COMPLETE SYSTEM

OF

HINDU ASTRONOMY,

BEING A

TRANSLATION

OF THE

FOREGOING WORK.

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PARAKITHAM.

This System of Hindu Astronomy was translated into Tamil, from the Sanskrit, by *Ullamudeian.*

To determine the four Yugas.

1. In each of the 12 signs, there are 1800 minutes; multiply this number by 12 and you have 21600; e. g. 1800×12=21600.

2. Multiply this, 21600, by 80 and it will give 1,728,000, which is the duration of the first age, called *Creta Yuga.*

3. If the same number be multiplied by 60, it will give 1,296,000, the years of the second age, *Treta Yuga.*

4. The same number multiplied by 40, gives 864,000, the length of the third age, *Dwapara Yuga.*

5. The same multiplied by 20, gives 432,000, the fourth age, *Cali Yuga.*

To determine the year of Salivakana Era.

Write down the number 60, and multiply it by the number of the complete cycles of 60 passed, (in 1847=23) and add the number of years passed in the present cycle, (=40), and to the whole add 349.

Note. Example for 1847; 60×23=1380+40=1420 +349=1769.

The number 349 is the year of this Era at which the cycle of 60 was introduced. This rule fixes *Salivakana* Epoch at A. D. 78.

The Cycle of 60.

I. Rule for finding the current year of the Cycle.

1. Take the year of *Salivakana,* and write it in two places; divide one by 60, and set down the *remainder.*

Then multiply the other by 22, and to the product add 4291; divide this by 1875, and add the quotient to the above mentioned *remainder*, and the sum will be *years*.

2. Take the remainder in the last division, and multiply it by 12, and divide the product by 1875, and the quotient will be *months*.

3. Multiply the last remainder (in No. 2.) by 30, and divide by 1875, and the result will be *days*.

4. Multiply the remainder in No. 3. by 60, and divide by 1875, and the quotient will give the *Nalikei*. For the *Vinalikei*, &c. repeat this process on each successive remainder.

The number of years, &c. found, will show to what year, &c. we have advanced in the cycle; and of course will indicate which of the three divisons named below, is passing.

II. There are three *Astrological divisions* of the Cycle.

1. The first division of 20 years is an *auspicious season.*

2. The second division of 20 years possesses a *medium character.*

3. The third division of 20 years is an *inauspicious season.*

NOTES. 1. These are not *solar years* but the *mean periods of Jupiter's* continuance in the several signs of the Zodiac.

2. The number 22 is the excess of Jupiter's periods in 1875 Solar years.

3. The *Salivakana Era* began 2 years, 3 mos. and 13 days after the commencement of the then current Cycle. This, in the peculiar style of these works, is expressed by the two numbers 4291 and 1875,—thus, $\frac{4291}{1875}=2$ years. 3 mos. 13 days. The whole process is as follows. The year of Salivakana for 1847 is 1769. (1.) $\frac{1769}{60}=29\frac{29}{60}$. (2.) $1769\times22+4291\div1875=23$ years. 0 mos. 16 days, & 8 *Nalikeis*. The first remainder, 29, added to 23, the last quotient, will make 52 years. We are therefore a little past the middle of the third division of the Cycle.

To determine Sutta Tinam, or, the time passed in Cali Yuga to any given year.

1. Add to the years of *Salivakana Era* 3179; and the *sum* will be the *years*.

2. Multiply this *sum* by 1,416,106, and divide the product by 3877, and the quotient will give the *days*.

3. Reduce the *successive remainders* by multiplying by 60, and dividing by 3877. This will give the *Nalikei*, *Vinalikei*, and *Tatparei*.

Notes. 1. Example. The year of *Salivakana* for 1847 is 1,769; 1,769+3,179=4,948×1,416,106=6,956,892, 488÷3,877=1,805,105 $\frac{3767}{3877}$ days.

2. This is on the principle that 1 (year): length of a year in days, &c. :: 3,877 : 1,416,106. This gives the length of the year=365d. 15n. 29v. 28.824t. In European notation=365d. 6h. 11m. 47.5296s. nearly. European year=365d. 6h, 9m. 9.6s.=365.258189. Hence the Hindu year is too great by 2m. 39.9s.

Another method for the days of Cali Yuga, &c.

1. Set down the number of *years* passed in *Cali Yuga*, multiply the same by 210,389; *subtract* from the product 1237, *divide* the remainder by 576, and we get the number of days. The length of the year by this process = 365d. 15n. 31v. 15t.

Note. The numbers 210,389 and 576 express the length of the year=$\frac{210389}{576}$=365d. 15n. 31v. 15t. The correction $\frac{1237}{576}$=2d. 8n. 57v. 15t. is for the Epoch. The subtraction of 1,237 *before* division, is the same as the subtraction of the 2d. 8n. &c. *after* it.

2. Multiply the *remainder* by 60, and divide by the same divisor, 576, and the quotient will be *Nalikei*. Treat the successive *remainders* in the same way for *Vinalikies*, *&c*. This is *Sutta Tinam* for the beginning of the year.

3. Divide the days thus found by 7, and the remainder will show the *day of the week*, counting from Friday as the first, on which the *year commences*.

4. For the commencement of any given month, add the

number for the said month in the second Table under the next article. If the month begins in the day time, the day thus arising is to be taken; but if it commences at night, the succeeding day is the one.

To determine the beginning of the year and months.

