and publishing such observations,

if, in all those cases where the moon's border has not been observed at an equal number of wires equally distant from the centre wire, the observed time of the transit at *each* wire were given. For, where the moon's border is not observed at an equal number of wires, equally distant from the centre, it becomes necessary to *reduce* the border to the middle wire: and, as different astronomers may adopt different modes of making this reduction (some of which it will be shown are not strictly correct) it is desirable that, in an affair of so much importance, all the steps of the process should be fully detailed. And this brings me to a more minute examination of the methods employed for this purpose.

29. Let ϖ denote the horizontal parallax of the moon, and θ' the equatorial interval in sidereal time between the given lateral wire and the central wire of the transit instrument: further, let ϕ denote the latitude of the place of observation, and δ the *true* declination of the moon. Then, the parallax, in right ascension $(=p)$, of the moon's border at that lateral wire will, on account of the smallness of the angle θ', be

$$p = \theta'. \sin \varpi. \cos \phi. \sec \delta \qquad \text{very nearly*}.$$

Consequently, when the border of the moon appears at the distance θ' from the centre wire, it is in fact distant therefrom only $(\theta' - \theta'. \sin \varpi. \cos \phi. \sec \delta)$. But, this quantity must be divided by $(1 - \cdot 00277\, m) \cos \delta$, in order to find the time employed by the moon's border in describing that interval: where m denotes the true motion (in right ascension) of the moon, expressed in degrees, during 24 true solar hours; and which may be readily taken from an ephemeris: and where δ still denotes the *true* declination of the moon. Whence the reduction to the meridian will be

$$\pm \frac{\theta'}{\cos \delta} \times \frac{1 - \sin \varpi. \cos \phi. \sec \delta}{1 - \cdot 00277\, m}$$

the upper sign being used when the illuminated border of the moon has not reached the centre wire: and the lower sign when it has passed it.

This formula differs from that which is given by M. Delambre, in the preface to Burg's Lunar Tables; and which is evidently incorrect. It also differs, in a slight degree, from the two formulæ given by M. Nicolai, in Schumacher's *Astron. Nach.* No. 37 and 52.†

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* The correct value is $\sin p = \sin \theta' \sin \varpi. \cos \phi. \sec \delta$; where θ' denotes the *apparent* hour angle, or the *apparent* distance of the moon's border from the meridian.

† The two formulæ given by M. Nicolai, and which he considers as identical, are as follow:

30. It sometimes happens that two observers do not observe the same stars at an equal number of wires in the transit instrument: and consequently such corresponding observations will not be of equal weight in the practical solution of the problem. In order to show the relative value of such corresponding observations, Professor GAUSS has deduced the following formula, depending on the method of minimum squares.

Let the number of wires, at which the moon is observed at one place, be denoted by l, and at the other place by l': further, let the number of wires at which the different stars are observed at one place be denoted by $a, b, c,$ &c. respectively, and at the other place by $a', b', c',$ &c. Put $\frac{l\,l'}{l+l'} = \lambda$, $\frac{a\,a'}{a+a'} = \alpha$, $\frac{b\,b'}{b+b'} = \beta$, $\frac{c\,c'}{c+c'} = \gamma$, &c.: and make $\sigma = \alpha + \beta + \gamma +$ &c. Then will the weight of each day's comparisons be denoted by $\frac{\sigma\,\lambda}{(\sigma+\lambda)\,n^2}$; where n denotes, as before, the value of the equation (D): and the weight of the result of all the comparisons will be expressed by $\Sigma\,\frac{\sigma\,\lambda}{(\sigma+\lambda)\,n^2}$. Let ε denote the probable error of observation; then will the probable error of the final result of all the observations be denoted by

$$\frac{\varepsilon}{\sqrt{\Sigma \cdot \frac{\sigma\,\lambda}{(\sigma+\lambda)\,n^2}}}$$

31. Hitherto the observations have been restricted to the transits of the moon and stars at the moment of their *culmination*: and certainly this point of time presents many advantages. But it is worthy of consideration whether circumstances may not occasionally occur where two observers, in frequent communication with each other, might take advantage of the favourable posi-

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$$\frac{\theta'}{\cos\delta} \times \frac{1 - \sin\varpi . \cos(\phi - \delta)}{1 - \cdot 00277\, m}$$

$$\frac{\theta'}{\cos\delta'} \times \frac{1 - \sin\varpi . \cos\phi . \sec\delta'}{1 - \cdot 00277\, m}$$

where δ' denotes the *apparent* declination of the moon. The formula given by M. DELAMBRE is

$$\frac{\theta'}{\cos\delta} \times \frac{1 - \sin\varpi . \cos\phi}{1 - \cdot 00277\, m}$$

where he has evidently omitted to multiply the second member of the numerator, by $\sec\delta$. M. NICOLAI, in referring to this formula, has considered M. DELAMBRE as using the *apparent* declination: but this is not the case, as he always, in his *formulæ*, uses δ to express the *true* declination; although in his *tables* I. II. III. IV. at the end, to which he refers, he has adopted the *apparent* declination. The fact is that M. DELAMBRE considered that, in the minute differences of which he was treating, we might adopt either one or the other.

tion of a star, and make *several* comparisons on the *same* night with the *same* star, on each side of, and near to the meridian, as well as at the exact time of culmination. The computations would be more intricate and troublesome, on account of the parallax in right ascension*: and the observations themselves are not so conveniently made. But these difficulties might be counterbalanced by the *number* of comparisons. For the purpose of making such observations, the telescope should be mounted equatorially; and furnished with a micrometer. The usual micrometers have only *one* vertical wire; but to the micrometer which is attached to my telescope, I have added four others, thus making *five* vertical wires: whereby differences in right ascension are more accurately determined, since we may take a mean of the whole as conveniently as in the transit instrument.

32. Since the preceding part of this paper was written, M. Nicolai (who has so much distinguished himself in perfecting this branch of astronomy) has proposed an *indirect* method of solving the problem; which will frequently be found very convenient, and is capable of considerable accuracy. The result of his investigation is nearly as follows:

Let c denote, as before, the apparent time of the moon's culmination at the western observatory, and $\varkappa$ the apparent time at the eastern observatory: and let the *assumed* difference of meridians be denoted as before by χ, and the error by e; so that we may always have

$$x = \chi + e$$

Then will the apparent time of the moon's culmination at the western observatory, be

$$c = \varkappa + (\chi + \Delta)\frac{86400}{s} \qquad \text{nearly.}$$

Assume them as equal: and let a and α denote, as before, the true right ascension of the moon at those assumed periods respectively. Then, if $15\,\Delta = (a - \alpha)$, the value of χ has been assumed correctly, and the problem is

* The parallax in right ascension would, in this case, be $\tan p = \frac{\sin \varpi .\cos \varphi .\sec \delta .\sin \theta}{1 - \sin \varpi .\cos \varphi .\sec \delta .\cos \theta}$; where θ denotes the *true* hour angle as determined by the clock, and the other quantities as in § 29. If we make $\sin \varpi .\cos \varphi .\sec \delta = \beta$ we shall have, by a well known transformation, $p = \beta\frac{\sin \theta}{\sin 1''} + \beta^2\frac{\sin 2\theta}{\sin 2''} + \beta^3\frac{\sin 3\theta}{\sin 3''} + \&c.$: which is Delambre's formula, and by far the most convenient one, for the computation of parallax, with which I am acquainted.

solved. But, if not, call the difference, in this last equation, d: whence we shall have

$$15\Delta = (a - \alpha) + d$$

and consequently

$$d = 15\Delta - (a - \alpha)$$

But d is evidently a function of the moon's difference in right ascension; and the time (e) in which it is described (or the variation which it will cause in the value of x) will depend on the relative motion of the moon, in right ascension, in a true solar hour. Now, since e is generally a very small quantity, the relative motion of the moon, during that short interval, may be deduced with sufficient accuracy from the moon's motion in 24 hours as shown by an ephemeris. Whence the value of e may be expressed by the following equation:

$$e = \frac{s}{m} \times d$$

where s may be taken, in all cases, equal to $24^h\ 4^m$.

33. For the convenience of those who pursue these enquiries, I have computed the following table of the value of $\frac{s}{m}$ depending on the true motion of the moon in right ascension in degrees during 24 solar hours, as shown by an ephemeris: which, being multiplied by d, will give the value of e required.

Argument = m = Moon's motion in Æ, in a true solar day.

Argument.	$\frac{s}{m}$	diff.	Argument.	$\frac{s}{m}$	diff.
10° 0′	2·4066		13° 0′	1·8513	
		·1145			·0686
10 30	2·2921		13 30	1·7827	
		·1042			·0637
11 0	2·1879		14 0	1·7190	
		·0951			.0592
11 30	2·0928		14 30	1·6598	
		·0873			·0554
12 0	2·0055		15 0	1·6044	
		·0802			·0517
12 30	1·9253		15 30	1·5527	
		·0740			·0485
13 0	1·8513		16 0	1·5042	

34. As an example of the application of this formula, and of the table, I shall compute therefrom the difference of meridians between Manheim and Paramatta, according to the observations already adduced in § 25. In this case we have $t = -\ 5^m\ 41^s,81$ and $\tau = -\ 33^m\ 7^s,74$; whence $(t - \tau) =$

$+\ 27^m\ 25^s,93$. The value of $\frac{1}{15}\left(\frac{r}{\cos d} - \frac{\varrho}{\cos \delta}\right)$ is equal to $+\ 0^s,386$: whence $\Delta = +\ 27^m\ 25^s,93 + 0^s,386 = 27^m\ 26^s,316$.

By considering Paramatta as the most *westerly* observatory (agreeably to what has been stated in § 25), we shall assume its *west* longitude from Manheim to be $14^h\ 30^m$: whence we have $\chi = 14^h\ 30^m$; and since $\varkappa = 7^h\ 51^m$, we have

$$c = 7^h\ 51^m + (14^h\ 30^m + 27^m\ 26^s,316)\ \frac{86400}{86644{\cdot}6} = 22^h\ 45^m\ 54^s,3$$

in Paris apparent time. The true right ascension of the moon, for this moment of time, is equal to 197° 48′ 15″,6: whence we have

$$\begin{array}{lll} c = 22^h\ 45^m\ 54^s,3 & & a = 197^\circ\ 48'\ 15'',6 \\ \varkappa = 7\ \ 51\ \ 0,0 & & \alpha = 190\ \ 56\ \ 41,5 \\ & (a-\alpha) = & 6\ \ 51\ \ 34,1 \\ & 15\,\Delta\ = & 6\ \ 51\ \ 34,7 \\ & d = & +\ 0,6 \end{array}$$

By the table in § 33 we have $\frac{s}{m} = 2{\cdot}19$, consequently $e = 2{\cdot}19 \times {\cdot}6 = +\ 1^s,31$. Whence $(\chi + e) = 14^h\ 30^m\ 1^s,31$: which, being deducted from 24^h, makes the longitude of Paramatta $9^h\ 29^m\ 58^s,69$ *east* from Manheim; differing only $0^s,25$ from the value deduced by the direct method in § 26.

35. In Schumacher's *Astron. Nach.* No. 52, M. Nicolai has hinted that the method of solution, which I have adopted in the preceding part of this paper, is nothing more than the *indirect* method here given. But, this is by no means the case. The formula, which I have adopted, is a rigid one; and will, in all cases, give the *correct* value. Whereas the *indirect* formula (like all other methods of *trial and error*) approximates only to the true result, according to the accuracy of the assumed values. The only real difference between M. Nicolai's formula and mine is in the substitution of $\frac{c-\varkappa}{a-\alpha}$ for $\frac{1^h}{h}$; the two formulæ being as under:

$$\text{Nicolai} = \left(15\,m.\,\frac{1^h}{h} - 1\right)\Delta$$

$$\text{Baily} \ = \left(\frac{s}{5760}\cdot\frac{c-\varkappa}{a-\alpha} - 1\right)\Delta$$

for, I have denoted by $\frac{s}{5760}$, the quantity which he denotes by $15\,m$.

36. M. Nicolai remarks that, when the difference of meridians is very small, my formula must be adopted with caution: and adduces, as an instance, the difference of meridians between Altona and Gottingen. Now, although

this difference amounts only to two or three seconds of time, it is evident that the relative motion of the moon is more correctly shown during that interval by the expression $\frac{c-x}{a-\alpha}$, than by $\frac{1^h}{h}$. For, in this short interval no correction is required for the *second differences* of the moon's motion; and the true value is shown by $\frac{c-x}{a-\alpha}$. But, if we adopt the expression $\frac{1^h}{h}$, the correction for second differences is necessarily involved in deducing the value of h. And this correction may in some cases, near the full moon, amount to upwards of 14″; although it must be evident that, where the difference of longitude is so small as that above mentioned, the *second differences* of the moon's motion are really of no value whatever.

37. M. Nicolai has also stated, that when only *one* difference of longitude is required to be determined from any corresponding observations of this kind, the method which I have proposed will be found most convenient and simple; but that, when we have to determine *many* differences of longitude from corresponding observations made at *several* places, it will be more convenient to resort to the *horary* motion of the moon. And the reason assigned is this: that the *horary* motion of the moon, being once determined, may be adopted in the solution of each particular case, and thus save much time and trouble: whereas, agreeably to my method, it will be necessary to determine the value of $\frac{c-x}{a-\alpha}$, for *each* comparison. But M. Nicolai seems to have forgotten that, if we adopt the value of $\frac{1^h}{h}$ for the mean period of all the observations, it must frequently be by a sacrifice of accuracy to convenience. For, strictly speaking, the value of h ought to be determined for that period of time which is half an hour before, and half an hour after the mean point of time between the two observations compared: and which value of h will consequently vary with *each pair* of observations. Thus, in determining the difference of meridians between Paramatta, Paris, and Manheim, from the observations already alluded to in § 25, the value of $\frac{1^h}{h}$, instead of being constant, will vary in the following manner:

Paramatta and Paris . . .	2. 17457
Paramatta and Manheim .	2. 17496
Paris and Manheim . . .	2. 18778

and which nearly accord with the values of $\frac{c-x}{a-\alpha}$, as given in the preceding part of this paper. So that, if the question be rigorously solved, nothing will be gained by adopting the *horary* motion of the moon in the given interval.

I have considered it necessary to make these remarks, not with a view to censure the methods proposed by M. Nicolai, who so justly deserves the thanks of every astronomer, but to remove any unfavourable impression which the writings of this distinguished mathematician may have created against the mode of solution which I have suggested in this paper. As the two methods are, however, now before the public, the practical astronomer may adopt that which may best suit his own convenience.

38. Although I have hitherto confined my remarks to the observatory, and considered the subject of this paper only as it regards the improvement of *astronomy*, yet it must be evident that it has an intimate connection also with the improvement of *navigation*: and, as such, is highly deserving the attention of those who are more immediately concerned in encouraging that science. The interests of astronomy and navigation would be materially advanced, if annual lists of such *moon-culminating* stars were published from time to time, and two or three years in advance, in the ephemerides of every country: whereby persons, situated in distant parts of the world, could make simultaneous observations; and thus render the method more universal. It is true that M. Schumacher publishes such lists; and astronomers are much indebted to him for the labour which he has bestowed on the subject. But they are contained in a periodical work printed in the German language, which I fear has not that extensive circulation (in this country) which its merits deserve; and of which, indeed, no copies can be procured except such as are subscribed for. Their great utility in navigation cannot be denied. It is well known that, by the liberality of His Majesty's Government, many important expeditions have been recently sent out from this country to distant and unfrequented parts of the world for the improvement of science and navigation. Other nations are following this laudable example: and a general spirit of enquiry has been excited, of which it would be desirable to take a favourable advantage. During these expeditions, a temporary landing is frequently made at places either wholly uninhabited, or whose positions are but very badly determined. It is therefore desirable, that an expeditious and correct mode of determining the longitude of such places should be immediately resorted to; and no method is perhaps so expeditious and at the same time so accurate, as that deduced from the method detailed in this paper.

This method, indeed, deserves encouragement on another account, which will be found conducive to the improvement of the connected sciences of astronomy and navigation. For, at the present time, a more than ordinary interest is excited in favour of astronomy. New observatories have recently been erected not only in our own country, but also in some of our possessions in the southern hemisphere, which already vie with those which have been long established in Europe. In our East India possessions, likewise, a degree of zeal has been manifested, which may be attended with the most beneficial results: the old observatories have been called into greater activity, and new ones are contemplated, furnished with the most approved and valuable instruments. The rising greatness also of the American states, both in the northern and the southern hemisphere, has led to the establishment of universities in various parts of that immense continent. The determination of the exact longitude of all these places, is an object of considerable importance, both in astronomy and navigation. Independent, however, of these national or public observatories, there are many belonging to private individuals not only at home, but also in distant and various parts of the world: and if facilities were given for making observations of the kind alluded to in this paper, there is no doubt that such persons, stimulated with a love of astronomy and a desire of rendering their labours serviceable to the public, would be induced to make observations (now wholly neglected) which would infallibly lead to a correct determination of the longitude of the place of observation, and thus tend to fix the positions of many important places on the sea coast, and thereby correct the charts of such countries. In fact, it is impossible to estimate justly the advantages which even an amateur astronomer may render to science by having facilities of this kind afforded him: for, insulated observations of this sort, even with an ordinary transit, might in many cases serve to determine positions, which would correct a whole line of coast, or be referred to as points of departure on distant expeditions.

39. This Society has, indeed, on several recent occasions of considerable importance, experienced the want of lists of these moon-culminating stars. In the summer of last year, Commodore Krusenstern (prior to the departure of the Russian expedition, under the command of Captain Kotzebue) applied to the Council of this Society for information and advice relative to some points of astronomical inquiry connected with their pursuits. The Council wished to furnish him, amongst other things, with those lists, for two or three years in advance: but no such lists were to be procured. Similar disappointments have also taken place on other occasions of the same kind, with respect

even to English vessels; but to which I shall not more immediately advert at present. Since that period, M. Schumacher has published lists of such stars for the years 1824 and 1825: and the Council was consequently desirous of presenting copies of them to the officers connected with the expedition which has just sailed under Capt. Parry to the North Pole. But, as no copies could be procured in England, and as there was not time to obtain them from M. Schumacher, the Council, with a proper regard for the promotion of the science, has forwarded to Capt. Parry the copy belonging to the Society. These facts will show the necessity of procuring a more general diffusion of such lists: and it is hoped that the subject will engage the attention of those who have the means of promoting so desirable and important an object.

APPENDIX.

The preceding paper was read before the *Astronomical Society of London*, during their late sessions, and will form a part of the second volume of their *Memoirs*. In the mean time, I have taken advantage of its publication, to obtain an impression of some separate copies, with an intention of distributing them in various parts of the world, in order to procure a fair and general trial of the method therein proposed.

The method has indeed been practised, for some time, on the continent; and with the happiest success. Observations of this kind now form a part of the regular business of the observatory at Königsberg; and are published by M. Bessel in the annual volumes of that distinguished observatory. Similar observations are also made by the Rev. Dr. Brinkley at Dublin; by M. Bouvard at the Royal Observatory at Paris; by M. Schumacher at Altona; M. Littrow at Vienna; M. Nicolai at Manheim; M. Struve at Dorpat; Sir Thomas Brisbane at Paramatta in New South Wales; and by other eminent astronomers: with one or more of which, comparisons may, from time to time, be made.

With a view to render the adoption of this method more universal, I now beg leave to present the preceding memoir to those persons who are desirous of thus promoting the connected sciences of astronomy, geography, and navigation. And, with a view to facilitate their pursuits, I have subjoined a list of those stars which, in the course of the ensuing year (1825), will be most favourably situated for comparisons of this kind, on such days as the moon can be conveniently observed. The right ascensions of the stars are brought up to the day of observation, to the nearest second only, without regard to the corrections for aberration and nutation; and the declinations, to the nearest minute only. For, all that is required, in such cases, is to enable the astronomer to identify the star, and to be prepared to observe it in the transit instrument. The stars have been selected from M. Piazzi's Catalogue, entitled *Præcipuarum Stellarum inerrantium positiones mediæ; Panormi* 1814: and the numbers prefixed, denote the numbers in Flamsteed's Catalogue, unless they are inclosed in a parenthesis; in which case they denote the numbers in Piazzi's Catalogue.

The right ascension and declination of the moon are such as they will be at the time of her culmination at Greenwich. Under any other meridian they will, of course, be different: a circumstance which must be kept in mind when the difference of meridians is considerable. The declinations are not corrected for parallax. The figures annexed to the moon denote the age of the moon, or the number of days elapsed since the time of the preceding new moon.

A list of stars, of the kind above alluded to, is generally formed for one or more of the three following purposes. 1° For the use of those observatories which are situated *near* to each other, or within 10 or 15 degrees of longitude and latitude; and which, since it applies to the greatest part of Europe, has hitherto been considered as of the greatest importance. 2° For the use of those observatories whose difference of longitude is not great, but which differ considerably in latitude: such as the European observatories and that at the Cape of Good Hope; or observatories situated in the northern and southern parts of the vast continent of America. 3° For the use of those persons whose positions on the globe differ considerably both in longitude and latitude, and who may even be antipodes to each other.