1. Divide the whole number of days passed in *Cali Yuga* by 7, and take the *remainder*, which will indicate (reckoning from Friday as the first) the day of the *week* and time of *day*, at which *Sittirei* begins, or the *beginning of the year.*

2. For the time of the day at which the year begins, add to the *Nalikeis* in the preceding *remainder*, 13 *Nalikeis* and 3 *Vinalikeis.*

This sum is called *Sankrama Druvam*,—which is the *standard number* for determining the commencement of other months. For this purpose use Table second.

Sankrama Vakyam.

Table First—Shows the quantities to be added to the time when the year commences, for determining the day of the week and the time of day on which the several months commence.

	D.	N.	V.
Veikasi	2	55	32
Ani	6	19	44
Adi	2	56	22
Avani	6	24	34
Puraddasi	2	26	44
Atpasi	4	54	6
Cartikei	6	48	13
Markali	1	18	37
Tei	2	39	30
Masi	4	6	46
Pankuni	5	55	10
Sittirei	1	15	31

Rule. For the day of the week on which any given month commences, add the quantity named for that month to the *standard number.*

Table Second—Gives the time past from the commencement of New year to the beginning of the months respectively.

	D.	N.	V.
Veikasi	30	55	32
Ani	62	19	44
Adi	93	56	22
Avani	125	24	34
Puraddasi	156	26	44
Atpasi	186	54	6
Cartikei	216	48	13
Markali	246	18	37
Tei	275	39	20
Masi	305	6	46
Pankuni	334	55	10
Sittirei	365	15	31

Rule. For the time at which any given month commences, add, to the *standard number*, the quantity corresponding to that month in the table.

Method of forming the Panchanka Vakyam, or Table of moon's longitude and daily motion.

1. Multiply 13° 10′ 35″ by 1, 2, 3, &c. to 248.
2. Multiply 0° 6′ 41″ by 1, 2, 3, &c. to 248.
3. Subtract the *latter products* from the *former*, each from each respectively, and you get the *argument* for the Moon's *Manta Jya.* [See Table No. III.]

Apply the equations thus taken from the Table, to the several products in No. 1; and the *results*, set opposite the Cardinal numbers, 1, 2, 3, &c. will constitute the Table. [See Table No. I.]

NOTE. The 13° 10′ 35″ mentioned above, is the mean daily motion of the moon in her orbit; and 6′ 41″ is that of her Apogee. The difference of these two motions gives the mean daily motion of the moon from Apogee=13° 3′ 54″. This determines the length of the moon's anomalistic revolution$=\frac{360}{13\ 3\ 54}=$27d. 33n. 16v. 19t.=27d. 13h. 18m. 8s. It should be 27d. 13h. 18m. 37.4s.

The true daily motion of the moon and her true longitude, are given for 248 days, reckoning from Apogee.

At the end of 248 days the longitude of the moon and Apogee are supposed to be the same again, or equal. It is nearly so.

To correct the Panchanka Vakyam.

1. If an error in the above Table be supposed in any *number*, subtract that *number* from 248, and take the longitude from the Table for the *remainder*, and subtract it from the last mentioned longitude in the table, and the remainder will be the *proper longitude* for the given number.
2. The longitude for the 124th number, is half of the last longitude given in the Table.
3. The last mentioned longitude is equal to that of the 247th added to that of the first number.

Directions for the use of Panchanka Vakyam.

1. From the whole number of days passed in *Cali Yuga*, subtract 1,565,411, and divide the remainder by 3031 and set the *quotient* aside, which may be called *Khandam.*
2. Divide the *last remainder* by 248 and the succeed-

ing *remainder* will show the number to be used in the table.

Notes. 1. The number 1,565,411 denotes days=4285·9+years. These are deducted from the period of *Cali Yuga* for the purpose of abridging the operation. *The period subtracted* is a multiple of the period in which the moon and her apogee are in conjunction in the first point of Aries.

2. The number, 3,031, also denotes *days*, making a *period* of *conjunction* of the moon and her apogee, after 110 revolutions of the moon. The division by this number casts out, from *Cali Yuga* reduced, *complete periods of conjunction* between the moon and her apogee.

3. The number 248 is an *approximate multiple* of the period of conjunction of the moon and apogee, and is the period of the *Panchanka Vakyam*. By this division the complete revolutions of this *Table* are removed from the remainder obtained in No. 2. The final remainder marks the given *day* in the current revolution of the 248 days of the Table.

4. When 12 revolutions of the table, and 55 days, have passed, the true place of the moon will differ from that in the table.

5. We must then calculate a new the *moon's mean place* for that day. The *Vakyam* for that day is the first, instead of the 56th.

6. The *Vakyam* for other days is to be taken according to the direction in the general rule above.

To determine the mean place of the moon's Apogee at the commencement of the Panchanka Vakyam, for any required time.

1. Take the quotient obtained in No. 1. of the preceding article, and multiply it by 22° 29′.

2. Multiply the quotient obtained in No. 2. of the preceding article by 27° 44′.

3. Subtract the first quantity from the second; and from the *remainder* subtract 5s. 0° 17′ and this will give the *mean longitude* of the *Moon's Apogee.*

4. If there be *no quotient* in No. 2. of the preceding article, subtract the 27° 44′ from 12s. and from the *re-*

mainder subtract 5s. 0° 17′ as in No. 3. and the result will be *the same*; i. e. *the mean longitude of Apogee at the beginning of the table for any given time.*

NOTES. 1. The 22° 29′ is the difference between the mean motion of ☽'s Apogee in 3,031 days and a complete revolution; e. g. 12s (=Rev. of Apogee)–11s. 7° 31′ (= mo. Ap. in 3031 days) =22° 29′.