Stars intended for the first and second class, should be limited to those which precede or follow the moon a few minutes only from the time of her culmination: but those intended for the third class, must be extended to those which precede or follow the moon, at least half an hour from her time of culmination; in order to equalize as much as possible the intervals between the transit of the moon and star, at the two most distant observatories.

With respect to the declinations of the stars, those of the first class should be chosen, so that they may differ as little as possible from the *apparent* declination of the moon at the time of her culmination; in order that the moon and stars may, if possible, be observed without any alteration in the position of the telescope. But, in the second class, it should be borne in mind, that the parallax will operate in a different direction. In the third class, the combinations may be infinitely varied; and therefore such stars should be chosen as will differ not more than about 2° from the *true* declination of the moon, *at the time she approaches the right ascension of such stars.*

In the following list, these different circumstances have been attended to. It was originally much more extensive: but, it has been reduced in the following manner: a detail of which may probably be useful to those who may be employed in similar pursuits. The right ascension and declination of the moon (to the nearest minute) were first computed for the time of her passing the meridian of Greenwich†. A list was then formed of all the stars, above the 8th magnitude, (situated near the *true* path of the moon) which would not differ more than about half an hour from the moon's right ascension thus computed, and whose declinations would not differ more than about two degrees from the *true* declination of the moon *at the time she approaches the right ascension of those stars.* From this list it was easy to select such as would probably pass within 15′ or 20′ (in declination) of the *apparent* centre of the moon in some part of Europe: and which, on that account, might probably suffer an occultation, at some time during the day, in this part of the world; and therefore be the best adapted for such comparisons with respect to the European observatories. These stars, in the ensuing list, are denoted by an asterisk (*) affixed to them. Any intervening stars, which were not considered of essential importance, and which might hurry or distract the attention of the observer, were then struck out: unless they were such as came within the second class, and might be conveniently compared with stars in more southern latitudes, not differing much in longitude from Greenwich. All the rest were retained for the purpose of comparisons with the accidental observations that might be made in the more remote observatories in Asia, Africa, or America.

I have considered it necessary to make these remarks, as the ensuing list will be found somewhat different from that published by M. SCHUMACHER. For, I have inserted several stars which do not occur in his list; and, for the reasons above mentioned, have rejected some which he has retained. Nevertheless I must acknowledge the great assistance which I have received from his publication; and without which, I should probably never have undertaken the formation of a new list.

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† By adding 1^m to the right ascension, prior to the full moon, and subtracting 1^m therefrom, subsequent thereto, we obtain the time of the transit of the moon's enlightened *border*. In winter time the moon's border may be conveniently and distinctly observed on the meridian' when she is about 6 days old; but in summer time, not before she is about 10 days old: and at these periods the observations should commence, and be continued each day till the moon has passed the full, so as to be extended at least two days beyond that period, in order that the eastern and western borders of the moon may be observed in each lunation.

It should be remembered, that the winter season in these latitudes is the summer season in the southern hemisphere: and therefore the list, *intended for observatories thus situated,* need not commence before the moon is 10 days old; unless the stars are of considerable magnitude. But, two observatories situated in the *same* hemisphere (such as those at the Cape of Good Hope and at Paramatta) might select their own stars during *their* winter season, for the purpose of determining their difference of meridians.

It will readily occur to the practical astronomer, that a list of stars of this kind, selected for any given year, may be of great use in the formation of new lists for any subsequent year. But it would be highly desirable, and would save considerable trouble, if a *general* list were formed, which should comprehend *all* the stars proper for such comparisons, in *any* position of the moon's nodes. In fact, the *Astronomical Society* is now engaged in reducing to the year 1830 (for other purposes) all the stars, not less than the sixth magnitude, within 30° of the equator; and all the stars, not less than the seventh magnitude, within 10° of the ecliptic: which will comprise nearly the whole of those which are adapted for such comparisons. So that when this catalogue is finished, the annual lists may be much more easily formed than at present, where we have to select them from nearly eight thousand stars, situated in every position of the heavens. To the stars which will form this catalogue, (about 3000 in number) will be annexed the *constants* for determining the precession, aberration, and nutation, both in right ascension and declination, agreeably to the principles which I have already detailed in the *Philosophical Magazine* for October 1822; and which will be found of considerable use in comparing such stars with a comet or planet, in taking altitudes for the time, in the computation of occultations, and in other branches of practical astronomy.

F. B.

Gray's Inn,
September 1, 1824.

A LIST

OF

MOON-CULMINATING STARS FOR THE YEAR 1825.

1825.	Stars.	Mag.	Æ.	D.
Jan. 1	7 Tauri	6	3h 24m 5s	+23° 52′
	11 ——	6	30 20	24 46
	16 ——	5·6	34 25	23 44
	17 ——	4·5	34 30	23 33
	η —— } Pleiades.	3	37 5	23 33
	27 ——	5	38 47	23 31
	28 ——	5·6	38 47	23 36
	33 —— *	6·7	46 41	22 40
	Moon (13)		54	22 57
	υ^1 Tauri *	5	4 15 51	22 24
	υ^2 —— *	6	16 50	22 36
	τ^2 —— *	5	31 45	22 37
Jan. 2	υ^1 Tauri	5	4 15 51	+22 24
	υ^2 ——	6	16 50	22 36
	τ^2 ——	5	31 45	22 37
	(243) —— *	6·7	47 12	23 40
	Moon (14)		54	23 59
	(295) Tauri	6	57 27	24 1
	108 ——	7	5 4 56	22 5
	n ——	5·6	8 45	21 54
	118 ——	7	18 31	25 0
	121 ——	6	24 46	23 55
	ζ ——	3·4	27 11	21 2
Jan. 3	o Tauri	5	5 17 8	+21 47
	ζ ——	3·4	27 11	21 2
	132 ——	5	38 16	24 30
	139 ——	5·6	47 8	25 55
	1 Gemin. *	5	53 29	23 16
	Moon (15)		58	23 30
	3 Gemin. *	6	59 6	23 8
	4 —— *	7	59 58	23 1

1825.	Stars.	Mag.	Æ.	D.
Jan. 3	6 Gemin. *	6·7	6h 1m 42s	+22° 56′
	η —— *	4·5	4 19	22 33
	9 ——	7	6 18	23 47
	10 ——	7·8	8 15	23 40
	11 ——	7	8 40	23 32
	μ —— *	3	12 23	22 36
Jan. 4	μ Gemin.	3	6 12 23	+22 36
	ν ——	5	18 34	20 20
	ε ——	3	33 9	25 18
	d ——	6·7	41 3	22 0
	ζ —— *	4	53 43	20 49
	Moon (16)		7 3	21 22
	q Gemin. *	5·6	11 37	20 46
	r —— *	7·8	16 37	20 36
	f ——	6	29 22	18 4
	g ——	6	35 59	18 56
Jan. 5	f Gemin.	6	7 29 22	+18 4
	g ——	6	35 59	18 56
	(261) Cancri *	7	46 34	16 59
	5 —— *	6	51 31	16 56
	Moon (17)		8 6	17 40
	d^1 Cancri	6	13 20	18 53
	d^2 ——	6	15 56	17 37
	29 Gemin.	6	18 51	14 47
	θ Cancri	5·6	21 36	18 41
	(106) ——	7·8	26 18	15 55
	δ ——	4·5	34 44	18 48
Jan. 6	a^1 Cancri	6·7	8 33 33	+13 18
	a^2 ——	6	37 20	12 45
	α^1 —— *	6	46 53	12 17
	α^2 —— *	5	48 54	12 32

1825.	Stars.	Mag.	Æ.	D.	1825.	Stars.	Mag.	Æ.	D.
Jan. 6	Moon (18)		9h 6m 0s	+12° 48′	Jan. 28	65 Arietis	6	3h 14m 21s	+20° 11′
	(35) Leonis *	7	8 21	12 14		66 ——	6·7	18 14	22 12
	ξ —— *	5	22 30	12 4		Moon (10)		27	21 52
	10 ——	5·6	27 58	7 37		16 Tauri (Pleiades)	5·6	34 25	23 44
	ο ——	4	31 48	10 41		17 —— (Pleiades)	4·5	34 30	23 33
	18 ——	6	36 57	12 37		η —— (Pleiades)	3	37 6	23 33
Jan. 26	37 Piscium	6·7	1 4 50	+15 12		27 —— (Pleiades)	5	38 47	23 31
	η —— *	4	22 8	14 26		28 —— (Pleiades)	5·6	38 47	23 36
	101 ——	6	26 26	13 46		(166) —— *	7	39 38	21 42
	103 ——	7·8	29 50	15 44		32 ——	6	46 32	21 58
	105 ——	6	30 15	15 31		(213) ——	7·8	50 34	22 42
	4 Arietis	6·7	38 42	16 5		a′ —— *	5	54 22	21 36
	Moon (8)		42	15 18		39 —— *	6·7	54 59	21 32
	ι Arietis	6	47 48	16 43	Jan. 29	36 Tauri	6·7	3 53 4	+23 37
	(243) ——	6	54 7	17 10		62 ——	7	4 13 27	23 53
	19 ——	7	2 3 31	14 27		υ¹ ——	5	15 51	22 24
	θ¹ ——	6	8 25	19 5		υ² ——	6	16 50	22 36
	θ² ——	7·8	9 26	18 53		Moon (11)		25	23 33
	27 ——	6	21 13	16 42		τ² Tauri	5	31 45	22 37
Jan. 27	γ Arietis	4·5	1 43 57	+18 26		(243) ——	6·7	47 12	23 40
	15 ——	6	2 0 57	18 40		ι ——	4·5	52 39	21 20
	θ¹ ——	6	8 25	19 5		(295) ——	6	57 27	24 2
	θ² ——	7·8	9 26	18 53	Jan. 30	n Tauri	5·6	5 8 45	+21 54
	26 ——	6·7	20 49	19 4		ο ——	5	17 8	21 47
	(112) ——	6·7	23 50	18 6		121 ——	6	24 46	23 55
	Moon (9)		33	19 5		Moon (12)		25	23 51
	ε Arietis	5	49 13	20 38		132 Tauri	5	38 16	24 30
	(261) ——	7	59 19	20 5		1 Gemin. *	5	53 29	23 16
	ζ ——	5	3 4 51	20 23		2 —— *	6·7	56 8	23 39
Jan. 28	ε Arietis	5	2 49 13	+20 38		3 —— *	6	59 6	23 8
	(261) ——	7	59 19	20 5	Jan. 31	1 Gemin.	5	5 53 29	+23 16
	ζ ——	5	3 4 51	20 23		2 ——	6·7	56 8	23 39
	τ¹ ——	6	11 8	20 31		3 ——	6	59 6	23 8
	τ² ——	7	12 41	20 21		6 ——	6·7	6 1 42	22 56