2. The 27° 44′ is the motion of Apogee in 248 days.

3. The 5s. 0° 17′ is the difference between the longitude of Apogee at Epoch and 12s, or a complete revolution. Hence,

4. The object of No 1. in the text is, to extend the quantities to be expelled from *Kandam*, obtained in No. 1. of the preceding article, to *complete revolutions* of *Apogee.*

5. The object of No. 2. in the text, is, to find the amount of longitude passed by Apogee, after the *reduction* by 3031 in No. 1. of the previous article.

6. Therefore the subtraction in No. 3. completes the process of casting out complete revolutions from the *Kandam.*

Another method for Moon's Apogee.

1. From the whole number of days passed in *Cali Yuga* subtract 1,600,984.

2. Divide the remainder by 12,372—Then divide the remainder in the first division, by 3,031, and the next remainder, by 248.

The remainder last obtained is the number of the *Vakyam* for the first day of the year.

3. We have now three quotients. Multiply the first quotient by 9s. 27°. 48′. 10″; the second, by 11s 7°. 31′. 1″; and the third, by 27° 44′. 6″.

Add these products together, and to this sum, add 7s. 2°. 0′. 7″; and we get the *mean long. of Apogee.*

REMARKS. This method includes the subject of the two preceding articles.

No 1. directs to the reduction of *Cali Yuga*, to facilitate calculation.

No. 2. casts out *complete revolutions* of the *period of conjunction* of moon and apogee. The numbers are multiples, more or less perfect, of this period.

No. 3. gives the progress of apogee in longitude for each of the three periods mentioned in No. 2; e. g. 12372 *days* give 9s. 27° 48′ 10″. &c.

Hence, manifestly, the longitude of Apogee is had by the process here required. The 7s. 2° 0′ 7″ to be added, is the longitude of Apogee at the Epoch of the system.

The moon's Longitude for any given time.

From the *Vakyam* of the given day, subtract that of the preceding day, multiply the remainder by the given *Nalikei* and the lowest number will be *seconds.*

Add the product, the longitude of Apogee, and the *Vakyam* for given day, together; the sum will be the moon's longitude. From this the *Nacshastras* may be determined.

To determine the four prominent things of the Hindu Calendar or Panchankam.

1. For Nacshastras.

1. Set down the longitude of Apogee; add to this the *Vakyam* for the given day, and the correction from the table *Maniyathi.* [See Table No. xiii.] for the same time; and you get the moon's longitude.

2. Reject the *full Nacshastras* passed, and multiply the remainder by 60, and *divide* the product by the moon's motion for the day, the result will be the number of *Nalikeis* passed in the current *Nacshastra*; subtract this number from 60, and it will give the time to the end of the *Nacshastra.*

2. For the Tithi.

1. Set down the moon's longitude and subtract the *months* and *days* passsed from the beginning of the year.

2. If the month begin in the *day time*, *add* the *Nalikeis* and *Vinalikeis* passed in the day, as minutes and seconds; but if it begin at *night*, *subtract* the *Nalikeis* and *Vinalikies* from 60, and then subtract the remainder from the whole result in No. 1.

3. *Add* or *subtract* the correction, from the table *Yokiathi*, [See Table No. xii.] according as the given time is *less or more* than seven months from *Pankuni*, and the result is the *longitude for the Tithis.*

4. Reject the number of complete *Tithis* and multiply the remainder by sixty, and divide the product by the difference of the motions of the sun and moon for the day; and the *result* will be the number of *Nalikeis* passed in the current *Tithi*. The remaining *Nalikeis* are found by subtracting this number from sixty.

3. *For the Yogas.*

1. From the moon's longitude subtract those quantities which were added to the longitude of *Tithi*, and *add* those that were *subtracted* from the same, and the result will be the longitude for the *Yogas*.

2. Reject the *complete yogas*, multiply the remainder by 60, and divide the product by the sum of the daily motions of the sun and moon. The quotient will be the *Nalikeis* passed in the current *Yoga*. For the remaining *Nalikeis* subtract this quantity from 60.

4. *For the Karanas.*

1. There are two *Karanas* to a *Tithi*, the first of which begins with the last half of *Prathamei* after new moon.

2. The first *seven Karanas* are to be taken eight times in rotation, then follow the *four fixed Karanas*.

REMARK. This gives sixty *Karanas* to the synodical revolution of the moon, which is twice the number of the Tithi. e. g. $8\times7=56+4=60$.

To obtain the Kandam for calculating longitude.

1. Set down the number of days from the beginning of *Cali Yuga* to the *given year*. *Add* to these the number of days from the beginning of the year to the time of calculation, reckoning by *Solar Months*.

2. From the whole number of days subtract 1,587,006 and the remainder will be the *Kandam* for the *planets* and *nodes*.

3. To prove that the work is correct, divide the *Kandam* by 7, the remainder will indicate the *day of the week* for which the calculation is made, reckoning from Saturday, as the first.

REMARK. This is for the purpose of abridging the calculation. The *Kandam* is an *abridged period*. The

1587006 days, which are equal to 4344 years and 324.5 days nearly, constitute the time passed at the *date of the system*. This is January, 1234 A. D.

For the Longitude of the Sun.