1825.	Stars.	Mag.	Æ.	D.
Jan. 31	η Gemin.	4·5	6h 4m 19s	+22° 33′
	10 ——	7·8	6 43	23 40
	11 ——	7	8 40	23 32
	μ ——	3	12 23	22 36
	ν ——	5	18 34	20 19
	Moon (13)		28	22 36
	d Gemin. *	6·7	41 3	22 0
	ζ ——	4	53 43	20 49
Feb. 1	ζ Gemin.	4	6 53 43	+20 49
	q ——	5·6	7 11 37	20 46
	r ——	7·8	16 38	20 36
	(146) —— *	7·8	27 18	19 18
	Moon (14)		32	19 47
	g Gemin. *	6	35 59	18 56
	(224) ——	7	41 45	19 46
	1 ——	6·7	45 27	20 20
	3 Cancri	6	50 45	17 47
Feb. 2	d² Cancri	6	8 15 55	+17 37
	29 Gemin.	6	18 51	14 47
	(98) Cancri	7·8	24 3	13 51
	(106) ——	7·8	26 18	15 55
	Moon (15)		33	15 29
	(203) Cancri	8	44 45	14 54
	α¹ ——	6	46 53	12 17
	α² ——	5	48 55	12 32
	74 ——	7·8	58 27	15 25
	π ——	6·7	9 2 43	15 42
Feb. 3	(46) Leonis	7·8	9 10 5	+10 31
	(66) ——	8	14 11	8 28
	ω ——	6·7	19 4	9 49
	6 ——	6	22 34	10 29
	10 ——	5·6	27 58	7 37
	ο ——	4	31 48	10 41
	Moon (16)		35	10 4
Feb. 3	10 Sextant.*	6	9h 47m 9s	+ 9° 46′
	11 —— *	6	48 51	9 9
	π Leonis	4·5	50 58	8 53
	14 Sextant.	6	57 38	6 28
	16 ——	6	10 0 4	7 1
Feb. 4	23 Sextant.*	6	10 12 0	+ 3 10
	31 —— *	7	21 28	3 3
	Moon (17)		33	3 58
	36 Sextant.*	6	36 8	3 14
	55 Leonis	6	46 42	1 40
	58 ——	5	51 31	4 33
	65 ——	5·6	57 59	2 54
Feb. 26	υ¹ Tauri	5	4 15 51	+22 24
	υ² ——	6	16 50	22 36
	τ² ——	6	31 45	22 37
	(243) ——	6·7	47 12	23 40
	Moon (9)		57	23 39
	(295) Tauri	6	57 27	24 1
	108 ——	7	5 4 56	22 5
	118 ——	7	18 31	25 0
	121 ——	6	24 46	23 55
	ζ ——	3·4	27 11	21 2
	125 ——	6	28 52	25 47
Feb. 27	o Tauri	5	5 17 8	+21 47
	ζ ——	3·4	27 11	21 2
	132 ——	5	38 16	24 30
	1 Gemin.	5	53 29	23 16
	2 ——	6·7	56 8	23 39
	Moon (10)		57	23 12
	3 Gemin. *	6	59 6	23 8
	η —— *	4·5	6 4 19	22 33
	9 ——	7	6 18	23 47
	11 ——	7	8 40	23 32
	μ ——	3	12 23	22 36
	15 ——	6	17 20	20 53

1825.	Stars.	Mag.	Æ.	D.	1825.	Stars.	Mag.	Æ.	D.
Feb. 28	μ Gemin.	3	6h 12m 23s	+22° 36′	Mar. 3	(208) Sextant.	7·8	9h 46m 40s	+ 8° 30′
	ν ——	5	18 34	20 20		(222) ——	7·8	49 40	5 39
	d ——	6·7	41 3	22 0		π Leonis	4·5	50 58	8 53
	ζ —— *	4	53 43	20 49		14 Sextant.*	6	57 38	6 28
	Moon (11)		58	21 14		Moon (14)		10 0	7 21
	q Gemin. *	5·6	7 11 37	20 46		16 Sextant.*	6	0 4	7 1
	r —— *	7·8	16 38	20 36		43 Leonis	6	13 51	7 26
	74 ——	6	29 22	18 4		32 Sextant.	7	23 13	5 32
	g ——	6	35 59	18 56		48 Leonis	5·6	25 40	7 51
Mar. 1	74 Gemin.	6	7 29 21	+18 4		35 Sextant.	7	34 15	5 40
	g ——	6	35 59	18 56	Mar. 4	55 Leonis	6	10 46 42	+ 1 40
	(261) Cancri *	7	48 32	16 59		(212) ——	7	52 6	+ 0 59
	(317) —— *	7·8	8 0 0	17 32		62 ——	6	54 39	+ 0 56
	Moon (12)		0	17 47		(230) ——	8	55 3	+ 1 2
	ζ Cancri	6	2 10	18 10		Moon (15)		58	+ 1 6
	20 ——	6	13 20	18 53		69 Leonis	5·6	11 4 48	+ 0 53
	d² ——	6	15 56	17 37		φ ——	5	7 47	− 2 42
	29 Gemin.	6	18 51	14 47		(50) ——	7	14 20	+ 1 5
	θ Cancri	5·6	21 36	18 41		e ——	4·5	21 23	− 2 2
	(106) ——	7·8	26 18	15 55		ν ——	4·5	27 59	+ 0 1
	δ ——	4·5	34 44	18 48	Mar. 5	φ Leonis	5	11 7 47	− 2 42
Mar. 2	α¹ Cancri *	6	8 46 53	+12 17		(148) Virginis*	6	34 59	5 42
	α² —— *	5	48 55	12 32		(167) ——	6	42 6	4 22
	(244) ——	7·8	56 6	11 32		(188) ——	8	46 30	4 9
	κ ——	5·6	58 16	11 22		Moon (16)		58	5 15
	Moon (13)		9 1	13 3		(237) Virginis *	7·8	58 17	5 47
	(35) Leonis *	7	8 21	12 14		(63) —— *	7·8	12 14 10	6 20
	ω ——	6·7	19 4	9 49		22 ——	5·6	24 45	8 29
	ξ ——	5	22 30	12 4	Mar. 6	q Virginis	5·6	12 24 45	− 8 29
	10 ——	5·6	27 58	7 37		(196) ——	6·7	42 17	9 23
	o ——	4	31 48	10 41		Moon (17)		58	11 10
	18 —— *	6	36 57	12 37		g Virginis	5·6	58 44	9 48
Mar. 3	10 Leonis	5·6	9 27 58	+ 7 37		(19) ——	7·8	13 4 10	12 32
	4 Sextant.	6	41 23	5 10		62 ——	7	11 10	10 23

1825.	Stars.	Mag.	Æ.	D.
Mar. 6	α Virginis	1	13h 16m 0s	−10° 15′
	(158) ——	7·8	31 42	11 54
	86 ——	6	36 38	11 33
Mar. 28	ζ Gemin.	4	6 53 43	+20 49
	q ——	5·6	7 11 37	20 46
	r ——	7·8	16 38	20 36
	(146) ——	7·8	27 18	19 18
	Moon (9)		34	19 12
	g Gemin. *	6	35 59	18 56
	(224) ——	7	41 45	19 46
	1 ——	6·7	45 27	20 20
	3 Cancri	6	50 45	17 47
Mar. 29	ζ¹ Cancri	6	8 2 10	+18 18
	d² ——	6	15 55	17 37
	29 Gemin. *	6	18 51	14 47
	(98) Cancri	7·8	24 3	13 51
	(106) ——	7·8	26 18	15 55
	Moon (10)		32	15 13
	(203) Cancri *	8	44 45	14 54
	(208) ——	8	45 57	14 51
	α¹ ——	6	46 53	12 17
	α² ——	5	48 55	12 32
	74 ——	7·8	58 27	15 25
	π ——	6·7	9 2 43	15 42
Mar. 30	(35) Leonis	7	9 8 21	+12 14
	(66) ——	8	14 11	8 28
	ω —— *	6·7	19 4	9 49
	6 ——	6	22 34	10 29
	10 ——	5·6	27 58	7 37
	Moon (11)		30	10 11
	10 Sextant.*	6	47 9	9 46
	11 ——	6	48 51	9 9
	π Leonis	4·5	50 58	8 53
Mar. 30	14 Sextant.	6	9h 57m 38s	+ 6° 28′
	16 ——	6	10 0 4	7 1
Mar. 31	19 Sextant.	6	10 3 42	+ 5 29
	23 ——	6	12 0	3 10
	31 ——	7	21 28	3 3
	Moon (12)		28	4 21
	36 Sextant.	6	36 8	3 14
	55 Leonis	6	46 42	1 40
	58 ——	5	51 31	4 33
	65 ——	5·6	57 59	2 54
Apr. 1	57 Leonis	7	10 47 12	+ 1 22
	(212) ——	7·8	52 6	+ 0 59
	61 ——	5·6	52 54	− 1 33
	66 ——	7	11 0 18	− 0 23
	69 ——	5·6	4 49	+ 0 53
	φ —— *	5	7 47	− 2 42
	(77) ——	7	18 58	− 0 44
	e ——	4·5	21 23	− 2 2
	Moon (13)		26	− 1 51
	(126) Virginis	7	29 28	− 1 28
	(167) ——	6	42 6	− 4 21
	(213) ——	7	52 5	− 0 47
	(230) ——	7	57 3	− 2 9
Apr. 2	(17) Virginis	7·8	12 5 18	− 4 45
	14 ——	6·7	10 21	7 56
	(63) ——	7·8	14 10	6 20
	q —— *	5·6	24 45	8 29
	Moon (14)		24	7 59
	χ Virginis	6	30 13	7 2
	(196) —— *	6·7	42 17	9 23
	ψ ——	5·6	45 16	8 35
	g ——	5·6	58 44	9 48

1825.	Stars.	Mag.	Æ.	D.
Apr. 3	(262) Virginis	6·7	12h 57m 14s	−13° 59′
	53 ——	5	13 2 46	15 15
	i ——	5	17 29	11 48
	75 —— *	6	23 31	14 28
	Moon (15)		25	13 35
	85 Virginis *	6	36 11	14 53
	89 ——	5·6	40 23	17 16
Apr. 27	10 Leonis	5·6	9 27 58	+ 7 37
	4 Sextant.	6	41 23	5 10
	(208) ——	7·8	46 40	8 30
	(222) —— *	7·8	49 40	5 39
	14 Sextant. *	6	57 38	6 28
	Moon (10)		10 2	6 42
	43 Leonis	6	13 51	7 26
	32 Sextant.	7	23 13	5 32
	48 Leonis	5·6	25 40	7 51
	35 Sextant.	7	34 15	5 40
Apr. 28	55 Leonis	6	10 46 42	+ 1 40
	(212) ——	7	52 6	+ 0 59
	(225) —— *	7	54 19	+ 0 12
	(232) —— *	7.8	55 24	+ 0 4
	Moon (11)		58	+ 0 54
	69 Leonis	5·6	11 4 48	+ 0 53
	(50) ——	7	14 20	+ 1 5
	e ——	4·5	21 23	− 2 2
	ν ——	4·5	27 59	+ 0 1
Apr. 29	(148) Virginis	6	11 34 59	− 5 42
	(167) ——	6	42 6	4 22
	Moon (12)		58	5 8
	(237) Virginis *	7·8	58 18	5 47
	14 ——	6·7	12 10 21	7 56
	(63) ——	7·8	14 10	6 20
	q ——	5·6	24 45	8 29
Apr. 30	q Virginis	5·6	12h 24m 45s	− 8° 29′
	(196) ——	6·7	42 17	9 23
	Moon (13)		53	10 51
	g Virginis	5·6	58 44	9 48
	(19) ——	7·8	13 4 10	12 32
	62 ——	7	11 10	10 23
	α ——	1	16 0	10 15
	(158) —— *	7·8	31 42	11 54
	86 —— *	6	36 38	11 33
May 1	69 Virginis	5·6	13 18 9	−15 4
	75 ——	6	23 32	14 28
	83 ——	6	35 4	15 18
	85 ——	6	36 12	14 53
	87 —— *	6	37 56	16 59
	89 —— *	5·6	40 24	17 16
	Moon (14)		53	15 55
	(300) Virginis	7·8	57 44	15 21
	(317) ——	6	14 1 18	15 28
	(22) ——	6	5 47	17 23
May 2	(116) Solitarii	7	14 25 2	−19 40
	(166) —— *	7	36 18	20 26
	(71) —— *	7	37 19	20 35
	(212) Libræ *	6	47 15	20 37
	Moon (15)		57	19 51
	ι^1 Libræ	5.6	15 2 17	19 7
	ι^2 ——	6·7	3 23	18 59
	(91) ——	7·8	21 41	19 34
	κ ——	5	31 53	19 6
May 3	42 Libræ	5·6	15 29 58	−23 15
	b Scorpii	5	40 29	25 13
	f —— *	6	43 33	23 27
	δ ——	3	50 1	22 7
	β^1 ——	2	55 18	19 19
	ω^1 ——	4·5	56 36	20 11

1825.	Stars.	Mag.	Æ.	D.
May 3	ω^2 Scorpii	4·5	$15^h57^m10^s$	−20°23′
	Moon (16)		16 1	22 19
	o Scorpii *	5·6	10 8	23 44
	σ ——	4	10 35	25 10
	g ——	5	15 7	23 2
	i ——	6	18 42	24 43
	ω Ophiu.	5	21 47	21 5
May 27	14 Virginis	6·7	12 10 21	− 7 56
	(69) —— *	7·8	15 21	9 31
	q ——	5·6	24 45	8 29
	Moon (10)		29	8 39
	(196) Virginis *	6·7	42 18	9 23
	ψ ——	5·6	45 16	8 35
	g —— *	5·6	58 45	9 48
	58 —— *	6	13 8 19	9 37
	α ——	1	16 0	10 15
May 28	(262) Virginis	6·7	12 57 14	−13 59
	53 —— *	5	13 2 46	15 15
	i ——	5	17 29	11 48
	Moon (11)		26	13 53
	85 Virginis *	6	36 12	14 53
	89 ——	5·6	40 23	17 16
May 29	(300) Virginis	7·8	13 57 44	−15 21
	(317) ——	6	14 1 18	15 28
	(22) ——	6	5 47	17 23
	(38) Solitarii	7·8	9 48	17 43
	(116) —— *	7	25 2	19 40
	Moon (12)		27	18 13
	(166) Solitarii	7	36 18	20 26
	(171) ——	7	37 19	20 35
	(212) Libræ	6	47 15	20 37
May 30	ι^1 Libræ	5·6	15 2 17	−19 7
	ι^2 ——	6·7	3 23	18 59

1825.	Stars.	Mag.	Æ.	D.
May 30	(19) Scorpii	6·7	$15^h\ 6^m17^s$	−21°46′
	(91) Libræ	7·8	21 41	19 34
	Moon (13)		29	21 19
	δ Scorpii *	3	50 1	22 7
	ω^1 ——	4·5	56 36	20 11
	ω^2 ——	4·5	57 10	20 23
May 31	δ Scorpii	3	15 50 1	−22 7
	ω^1 ——	4·5	56 36	20 11
	ω^2 ——	4·5	57 10	20 23
	(10) ——	6	16 3 25	20 56
	o ——	5·6	10 8	23 44
	g —— *	5	15 7	23 2
	i ——	6	18 42	24 43
	ω Ophiu.	5	21 47	21 5
	Moon (14)		33	22 58
	22 Ophiu. *	6·7	44 18	23 13
	24 —— *	6·7	46 17	22 52
	26 ——	6	49 28	24 43
	39 ——	5·6	17 7 23	24 4
	(33) ——	6	9 28	23 51
	θ ——	3·4	11 18	24 49
	b ——	5·6	15 43	24 0
	e^2 ——	5	20 46	23 49
June 1	22 Ophiu.	6·7	16 44 18	−23 13
	26 ——	6	49 28	24 43
	θ ——	3·4	17 11 18	24 49
	b —— *	5·6	15 43	24 0
	e^2 —— *	5	20 46	23 49
	Moon (15)		37	23 2
	4 Sagitt. *	5	49 8	23 47
	7 —— *	6	52 9	24 16
	(386) —— *	6	18 1 4	23 44
June 2	4 Sagitt.	5	17 49 8	−23 47
	a ——	6	52 9	24 16

1825.	Stars.	Mag.	Æ.	D.	1825.	Stars.	Mag.	Æ.	D.
June 2	(386) Sagitt.	6	18h 1m 4s	−23°44′	June27	β Scorpii	2	15h55m18s	−19°19′
	μ¹ ——	3·4	3 19	21 6		Moon (11)		16 5 0	22 28
	μ² ——	6	4 48	20 47		o Scorpii *	5·6	10 8	23 44
	21 ——	6	14 57	20 38		g —— *	5	15 8	23 2
	(125) ——	6·7	27 27	21 32		ωOphiu.	5	21 48	21 5
	(131) ——	6·7	28 29	21 11	June28	a Ophiu.	4·5	17 4 38	−26 20
	26 ——	6	31 13	23 59		39 —— *	5·6	7 23	24 4
	28 —— *	6	35 49	22 34		(33) —— *	6	7 28	23 51
	Moon (16)		38	21 34		Moon (12)		8	23 10
	30 Sagitt. *	6	40 21	22 22		θ Ophiu.	3·4	11 19	24 49
	31 —— *	6	41 39	22 8		33 Scorpii *	7	14 27	24 4
	ν¹ —— *	5	43 38	22 58		b Ophiu. *	5·6	15 43	24 0
	ν² —— *	5	44 34	22 54		e² ——	5	20 46	23 49
	ξ¹ ——	6	46 58	21 47		d ——	5	32 59	21 35
	ξ² ——	5	47 19	21 20	June29	d Ophiu.	5	17 32 59	−21 35
	(255) ——	6·7	51 6	22 56		4 Sagitt. *	5	49 8	23 47
	o ——	4·5	54 13	21 59		(386) —— *	6	18 1 4	23 44
	π ——	4·5	59 23	21 18		μ¹ ——	3·4	3 19	21 6
June 26	(116) Solitarii	7	14 25 2	−19 40		Moon (13)		9	22 21
	(166) ——	7	36 18	20 26		(129) Sagitt. *	6	27 54	23 39
	(171) ——	7	37 19	20 35		26 ——	6	31 13	23 59
	(212) Libræ	6	47 16	20 37		28 ——	6	35 49	22 34
	γ ——	3·4	53 52	24 35		30 ——	6	40 21	22 22
	ι¹ ——	5·6	15 2 17	19 7		31 ——	6	41 39	22 8
	ι² ——	6·7	3 23	18 59		ν¹ ——	5	43 38	22 58
	Moon (10)		4	20 15		ν² ——	5	44 34	22 54
	(19) Scorpii *	6·7	6 17	21 44	June30	ν¹ Sagitt.	5	18 43 38	−22 58
	42 Libræ	5·6	29 58	23 15		ν² ——	5	44 34	22 54
	λ ——	5	43 13	19 38		ξ¹ ——	6	46 58	21 47
	δ Scorpii	3	50 1	22 7		ξ² —— *	5	47 19	21 20
	β ——	2	55 18	19 19		o ——	4·5	54 13	21 59
June 27	42 Libræ	5.6	15 29 58	−23 15		π —— *	4·5	59 23	21 18
	f Scorpii *	6	43 33	23 27		Moon (14)		19 9	20 16
	δ ——	3	50 1	22 7		(138) Sagitt.	6	20 32	21 41

1825.	Stars.	Mag.	Æ.	D.
June30	(166) Sagitt. *	7	$19^h 25^m 16^s$	−21° 9′
	e^1 ——	5·6	30 43	16 41
	e^2 ——	5	32 32	16 32
	f ——	6	36 11	20 11
	57 ——	5·6	42 4	19 29
July 1	f Sagitt.	5	19 36 11	−20 11
	57 ——	5·6	42 4	19 29
	g ——	6	48 3	15 57
	(381) ——	7·8	55 25	16 52
	Moon (15)		20 4	17 3
	σ Capric.	5·6	9 19	19 20
	β ——	3·4	11 12	15 20
	π ——	5	17 19	18 47
	ρ ——	5	18 54	18 23
	τ ——	6	29 31	15 34
July 25	g Scorpii	5	16 15 8	−23 2
	ω Ophiu.	5	21 48	21 5
	18 —— *	6	39 8	24 19
	Moon (10)		47	23 3
	39 Ophiu. *	5·6	17 7 23	24 4
	θ ——	3·4	11 18	24 49
	b —— *	5·6	15 43	24 0
	e^2 ——	5	20 46	23 49
July 26	θ Ophiu.	3·4	17 11 18	−24 49
	b ——	5 6	15 43	24 0
	e^2 ——	5	20 46	23 49
	2 ——	6	28 16	21 48
	d ——	5	33 0	21 35
	(283) Sagitt. *	7·8	46 28	23 54
	Moon (11)		47	22 45
	4 Sagitt. *	5	49 8	23 47
	(312) ——	6	51 20	22 46
	μ^1 ——	3·4	18 3 19	21 6
July 26	μ^2 Sagitt.	6	$18^h 4^m 48^s$	−20° 47′
	21 ——	6	14 57	20 38
July 27	21 Sagitt.	6	18 14 57	−20 38
	(125) ——	6·7	27 28	21 32
	(131) ——	6·7	28 29	21 11
	28 —— *	6	35 50	22 34
	30 —— *	6	40 21	22 22
	31 —— *	6	41 39	22 8
	Moon (12)		45	21 11
	ο Sagitt. *	4·5	54 13	21 59
	π ——	4·5	59 23	21 18
	(4) —— *	6	19 2 2	21 57
	(61) ——	6	10 11	22 43
	(138) —— *	6	20 32	21 41
July 28	ρ^1 Sagitt.	5	19 11 33	−18 11
	ρ^2 ——	5·6	11 40	18 38
	(138) ——	6	20 32	21 41
	(176) —— *	7	26 15	19 14
	e^1 ——	5·6	30 43	16 41
	e^2 ——	5	32 32	16 32
	f ——	6	36 11	20 11
	Moon (13)		40	18 26
	57 Sagitt. *	5·6	42 4	19 29
	g ——	6	48 4	15 57
	β Capric.	3·4	20 11 12	15 20
July 29	β Capric.	3·4	20 11 12	−15 20
	π ——	5	17 19	18 47
	ρ ——	5	18 54	18 23
	13 —— *	6	27 34	15 45
	τ —— *	6	29 31	15 34
	Moon (14)		34	14 47
	(325) Capric.	6·7	41 4	13 11
	(351) Aquarii	6	43 32	12 14