1. Multiply the Kandam by 20, and divide the product by 7,305, and the quotient will be the number of complete revolutions.

NOTE. This is on the principle:—one revolution : number of days in it :: 20 : 7,305. This gives the year=365. 25*d.*

2. Reduce the remainder to *signs*, *degrees*, and *minutes*, by multiplying it by 12, 30, and 60, and dividing each product by 7,305.

3. Correction for the revolutions found in No. 1.

RULE. Multiply the number of revolutions by 300, and divide by 618, and the quotient will be minutes, which are to be subtracted from the *minutes* &c. found in No. 2.

NOTE. This gives 29 seconds to *one revolution.*

4. Add to the amount thus obtained 10*s*. 13° 40′. The result is the sun's mean longitude for the given time.

NOTE. The 10*s*. 13° 40′ is the longitude of the sun at the beginning of *Kandam*, or at the Epoch of the system.

5. For the sun's mean *anomaly*.

RULE. Subtract 2*s*. 15° (=the longitude of sun's apogee,) from the sun's mean longitude, and the result is the sun's *mean anomaly*; and notice whether this *anomaly* is less or greater than 6 *signs*.

6. RULE—to reduce the anomaly to the limits of *Manta Jya* (i. e. the table for the equation of the centre.)

1. From the sun's mean anomaly subtract alternately *Bhuja* and *Kodi*, as often as they are contained in the quantity. If the remainder be *Kodi*, it is to be subtracted from 3 signs, and the remainder to be taken as the argument.

NOTE. *Bhuja* is the first and third *quadrants*, and *Kodi* is the second and fourth *quadrants*, of the orbit.

The rule may be stated as follows:—If the number exceeds 3*s*. subtract it from 6*s*.; if it exceeds 6*s*. subtract 6*s*. from it; and if it exceeds 9*s*. subtract it from 12*s*.; the result is the same.

2. With the *reduced argument*, take the equation from the table of the sun's *Manta Jya*, reckoning $3\frac{3}{4}$ degrees of the argument to a *Jya*, or *tabular unit*. (See table No. II.)

The remainder of the argument is to be reduced to minutes. Above this number of minutes place the equation taken out; and below it, the next greater equation, (which are given in minutes.)

Then *subtract* the *first* number from the *third*, and multiply the *second* by the remainder; divide this product by 225, and add the *quotient* to the first number.

The result is the equation to be applied to the sun's *mean longitude* by *subtraction*, if *Medathi*, i. e. if the anomaly be less than six signs.

If the third *number of minutes* be not sufficient to allow the first to be subtracted, reverse the order of the first and third numbers, and proceed as before, except that you must *subtract*, and not *add*, the quotient from the first number, as they now stand, and the result will be the required equation to be applied as before directed.

NOTE. In the calculation of these tables $3^\circ\ 45'=225'$ is made the foundation or tabular unit, and the *equation* is not carried beyond minutes. The process in this case is on the principle, 225 : difference of two tabular equations : : remaining minutes : the correction which is to be added to the first equation.

3. If the argument is not equal to *one tabular* unit ($=3^\circ\ 45'$) then reduce the whole to minutes and multiply them by the equation in the table corresponding to the first number. Divide this product by 225, and the result will be the equation required, to be applied (as in No. 2.)

NOTE 1. The numbers in the tables extend only to 24 $=90^\circ=3s$. These are supposed to embrace all the equations from the least to the greatest.

2. This process is on the principle:—Tab. unity$=225'$: its equation : : given minutes : their equation = *first equation into given minutes*$\div 225'$.

Situation of the Moon.

1. Multiply *Kandam* by 600, and divide by 16,393, and the quotient will show the revolutions, to be omitted. Reduce the remainder by multiplying by 12, 30, and 60 successively, and divide by 16,393, and you get the *fractions* of a revolution in signs, degrees and minutes at the given time.

Note. This is on the principle:—☽'s periodic rev. : its length : : 600 : 16,393=27.3213*d.* length of rev.

2. To correct for the above excess annually recurring.

Rule. Divide the whole number of *revolutions* of the sun by 8, and the quotient will be the number of *minutes* to be *subtracted* from the minutes in No. 1. (i. e. 1′ in 8 *years.*)

3. To the last found quantity add 11*s.* 23° (=*the longitude of the moon* at Epoch) and the sum will be the *moon's mean longitude.*

4. For the longitude of the moon's *apogee.*

Rule 1. Divide the *Kandam* by 3232, neglect the quotient (=complete revolutions) and reduce the remainder by multiplying by 12, 30 and 60 successively, and dividing by 3232, for signs, degrees, and minutes.

Note. For,–3232 : 1 rev. : : Kandam : rev. of apogee.

2. Multiply the whole number of the *sun's revolutions* in the *Kandam* by 1195, and divide by 310, and the quotient will be minutes, to be subtracted from the quantity found in No. 1.

Note. This is, as 310 : 1195 : revolutions of the sun in the *Kandam* : correction required. This gives about 3′ .855 a year; and for a mean revolution of Apogee, 3232 .57534.*d.*

3. Add to the *last found* amount in No. 2, the longitude of apogee at the commencement of the *Kandam,* which is 3*s.* 5° 7′; and the sum is the mean longitude of apogee. Subtract this from the *moon's mean longitude,* and we have the *moon's mean anomaly.*

5. To get the equation for the moon's longitude, proceed according to the principles in No 6. in the preceding article on the sun,–using the *Lunar Table,* or *moon's Manta Jya,* (see Table III.)