1825.	Stars.	Mag.	Æ.	D.
July 29	8 Aquarii	6	20h 50m 20s	−13° 43′
	ν ——	5	21 0 5	12 4
July 30	ν Aquarii	5	21 0 5	−12 4
	14 ——	7·8	6 56	9 56
	17 ——	6	13 33	10 4
	19 ——	6	15 48	10 30
	Moon (15)		26	10 30
	ξ Aquarii	5	28 28	8 36
	c^1 Capric.	6	35 41	9 53
	c^2 ——	6·7	36 57	10 5
	30 Aquarii	5·6	54 5	7 22
	(2) ——	6·7	22 1 19	5 7
July 31	c^1 Capric.	6	21 35 41	− 9 53
	c^2 ——	6·7	36 57	10 5
	(345) Aquarii *	6·7	49 4	6 16
	30 ——	5·6	54 5	7 22
	(2) ——	6·7	22 1 19	5 7
	θ ——	4·5	7 37	8 39
	44 —— *	6·7	8	6 16
	Moon (16)		13	5 51
	51 Aquarii	6	15 1	5 43
	(166) ——	6	28 43	5 8
	(183) ——	7·8	31 47	4 27
	(219) ——	7·8	38 50	5 8
Aug. 22	39 Ophiu.	5·6	17 7 23	−24 4
	(33) ——	6	7 28	23 51
	θ ——	3·4	11 19	24 49
	b —— *	5·6	15 43	24 0
	e^2 —— *	5	20 46	23 49
	Moon (9)		30	22 50
	(283) Sagitt. *	7·8	46 28	23 54
	4 —— *	5	49 9	23 47
	7 ——	6	52 9	24 16
	(386) —— *	6	18 1 4	23 44
Aug. 23	μ^1 Sagitt.	3·4	18h 3m 19s	−21° 6′
	μ^2 ——	6	4 48	20 47
	21 ——	6	14 57	20 38
	(125) ——	6·7	27 27	21 32
	Moon (10)		28	21 41
	28 Sagitt. *	6	35 50	22 34
	30 —— *	6	40 21	22 21
	ν^1 —— *	5	43 37	22 58
	ν^2 —— *	5	44 35	22 54
	ξ^1 ——	5·6	46 59	20 53
	ξ^2 ——	5	47 19	21 20
	ο ——	4·5	54 13	21 59
	π ——	4·5	59 23	21 18
Aug. 24	π Sagitt.	4·5	18 59 23	−21 18
	d ——	5	19 7 25	19 15
	ρ^1 ——	5	11 33	18 11
	ρ^2 ——	5·6	11 40	18 38
	(138) ——	6	20 32	21 41
	Moon (11)		22	19 20
	e^1 Sagitt.	5·6	30 43	16 41
	e^2 ——	5	32 32	16 32
	f —— *	6	36 12	20 11
	57 ——	5·6	42 4	19 29
	g ——	6	48 4	15 57
Aug. 25	g Sagitt.	6	19 48 4	−15 57
	(381) —— *	7·8	55 26	16 52
	α^2 Capric.	3	20 8 22	13 5
	β^2 ——	3·4	11 12	15 20
	Moon (12)		15	16 3
	(172) Capric. *	7·8	22 38	17 11
	(194) —— *	7	25 39	17 7
	13 ——	6	27 34	15 45
	τ ——	6	29 31	15 34
	(325) ——	6·7	41 4	13 11

1825.	Stars.	Mag.	Æ.	D.
Aug. 26	ε Aquarii	4·5	20h 38m 14s	−10° 8′
	(325) Capric. *	6·7	41 4	13 11
	(351) Aquarii	6	43 32	12 14
	8 ——	6	50 20	13 43
	ν ——	5	21 0 6	12 4
	Moon (13)		6	12 2
	(82) Aquarii	7·8	12 1	12 12
	17 ——	6	13 33	10 4
	19 ——	6	15 48	10 30
	(119) —— *	7·8	16 56	12 50
	λ Capric.	5.6	37 8	12 10
Aug. 27	ξ Aquarii *	5	21 28 28	− 8 38
	c^1 Capric.	6	35 41	9 53
	c^2 ——	6·7	36 57	10 5
	30 Aquarii	5·6	54 5	7 22
	Moon (14)		54	7 35
	(14) Aquarii	7·8	22 3 32	7 20
	θ —— *	4·5	7 37	8 39
	ρ —— *	6	11 1	8 42
	51 ——	6	15 1	5 43
Aug. 28	γ Aquarii	4	22 12 39	− 2 16
	51 ——	6	15 1	5 43
	60 ——	6·7	25 4	2 28
	(166) ——	6	28 43	5 8
	(183) ——	7·8	31 47	4 27
	Moon (15)		43	2 51
	3 Piscium	6	51 41	0 45
	(17) —— *	7·8	23 5 8	3 35
	(68) ——	6·7	14 35	0 40
Aug. 29	a Piscium	6	22 59 45	+ 1 11
	γ ——	4·5	23 8 8	2 20
	χ^1 ——	5·6	17 59	0 18
	χ^2 ——	6	18 19	0 10
	Moon (16)		28	1 56

1825.	Stars.	Mag.	Æ.	D.
Aug. 29	λ Piscium	5	23h 33m 9s	+ 0° 49′
	19 ——	6	37 29	2 31
	22 ——	6	43 2	1 58
	ω ——	4·5	50 22	5 54
Aug. 30	ω Piscium *	4·5	23 50 22	+ 5 54
	c^1 ——	6	53 29	7 59
	c^2 ——	6	53 35	7 31
	35 ——	6	0 6 0	7 51
	Moon (17)		13	6 35
	45 Piscium	6	16 43	6 43
	51 —— *	6·7	23 24	6 0
	60 —— *	6	38 22	5 47
	δ ——	5	39 38	6 38
Sept. 20	ν^2 Sagitt.	5	18 44 35	−22 53
	ξ^1 —— *	6	46 59	20 53
	ξ^2 ——	5	47 20	21 20
	ο ——	4·5	54 14	21 59
	π —— *	4·5	59 23	21 18
	Moon (8)		19 6	19 56
	d Sagitt.	5	7 25	19 15
	ρ^1 ——	5	11 33	18 11
	ρ^2 ——	5·6	11 40	18 38
	e^1 ——	5·6	30 45	16 41
	f ——	5	36 12	20 11
	57 ——	5·6	42 6	19 29
Sept. 21	f Sagitt.	5	19 36 12	−20 11
	57 ——	5·6	42 6	19 29
	g ——	6	48 4	15 57
	(381) ——	7·8	55 25	16 52
	Moon (9)		20 0	16 57
	σ Capric.	5·6	9 19	19 40
	β ——	3·4	11 13	15 20
	π ——	5	17 20	18 47
	ρ ——	5	18 54	18 23
	τ ——	6	29 33	15 34

1825.	Stars.	Mag.	Æ.	D.
Sept. 22	β Capric.	3·4	20h 11m 13s	−15° 20′
	13 ——	6	27 34	15 45
	τ ——	6	29 33	15 34
	ε Aquarii	4·5	38 14	10 8
	(325) Capric.	6·7	41 4	13 11
	μ Aquarii	4·5	43 15	9 38
	8 —— *	6	50 20	13 43
	9 —— *	6	51 32	14 12
	Moon (10)		51	13 13
	ν Aquarii	5	21 0 6	12 4
	14 ——	7·8	6 57	9 56
	18 —— *	6	14 39	13 38
	19 ——	6	15 48	10 30
	c^1 Capric.	6	35 42	9 53
	c^2 ——	6·7	36 58	10 5
Sept. 23	19 Aquarii	6	21 15 48	−10 30
	(134) ——	7·8	18 47	12 19
	c^1 Capric. *	6	35 42	9 53
	c^2 —— *	6·7	36 58	10 5
	Moon (11)		40	8 57
	30 Aquarii	5·6	54 6	7 22
	36 ——	7	22 0 20	9 3
	θ ——	4·5	7 38	8 39
	ρ ——	6	11 2	8 41
Sept. 24	30 Aquarii	5·6	21 54 6	− 7 22
	(2) —— *	6·7	22 1 27	5 7
	44 ——	6·7	8 1	6 15
	51 ——	6	15 2	5 43
	Moon (12)		26	4 22
	(166) Aquarii *	6	28 43	5 8
	(219) —— *	7·8	38 51	5 8
	(254) ——	7·8	48 16	5 44
Sept. 25	1 Piscium	6	22 46 4	+ 0 8
	3 —— *	6	51 41	− 0 45