Situation of Mars.

1. Divide the *Kandam* by 687, omitting the quotient (=number of complete revolutions); reduce the *remainder* by multiplying by 12, 30 and 60 successively, and dividing by 687, for *signs, degrees and minutes*.

Note. This is, as 687 : 1 rev. of Mars :: *Kandam* : revolutions, &c. passed. But 687*d.* is too great. Mars' mean sidereal period=686.9796458*d.*

2. To correct the above Rule, multiply the whole number of sun's revolutions in the Kandam by 46, and divide by 230, and the quotient will be *minutes*; this is additive.

Note. This is, as 230 : 46 :: ⊙'s rev. in *Kandam* : correction required. This gives for one year, 12″. This is required because the mean period of Mars is given too great in No. 1.

3. From this whole amount, subtract Mars' longitude at Epoch, which is 11*s.* 8° 31′, and we obtain *Mars' mean longitude.*

4. From this subtract Mars' *aphelion longitude*, =3*s.* 28°, and we obtain Mars' mean anomaly.

Take the equation from Mars' *Manta Jya* (see Table IV.) and divide it by 2. This quotient is *subtractive or additive*, according as the anomaly is less or greater than 6 signs, and is to be thus applied to Mars' mean longitude.

This gives the 1st *equated heliocentric-longitude.* Subtract this from sun's mean longitude. This gives a *new argument* (=mean commutation.)

Note. At this point, in reference to all the planets, are introduced *two tables*—Elongation Tables :—

1st. For the 1st and last three signs,

2d. For the second and third three signs, of Commutation. These are respectively called *Makara Jya* and *Katki Jya.* In English these two tables are given in one table. (For Mars, see Table V.)

5. With this *new argument*, take out the equation from the 1st or 2d table just named, (as the case may be) on the same principles as in the case of the *sun and moon*, and divide it by 2. This quotient is to be *added to*, or *subtracted from, the first equated longitude*, accord-

ing as the argument is *less* or *greater* than 6s.; from this we get the *second equated longitude.*

6. From the *second equated longitude, subtract Mars' aphelion longitude*=3*s.* 28°; and we get a *corrected mean anomaly.* With this take the equation from *Mars' Manta Jya,* and apply it to *Mars' mean longitude,* according to previous principles, and we get the third *equated longitude.*

7. Subtract the *third equated longitude* from ☉'s *mean longitude,* and take the *equation* for the *remainder* from *Makara Jya,* or *Katki Jya,* as the case may be, and apply it to Mars' *third equated longitude,* according to previous principles, and we get *Mars' geocentric longitude.*

Situation of Mercury.

1. Multiply the *Kandam* by 100, and divide by 8797, for revolutions to be rejected. Reduce the *remainder* by multiplying, successively, by 12, 30, and 60, and dividing each product by 8797, to signs, degrees, and minutes.

Note. That is, as 8797 days : 100 revolutions : : *Kandam* : revolutions, &c. in Kandam. This gives the revolutions too small, as it assumes, *as a divisor,* (87*d.*97 for a revolution.) which is too great.

2. To correct the above,–Rule. Multiply the number of the sun's revolutions in the Kandam by 448, and divide by 230. This gives minutes, to be added.

Note. This gives for one year, 1′. 9478; which makes the time of the revolution=87.9621*d.*

3. From this sum *subtract* the longitude at Epoch = 7*s.* 7° 50′, and we get Mercury's *mean heliocentric longitude.*

4. From this mean longitude subtract ☉'s *mean longitude,* and the remainder will be the *mean angle of commutation.*

Take out the equation for this from Mercury's *Makara* or *Katki Jya,* as the case may be, (see Tab. VII.) and *divide it by* 2, and apply the *quotient* to sun's mean longitude, according as the angle of commutation is *less* or *greater* than *six signs.* The result will be the sun's first *equated longitude.*

5. From the first *equated longitude, subtract aphelion* =7*s.* and we get Mercury's *anomaly.*

Determine whether this be less or greater than 6*s* and take the equation from Mercury's *Manta Jya,* (see Tab. VI.) and apply it to the ☉'s *mean longitude.* This will give sun's *second equated longitude.*

6. From the *mean longitude* in No. 3. subtract *sun's second equated longitude,* and we get the *true commutation.*

With this, as an argument, take the equation from Mercury's *Makara* or *Katki Jya,* as the case may be, and apply the elongation, according to previous directions, to the sun's *second equated longitude,* and the result will be *Mercury's geocentric longitude.*

Situation of Jupiter.

1. To obtain the revolutions, &c. in *Kandam:*—Rule. Divide the *Kandam,* having added a cypher to it, by 43, 323, and reduce the remainder to signs, degrees, and minutes, as before.

Note. This is on the principle:—43,323*d.* : 10 rev. : : *Kandam :* the number of revolutions, &c. in it. Not exact, for it gives 4,332.3*d.*=revolution, which is too little.

2. To correct the above:—

Rule. Multiply the sun's complete revolutions in *Kandam* by 44, and divide by 230; which gives *minutes,* to be *subtracted* from the signs, &c. found above.

3. From the quantity thus found, subtract Jupiter's longitude at Epoch=8*s.* 6° 35′, and it will give Jupiter's *mean longitude.*

4. From this subtract aphelion=6*s.* and it gives Jupiter's *mean anomaly*=the argument for Jupiter's *Manta Jya.* (see Table VIII.)