1825.	Stars.	Mag.	Æ.	D.
Sept. 25	Moon (13)		23h 11m 0s	+ 0° 21′
	(68) Piscium *	6·7	14 35	− 0 40
	κ^1 ——	5·6	17 59	+ 0 18
	κ^2 ——	6	18 19	+ 0 10
	16 ——	6	27 30	+ 1 8
	λ ——	5	33 9	+ 0 49
	22 ——	6	43 2	+ 1 58
Sept. 26	θ Piscium	5	23 19 7	+ 5 25
	ι —— *	4·5	30 59	4 41
	19 ——	6	37 29	2 31
	26 ——	6	46 12	6 6
	ω ——	4·5	50 22	5 54
	Moon (14)		56	5 0
	36 Piscium	6·7	0 7 37	7 16
	d ——	5·6	11 38	7 13
	45 ——	6	16 43	6 43
	51 ——	6·7	23 24	6 0
	62 ——	6	39 15	6 21
	δ ——	5	39 38	6 38
Sept. 27	d Piscium	5·6	0 11 38	+ 7 13
	(110) ——	7	25 9	9 20
	62 ——	6	39 15	6 21
	δ ——	5	39 38	6 38
	Moon (15)		44	9 28
	(262) Piscium	7	53 26	7 53
	75 ——	6·7	57 24	12 0
	(8) ——	7	1 2 22	9 22
	(101) ——	7·8	22 31	9 59
Sept. 28	75 Piscium	6·7	0 57 24	+12 0
	(311) ——	6	1 0 57	14 45
	η ——	4	22 10	14 27
	101 ——	6	26 28	13 46
	104 —— *	6	29 55	13 24
	Moon (16)		31	13 32

1825.	Stars.	Mag.	Æ.	D.
Sept.28	4 Arietis	6·7	$1^h\ 38^m 44^s$	+ 16° 5′
	ι ——	6	47 50	16 43
Sept.29	ι Arietis	6	1 47 50	+16 43
	(243) ——	6	54 9	17 10
	15 ——	6	2 0 58	18 40
	θ^1 ——	6	8 27	19 5
	θ^2 ——	7·8	9 28	18 53
	Moon (17)		19	17 8
	27 Arietis *	6	21 15	16 42
	(112) ——	6·7	23 52	18 6
	36 ——	7	34 36	17 1
	40 ——	6	38 46	17 33
	ρ^2 ——	6	46 0	17 37
	ρ^3 ——	6	46 36	17 19
	(230) ——	7·8	50 44	17 18
	δ ——	4	3 1 40	19 4
Oct. 18	ρ^1 Sagitt. *	5	19 11 34	−18 11
	ρ^2 —— *	5·6	11 41	18 38
	(138) ——	6	20 32	21 41
	(176) ——	7	26 15	19 14
	(180) —— *	7	26 56	18 37
	e^1 ——	5·6	30 44	16 41
	e^2 ——	5	11 41	16 32
	f ——	6	36 13	20 11
	Moon (7)		42	17 50
	g Sagitt.	6	48 5	15 57
	(381) Capric.	7·8	55 27	16 52
	(404) ——	7	58 39	15 31
	β ——	3·4	20 11 13	15 20
Oct.19	β Capric. *	3·4	20 11 13	−15 20
	π ——	5	17 20	18 47
	ρ ——	5	18 54	18 23
	13 —— *	6	27 35	15 45
	τ —— *	6	29 32	15 34

1825.	Stars.	Mag.	Æ.	D.
Oct.19	Moon (8)		$20^h 34^m\ 0^s$	−14° 18′
	(325) Capric.	6·7	41 4	13 11
	(351) Aquarii	6	43 33	12 14
	8 ——	6	50 20	13 43
	ν ——	5	21 0 6	12 4
Oct.20	ν Aquarii	5	21 0 6	−12 4
	14 ——	7·8	6 57	9 56
	17 ——	6	13 34	10 4
	19 —— *	6	15 49	10 30
	Moon (9)		24	10 10
	ξ Aquarii	5	28 28	8 36
	c^1 Capric.	6	35 42	9 53
	c^2 ——	6·7	36 58	10 5
	30 Aquarii	5·6	54 6	7 22
	(2) ——	6·7	22 1 20	5 7
Oct.21	c^1 Capric.	6	21 35 42	− 9 53
	c^2 ——	6·7	36 58	10 5
	(345) Aquarii *	6·7	49 5	6 15
	30 ——	5·6	54 6	7 22
	(2) ——	6·7	22 1 20	5 7
	44 —— *	6·7	8 2	6 16
	Moon (10)		11	5 43
	51 Aquarii	6	15 2	5 43
	(166) ——	6	28 43	5 8
	(183) ——	7·8	31 47	4 27
	(219) ——	7·8	38 51	5 8
Oct.22	ζ Aquarii	4	22 19 51	− 0 55
	η ——	4	26 42	− 1 1
	1 Piscium	6	46 5	+ 0 8
	2 ——	6·7	50 32	+ 0 2
	3 ——	6	51 41	− 0 45
	Moon (11)		56	− 1 4
	a Piscium	6	59 46	+ 1 11
	γ ——	4·5	23 8 8	+ 2 20

1825.	Stars.	Mag.	Æ.	D.
Oct.22	(68) Piscium	6·7	$23^h 14^m 35^s$	− 0°40′
	κ^1 ——	5·6	18 0	+ 0 18
	κ^2 ——	6	18 20	+ 0 10
	12 —— *	7	20 34	− 2 0
	13 —— *	7	21 42	− 2 3
Oct.23	κ^1 Piscium	5·6	23 18 0	+ 0 18
	κ^2 ——	6	18 20	0 10
	16 ——	6	27 30	1 8
	ι ——	4·5	30 59	4 41
	19 —— *	6	37 29	2 31
	Moon (12)		42	3 34
	26 Piscium	6	46 12	6 6
	ω ——	4·5	50 22	5 54
	51 ——	6·7	0 23 24	6 0
Oct.24	26 Piscium	6	23 46 12	+ 6 6
	ω ——	4·5	50 22	5 54
	35 —— *	6	0 6 1	7 51
	36 —— *	6·7	7 38	7 16
	38 —— *	7·8	8 17	7 36
	d —— *	5·6	11 39	7 13
	Moon (13)		27	8 3
	δ Piscium	5	39 39	6 38
	(262) —— *	7	53 27	7 53
	(297) Ceti	7·8	59 16	8 58
Oct.25	58 Piscium	6	0 37 56	+11 1
	(231) ——	7	47 1	13 0
	(257) ——	7·8	52 15	10 58
	75 —— *	6·7	57 25	12 1
	Moon (14)		1 13	12 14
	η Piscium	4	22 11	14 27
	100 —— *	7	25 36	11 40
	π ——	6	27 52	11 15
Oct.26	η Piscium	4	1 22 11	+14 27
	(120) ——	6	26 30	16 32

1825.	Stars.	Mag.	Æ.	D.
Oct.26	103 Piscium *	7·8	$1^h 29^m 52^s$	+15°44′
	105 —— *	6	30 18	15 31
	4 Arietis	6·7	38 45	16 5
	γ ——	4·5	43 59	18 26
	ι ——	6	47 51	16 58
	(243) ——	6	54 9	17 10
	Moon (15)		2 2	15 56
	θ^1 Arietis	6	8 27	19 5
	θ^2 ——	7·8	9 28	18 53
	27 ——	6	21 15	16 42
	(112) ——	6·7	23 53	18 6
Oct.27	(112) Arietis *	6·7	2 23 53	+18 6
	μ ——	6	32 33	19 16
	40 ——	6	38 47	17 33
	ρ^2 ——	6	46 1	17 37
	ρ^3 ——	6	46 37	17 19
	Moon (16)		53	18 56
	δ Arietis *	4	3 1 41	19 4
	ζ ——	5	4 54	20 24
	τ^1 ——	6	11 12	20 31
	τ^2 ——	7	12 45	20 21
	65 ——	6	14 24	20 11
Oct.28	δ Arietis	4	3 1 41	+19 4
	ζ —— *	5	4 54	20 24
	τ^1 —— *	6	11 12	20 31
	τ^2 —— *	7	12 45	20 21
	65 ——	6	14 24	20 11
	13 Tauri	6·7	32 17	19 8
	14 ——	7	33 43	19 6
	16 ——	5·6	34 28	23 44
	17 ——	4·5	34 33	23 33
	η —— } Pleiades.	3	37 8	23 33
	27 ——	5	38 50	23 31
	28 ——	5·6	38 50	23 36

1825.	Stars.	Mag.	Æ.	D.
Oct.28	Moon (17)		3^{h}53^m 0^s	+21° 5′
	a^1 Tauri	5	54 25	21 36
	39 ——	6·7	55 2	21 32
	ω^1 ——	6	59 1	19 8
	a^2 ——	5·6	4 7 4	20 8
	53 —— *	6·7	9 10	20 42
	κ^1 ——	5·6	14 59	21 53
	κ^2 ——	6·7	15 2	21 47
Nov.16	ε Aquarii	4·5	20 38 14	−10 8
	(325) Capric.	6·7	41 5	13 11
	(351) Aquarii *	6	43 33	12 14
	(423) —— *	7·8	52 29	12 23
	ν —— *	5	21 0 7	12 4
	Moon (7)		4	11 39
	(82) Aquarii *	7·8	12 1	12 12
	(126) —— *	7·8	18 12	12 25
	(134) —— *	7·8	18 48	12 20
	λ Capric. *	5·6	37 9	12 10
Nov.17	ξ Aquarii	5	21 28 29	− 8 38
	c^1 Capric.	6	35 42	9 53
	c^2 ——	6·7	36 58	10 5
	Moon (8)		53	7 13
	30 Aquarii	5·6	54 6	7 22
	14 ——	7·8	22 3 32	7 20
	θ ——	4·5	7 37	8 39
	(81) —— *	7	14 23	8 5
	51 ——	6	15 2	5 43
Nov.18	(2) Aquarii	6·7	22 1 29	− 5 7
	(43) ——	7	7 35	2 28
	γ ——	4	12 39	2 16
	51 ——	6	15 2	5 43
	60 ——	6·7	25 4	2 28
	(183) ——	7·8	31 48	4 27
	Moon (9)		41	2 26

1825.	Stars.	Mag.	Æ.	D.
Nov.18	3 Piscium	6	22^{h}51^{m}41^s	− 0°45′
	(17) —— *	7·8	23 5 9	3 35
	(68) ——	6·7	14 35	0 40
	12 ——	7	20 34	2 0
	13 ——	7	23 1	2 3
Nov.19	a Piscium *	6	22 59 46	+ 1 11
	γ ——	4·5	23 8 9	2 20
	κ^1 ——	5·6	18 0	0 18
	κ^2 ——	6	18 20	0 10
	Moon (10)		26	2 3
	λ Piscium	5	33 9	0 49
	19 ——	6	37 30	2 31
	(193) —— *	7·8	39 54	1 14
	(206) —— *	8	42 12	1 16
	22 ——	6	43 3	1 58
	ω ——	4·5	50 23	5 54
Nov.20	26 Piscium *	6	23 46 13	+ 6 6
	ω —— *	4·5	50 22	5 54
	c^1 ——	6	53 29	7 59
	c^2 ——	6	53 35	7 31
	35 ——	6	0 6 0	7 51
	Moon (11)		11	6 36
	45 Piscium	6	16 43	6 43
	51 —— *	6·7	23 25	6 0
	δ ——	5	39 39	6 38
Nov.21	γ Pegasi	2·3	0 4 17	+14 13
	42 Piscium	7	13 25	12 30
	(110) ——	7	25 9	9 20
	(140) —— *	7·8	30 37	10 34
	58 ——	6	37 56	11 1
	(255) —— *	8	52 8	10 14
	Moon (12)		57	10 52
	η Piscium	4	1 22 11	14 26