5. With this argument take out the *equation,* as above directed, and divide it by 2; the *result* is to be applied to Jupiter's *mean longitude* by way of *subtraction,* if the *anomaly* be less than 6*s.*; and by way of *addition,* if the *anomaly* be more than 6*s.*

This gives Jupiter's first equated *heliocentric longitude.*

6. Subtract this from the sun's *mean longitude,* which gives the mean commutation as an argument for the Table; with this take out the equation from *Makara* or *Kat-*

ki Jya, (see Table IX.) as the case may be, and divide it by 2. The result is to be added to, or subtracted from, the first equated heliocentric longitude, &c. as the commutation is less or greater than six signs. The final result is Jupiter's first equated *geocentric longitude*.

7. From this first equated geocentric longitude, subtract *aphelion*=6*s* which gives the corrected *anomaly*. With this take out the equation from Jupiter's *Manta Jya*, which is to be added to, or subtracted from, the mean longitude of Jupiter, according as the corrected anomaly is less or greater than 6*s*. and we get Jupiter's second *equated heliocentric longitude*. Subtract this from the sun's *mean longitude*. It will give the corrected commutation as an argument for the elongation Table.

8. With this argument enter Jupiter's *Makara* or *Katki Jya*, as the case requires, and take out the equation. This is to be added to, or subtracted from, (as the case may be,) Jupiter's second *equated heliocentric longitude*. This gives *Jupiter's geocentric longitude*.

Situation of Venus.

1. To obtain the revolutions, &c. in the *Kandam*.

Rule. Multiply the *Kandam* by 500, and divide the product by 112,349. Then reduce the remainder to signs, degrees, and minutes, as before.

Note. This is on the principle, that 112,349 : 500 : : Kandam : revolutions in the same. This gives the periodic revolution too small.

2. To correct this:—Rule. Multiply the sun's *revolutions* in the *Kandam* by 158, and divide by 230, which gives minutes, to be subtracted.

Note. As in 230 years the amount of correction is 158 minutes, (as plainly implied in the rule,) the correction for one year will be 41.2 *seconds*.

3. Subtract the longitude at Epoch=2*s*. 9° 9′, from the corrected amount, and the result will be Venus' *mean heliocentric longitude*.

4. From this subtract the sun's mean longitude, and you get the *first commutation*, as an argument for the elong-

ation Tables. With this take out the equation according to the rule previously given, and divide it by 2. This is to be applied to the sun's mean longitude, by *addition* or *subtraction*, as the case may require. This will give Venus' *first equated geocentric longitude*

5. From this subtract *aphelion*=3*s*.; and you get the *anomaly*,--which is the argument for *Manta Jya*.

6. With this take out the equation from Venus' *Manta Jya* (See Tab. No. x.); and apply it to the sun's mean longitude, according to rules before given. This will give the sun's *equated longitude*.

7. Subtract this from Venus' *mean longitude*; and it will give the *second commutation*, as an argument for the tables; with this take out the equation from Venus' *Makara* or *Kalki Jya*, (See Tab. No. xi.) as the case requires, and apply it to the sun's equated longitude, by addition or subtraction, according to the above rule. This gives Venus' *geocentric longitude*.

Situation of Saturn.

1. For the revolutions, &c. in the *Kandam*:

Rule. Divide the *Kandam* by 10,766; and reduce the remainder to signs, degrees, and minutes, as before.

Note. This supposes 10,766 days to *one revolution*, which is *too great*, and therefore leaves the remainder too small.

2. To correct the above,—Rule. Multiply the sun's revolutions in the *Kandam* by 19, and divide by 230. This gives *minutes*, which are to be added to the above remainder.

Note. Here it is manifest, that in 230 years, the correction amounts to 19 minutes. Hence the correction for one year is a little less than five seconds.

3. Subtract the longitude at Epoch=7*s*. 1° 59′, and it will give Saturn's *mean heliocentric longitude*.

4. From this subtract aphelion=7*s*. 26°, and it gives the mean anomaly, as an argument for *Manta Jya*.

5. With this argument take the equation from Saturn's *Manta Jya*, (See Tab. No. xii.) and divide it by 2. This is to be *added* to, or *subtracted* from, Saturn's *mean*

longitude, according as the anomaly is greater or less than six signs. This gives the *first equated heliocentric longitude* of Saturn.

6. Subtract this from the sun's mean longitude, and it gives the first *commutation*. With this, as the *argument*, take the equation from Saturn's *Makara* or *Katki Jya*, (See Tab. No. XIII.) as the case requires, and divide it by 2. This is to be *added* to, or *subtracted* from, Saturn's *first equated heliocentric longitude*, according as the first commutation is less or greater than six signs; the result will be Saturn's *first equated geocentric longitude*.

7. From this subtract aphelion=7*s*. 26°, which will give the corrected anomaly. With this, as an *argument*, take the equation from Saturn's *Manta Jya*, and apply it to the planet's *mean heliocentric longitude*, by adding or subtracting, according as the corrected anomaly is less or greater than six signs. The result will be the planet's *second equated heliocentric longitude*.

8. Subtract this from the sun's mean longitude, and the remainder will be the second commutation. With this, as an argument, take the equation from Saturn's *Makara or Katki Jya*, as the case requires. This is to be *added to*, or *subtracted from*, (as the case requires) the planet's second equated heliocentric longitude. The result is the planet's *geocentric longitude*.

Immersion and Emersion.

Distances from the sun at which the Immersion and Emersion of the several planets occur in reference to the solar rays:—

The Immersion or Emersion of Mars will take place at the distance of 17° from the sun. The former, when the planet is west of the sun; and the latter, when it is east of the sun.

That of the *Moon* and *Mercury*, at the distance of 13°.

That of Jupiter, at 11°; that of Venus, at 9°; that of Saturn, at 15° from the sun.

For the Immersion and Emersion of Venus:—

Rule 1. To the *Kandam* add 577, and divide by 584; if there be no remainder, Venus will disappear in her retrograde motion, or on the east of the sun.

2. Add to the *Kandam* 255, and divide by 584. If there be no remainder, Venus will disappear in her *direct motion*, or on the west of the sun.

3. If she disappears at the west of the sun, she will re-appear in 10 days at the *east of the sun*.

If she disappears at the east of the sun, she will re-appear in seventy days at the *west* of the *sun*.

NOTE. The number 584 is the period of Venus' synodical revolution; and 577 expresses the number of days which intervened between the commencement of the *Kandam* and the preceding disappearance of Venus in *her retrograde motion*. The number 255 expresses the same in her *direct motion*.

Situation of the Nodes, Raku and Kethu.

1. For revolutions, &c. in the *Kandam*.

RULE. Divide the *Kandam* by 6795, and reduce the remainder to signs, degrees, and minutes.

NOTE. This is on the supposition that, 6795*d.* = one revolution, which is too much, and gives too small a remainder.

2. To correct this:–RULE. Multiply the sun's revolutions in the *Kandam* by 103, and divide by 230, which will give minutes to be *added*.

NOTE. At the rate of 103 minutes in 230 years, the correction for one year will be 26.9''.

3. To this add *Raku's longitude* at Epoch=27° 47', and it will give the supplement of its *longitude*.

4. Subtract this from 12*s* and it will give *Raku's longitude*.

5. Add to this 6*s*. and you get *Kethu's longitude*.

[The following is from a different author from that of the foregoing.]

To determine the mean places of the Planets.

From the *Sutta Tinam* for the given year, subtract 1,683,112; the remainder will be the *Kandam*.

NOTE. This will fix the Epoch of this system at A. D. 1507.

Multiply the *Kandam* by the numbers which are found in the column of multipliers in the following table, and divide the several products by the respective numbers in the column of *divisors*. Reject the *quotients* and reduce the *remainders* to signs, degrees and minutes, by multiplying successively by 12, 30 and 60, dividing each product by the respective numbers used before as divisors.

To correct the above.

Rule. Divide the *Kandam* by the respective numbers in the column of *Pakanas* (i. e. Corrections) given in the following table; and the results will be in *minutes*. Add these results to the signs, degrees, &c. found above, in the case of Mars, Mercury, Saturn, and Raku; but in the case of the other planets, the results must be *subtracted*.

To the last found quantities add the respective *longitudes* at the Epoch, as given in the table below. The sums found will be the *mean longitudes* for the respective planets.

Table referred to above.

Planets.	Multipliers.	Divisors.	Pakanas.	Longitudes at the Epoch.
Sun	31	11,323	10,026	0*s*. 0° 0′
Moon	600	16,393	2,920	6*s*. 19° 17′
Mars	1	687	1,866	1*s*. 13° 34′
Mercury	100	8,797	191	10*s*. 25° 1′
Jupiter	10	43,323	1,940	5*s*. 28° 44′
Venus	500	112,349	543	6*s*. 6° 17′
Saturn	1	10,766	4,526	4*s*. 1° 58′
Raku	1	6,795	813	2*s*. 21° 27′
☽'s Apogee	1	3,232	768	11*s*. 28° 8′

Vakya System for five Planets.

The following process for the planetary phenomena is from a still different author, who is said to have flourished in the reign of the king *Sakarasasekara*, about A. D. 1500.

The *Vakyas* used in this system are said to have been originally constructed by *Vararushi*, one of the "nine gems" of Vikramaditya's court.

This is the process usually followed at the present time in this Province.

To calculate the geocentric longitudes of the five following planets; viz: *Mars*, *Mercury*, *Jupiter*, *Venus*, and *Saturn*.—

Rule 1. Set down *Sutta Tinam*, for the given time, and subtract from it such and as many of the *Sodya Vakya*, as can be, and write down the remainder; taking care to note down the corresponding *Druvakkaram*, from the *Sodya Vakya*, (See Tab Nos. xvi.—xx.) with the proper signs.

2. Then add together the *Druvakkarams* prefixing, to the sum, the proper sign.—This gives *Druvam*; i. e. *The distance of aphelion from the first point of Aries.*

3. Divide the *days* and *Nalikies*, remaining in No. 1, by the last number in the second column in the table 3*Parivritti*. (See Tables No xxi.—cii.)

Note. This tabular number expresses the days in a synodic revolution of the planet. *Parivritti* means *revolution*.

The quotient in this case is called *Katha Parivritti* (or revolutions passed,) and indicates which of the tables is to be used at the time. The remainder is called *Varuda Sesha* (which is a portion of the revolution.) and indicates which of the *longitudes* in the table is to be taken.

4. From the last column of the table to be used, take the number of *days*, equal to, or next less than, the *Varuda Sesha*. If it be less than *Varuda Sesha*, take and note down the difference between them, which is called *Tina Sesha*.