1825.	Stars.	Mag.	Æ.	D.
Nov.21	101 Piscium	6	1h 26m 29s	+13° 46′
	104 ——	6·7	29 56	13 24
Nov.22	η Piscium *	4	1 22 11	+14 26
	101 ——	6	26 29	13 46
	103 ——	7·8	29 53	15 44
	105 ——	6	30 18	15 31
	4 Arietis	6·7	38 45	16 5
	Moon (13)		45	14 44
	(243) Arietis	6	54 10	17 10
	19 —— *	7	2 3 34	14 27
	29 —— *	6·7	23 22	14 15
Nov.23	γ Arietis	4·5	1 44 0	+18 26
	15 ——	6	2 1 0	18 40
	θ^1 ——	6	8 28	19 5
	θ^2 ——	7·8	9 29	18 53
	26 ——	6·7	20 52	19 4
	(112) ——	6·7	23 53	18 6
	μ ——	6	32 33	19 16
	Moon (14)		34	17 59
	40 Arietis *	6	38 47	17 33
	ϱ^2 —— *	6	46 1	17 37
	ϱ^3 —— *	6	46 37	17 20
	(230) —— *	7·8	50 45	17 18
	53 —— *	6	57 38	17 12
	ζ ——	5	3 4 54	20 23
Nov.24	ζ Arietis	5	3 4 54	+20 23
	τ^1 ——	6	11 12	20 31
	τ^2 —— *	7	12 45	20 21
	65 —— *	6	14 24	20 11
	66 ——	6·7	18 17	22 12
	Moon (15)		26	20 27
	(128) Tauri *	7·8	34 21	20 22
Nov.24	16 Tauri (Pleiades)	5·6	3h 34m 28s	+23° 44′
	17 —— (Pleiades)	4·5	34 33	23 33
	η —— (Pleiades)	3	37 9	23 33
	27 —— (Pleiades)	5	38 50	23 31
	28 —— (Pleiades)	5·6	38 50	23 36
	32 ——	6	46 35	21 58
	(213) ——	7·8	50 37	22 42
	a ——	5	54 25	21 36
	39 ——	6·7	55 2	21 32
Nov.25	a Tauri *	5	3 54 25	+21 36
	39 —— *	6·7	55 2	21 32
	κ^1 —— *	5·6	4 15 0	21 53
	κ^2 —— *	6·7	15 3	21 48
	(82) —— *	7·8	17 41	21 11
	Moon (16)		21	21 57
	τ^2 Tauri	5	31 48	22 37
	(243) ——	6·7	47 15	23 40
	ι —— *	4·5	52 42	21 20
	105 —— *	6	57 32	21 28
	108 ——	7	5 5 0	22 5
	n —— *	5·6	8 49	21 54
Nov.26	τ^2 Tauri	5	4 31 48	+22 37
	ι —— *	4·5	52 42	21 20
	105 —— *	6	57 32	21 28
	108 —— *	7	5 5 0	22 5
	n —— *	5·6	8 49	21 54
	Moon (17)		16	22 19
	ο Tauri *	5	17 11	21 47
	ζ ——	3·4	27 14	21 2
	132 ——	5	38 19	24 30
	χ Orionis	5	44 4	20 14
	1 Gemin.	5	53 32	23 16
Dec.15	30 Aquarii	5·6	21 54 5	− 7 22
	(2) —— *	6·7	22 1 29	5 7

1825.	Stars.	Mag.	Æ.	D.
Dec.15	51 Aquarii *	6	22h 15m 3s	− 5°43′
	Moon (6)		21	4 31
	(166) Aquarii *	6	28 45	5 8
	(219) —— *	7·8	38 52	5 8
	(254) —— *	7·8	48 17	5 44
Dec.16	1 Piscium	6	22 46 5	+ 0 8
	3 —— *	6	51 43	− 0 45
	a ——	6	59 46	+ 1 11
	Moon (7)		23 7	+ 0 12
	(68) Piscium *	6·7	14 36	− 0 40
	κ^1 ——	5·6	18 0	+ 0 18
	κ^2 ——	6	18 20	+ 0 10
	16 ——	6	27 30	+ 1 8
	λ ——	5	33 9	+ 0 49
	22 ——	6	43 3	+ 1 58
Dec.17	b Piscium *	6	23 11 28	+ 4 26
	ϑ ——	5	19 8	5 25
	ι —— *	4·5	31 0	4 41
	19 ——	6	37 30	2 31
	26 ——	6	46 13	6 6
	ω ——	4·5	50 23	5 54
	Moon (8)		53	4 50
	36 Piscium	6·7	0 7 37	7 16
	d ——	5·6	11 39	7 13
	45 ——	6	16 44	6 43
	51 ——	6·7	23 25	6 0
	(189) —— *	6	39 15	4 23
	δ ——	5	39 39	6 38
Dec.18	d Piscium	5·6	0 11 39	+ 7 13
	(110) ——	7	25 10	9 20
	62 ——	6	39 16	6 21
	Moon (9)		39	9 15
	(262) Piscium	7	53 27	7 53
	(297) Ceti *	7·8	59 16	8 58

1825.	Stars.	Mag.	Æ.	D.
Dec.18	(8) Piscium	7	1h 2m 23s	+ 9°22′
	(101) ——	7·8	22 32	9 59
Dec.19	(257) Piscium	7·8	0 52 16	+ 10 58
	75 ——	6·7	57 24	12 0
	(311) ——	6	1 0 58	14 45
	η ——	4	22 11	14 27
	Moon (10)		26	13 17
	101 Piscium	6	26 29	13 46
	104 ——	6	29 56	13 24
	4 Arietis	6·7	38 45	16 5
	ι ——	6	47 51	16 43
Dec.20	ι Arietis	6	1 47 51	+ 16 43
	(243) ——	6	54 10	17 10
	15 ——	6	2 1 0	18 40
	θ^1 ——	6	8 28	19 5
	θ^2 ——	7·8	9 29	18 53
	Moon (11)		15	16 47
	27 Arietis	6	21 16	16 42
	(112) ——	6·7	23 53	18 6
	36 ——	7	34 37	17 1
	π ——	5	39 35	16 44
	ρ^2 ——	6	46 1	17 37
	ρ^3 ——	6	46 37	17 20
	(230) ——	7·8	50 45	17 18
	δ ——	4	3 1 40	19 4
Dec.21	(112) Arietis	6·7	2 23 54	+ 18 6
	μ —— *	6	32 34	19 16
	40 ——	6	38 47	17 33
	47 ——	6	48 7	19 58
	54 ——	6·7	58 30	18 7
	δ —— *	4	3 1 40	19 4
	Moon (12)		5	19 34
	τ^1 Arietis	6	11 13	20 31
	τ^2 ——	7	12 46	20 21

1825.	Stars.	Mag.	Æ.	D.
Dec. 21	65 Arietis	6	3h 14m 24s	+20° 11′
	13 Tauri *	6·7	32 17	19 8
	14 —— *	7	33 43	19 6
	16 —— (Pleiades.)	5·6	34 29	23 44
	17 —— (Pleiades.)	4·5	34 34	23 33
	η —— (Pleiades.)	3	37 9	23 33
	27 —— (Pleiades.)	5	38 51	23 31
	28 —— (Pleiades.)	5·6	38 51	23 36
Dec. 22	7 Tauri	6	3 24 9	+23 52
	11 ——	6	30 24	24 46
	16 —— (Pleiades.)	5·6	34 29	23 44
	17 —— (Pleiades.)	4·5	34 34	23 33
	η —— (Pleiades.)	3	37 9	23 33
	27 —— (Pleiades.)	5	38 51	23 31
	28 —— (Pleiades.)	5·6	38 51	23 36
	33 ——	6·7	46 45	22 40
	a¹ ——	5	54 25	21 36
	39 ——	6·7	55 2	21 32
	Moon (13)		59	21 29
	(6) Tauri	7	4 2 33	21 57
	51 —— *	7	8 5	21 8
	53 ——	6·7	9 11	20 32
	56 —— *	6·7	9 19	21 20
	(47) —— *	7·8	11 16	20 37
	(48) —— *	7·8	11 17	20 46
	(53) ——	7	12 9	20 24
	(61) ——	7·8	13 18	20 34
	(82) —— *	7·8	19 1	21 14
	τ² ——	5	31 49	22 37
Dec. 23	υ¹ Tauri	5	4 15 55	+22 24
	υ² ——	6	16 54	22 36
	τ² ——	5	31 49	22 37
	(243) ——	6·7	47 16	23 40
	ι ——	4·5	52 43	21 20

1825.	Stars.	Mag.	Æ.	D.
Dec. 23	Moon (14)		4h 53m 0s	+22° 19′
	105 Tauri	6	57 33	21 20
	108 —— *	7	5 5 0	22 5
	n —— *	5·6	8 50	21 54
	o —— *	5	17 12	21 47
	121 ——	6	24 50	23 55
	ζ ——	3·4	27 15	21 2
Dec. 24	o Tauri *	5	5 17 12	+21 47
	121 ——	6	24 50	23 55
	ζ ——	3·4	27 15	21 2
	132 ——	5	38 20	24 30
	χ Orionis	5	44 4	20 14
	Moon (15)		50	21 56
	1 Gemin.	5	53 33	23 16
	2 ——	6·7	56 12	23 29
	3 ——	6	59 10	23 8
	4 ——	7	6 0 2	23 1
	6 ——	6·7	1 46	22 56
	η ——	4·5	4 23	22 23
	9 ——	7	6 22	23 47
	10 ——	7·8	8 19	23 40
	11 ——	7	8 44	23 32
	μ ——	3	12 27	22 36
Dec. 25	μ Gemin.	3	6 12 27	+22 36
	ν ——	5	18 38	20 20
	22 —— *	7·8	24 23	19 33
	ε ——	3	33 13	25 18
	36 ——	6·7	41 7	22 0
	Moon (16)		50	20 20
	ζ Gemin.	4	53 47	20 49
	δ ——	3·4	7 9 43	22 18
	56 ——	5·6	11 41	20 46
	61 ——	7·8	16 41	20 36
	74 ——	6	29 26	18 4
	81 ——	6	36 3	18 56

FINIS.