Set down also the longitude from the first column in the table called the *Puruva Vakya*, corresponding to the days taken out, and the longitude next below which is called *Apara Vakya*. Then take out the *corrections* in the table corresponding to these longitudes. and multiply both by the *Druvam* found in No. 1. These products are to be applied, each to its respective *longitude*.

In the case of *Venus*, there are two *corrections* given. If the *Druvam* be a negative quantity, the first correction is to be used; but if the *Druvam* be *positive*, the second correction is to be used.

6. Subtract the *Puruva Vakya* from the *Apara Vakya*, and reduce the *remainder* to *minutes*. Then add a cypher to these minutes, and multiply the whole by 6, and divide the product by the number of days (called *Ilakkantaram*) occurring between the tabular days corresponding to the longitudes taken out. The quotient is the daily motion, called *Putti*.

NOTE. The process here is simple; it takes the longitude for a certain number of days, reduces it to seconds, and then divides by the number of days. This gives the daily motion in seconds.*

7. Multiply the *Tina Sesha* by the *Putti*, and add it to the *Puruva Vakya*. To this sum add the *Druvam*, and the result will be the planet's *geocentric longitude*.

Retrogradation.

8. When these planets are in their retrograde course, the *Puruva Vakya* will be greater than the *Apara Vakya*.

In this case set down the *Puruva Vakya* in two places. From one subtract the succeeding, or *Apara Vakya*, reduce the remaining degrees, &c. to minutes, add a cypher, and multiply the same by 6, and divide the product by the *Ilakkantaram*; and the quotient will be the *Putti*.

9. Multiply the *Tina Sesha* by this *Putti*, and subtract the product from the *Puruva Vakya*; to the remainder add *Druvam*. The result will be the longitude at which the planet begins to retrograde.

Planets entering the signs.

10. Set down the *Piramanam*, (i. e. the longitude at the end of the sign in which the planet is,) and subtract *Druvam*. The result is called *Ishda*. Take from the table *Parivritti*, the next *less* and the next *greater longitudes*, than *Ishda*, and correct them as before directed.

Ascertain whether the motion of the planet be retrograde or direct, as directed in No. 8. If direct, subtract the *Puruva* from the *Apara Vakya*; reduce all to minutes, add a cypher, and multiply by 6. Then divide this product by *Ilakkantaram*, and the result will be *Putti*.

11. From the *Ishda*,* subtract the *Puruva Vakya* cor-

rected as before; reduce the remainder to minutes, and divide by *Putti*, which gives the required *days*.

The remainder is reduced to *Nalikies*, by multiplying by 60, and dividing by *Putti*.

12. Add to this quantity of *days and Nalikies*, the number of days in the table corresponding to the *Puruva Vakya*, and if a table has been completed since the commencement of the year, then add to this sum the highest number of days in the table. Subtract from the whole sum, the *Varuda Sesha*, and as many *Matha Vakya* (days in a month) as are contained in the sum.

The number of *Matha Vakya* subtracted at once, indicates the month in which the transit will take place, and the *remainder* will show the time in the month at which the planet will pass to the *new sign*.

Anuvakkram.

The *transit* of a *planet* in *retrogradation*, into the *preceding sign*.

13. From *Ishda* subtract 30°, and the remainder will be *Anuvakkra Ishda*.

If, during the time between the commencement of Retrogradation and that of the planet's becoming stationary, there be found in the Table any longitude, less than the *Anuvakkra Ishda*, then it will re-enter the preceding sign.

14. Take out the longitudes, the next less and the next greater than the *Anuvakkra Ishda*, and correct them according to the preceding rule.

From the greater longitude subtract the less, and reduce the remainder to seconds, and divide them by the *Ilakkantaram*, and the quotient will be *Putti*.

15. From the greater of the two longitudes, subtract *Anuvakkra Ishda*, and reduce the remainder to seconds and divide by *Putti*. The quotient will be *days*.

Multiply the remainder from the last division by 60, and divide by *Putti*, and the quotient will be *Nalikies*.

Add to these *days* and *Nalikies* the number of *days* in the Table corresponding to the greater longitude taken ant. Subtract the *Varuda Sesha*, and as many *Matha Vakyas* as can be. The number of *Matha Vakyas* subtracted will indicate the month of *Anuvakkram*; and the remainder will show the time in the month of the planet's re-entrance into that sign.

Planetary Limits as to Immersion, &c.

16. In the case of Mars:

When the *tabular number* of days equals 725, Mars will immerse, or disappear in connection with the sun.

When the tabular days equal 55, there will be an emersion, or re-appearance.

When the tabular days equal 321, Mars will begin to retrograde.

When the tabular days number 429, Mars will be stationary, after retrogradation.

17. In the case of Mercury:

When the tabular days number 100, it will immerse.
When " 17, it will emerse.
When " 49, will begin to retrograde.
When " 51, immerse in retrogradation.
When " 65, emerse while retrograding.
When " 70, will be stationary after retro.

18. In the case of Jupiter:

When the days equal 385, it will immerse.
When " 14, will emerse.
When " 139, will begin to retrograde.
When " 259, will be stationary after retro.

19. In the case of Venus:

When her tabular days are 549, she will immerse.
When " 35, will emerse.
When " 267, will begin to retrograde.
When " 287, will immerse in retrogradation.
When " 297, will emerse in retrogradation.
When " 314, will be stationary.

20. In the case of Saturn:

When his tabular days are 361, he will immerse.
When " 17, will emerse.

When " 120, will begin to retrograde.
When " 360, will be stationary.

21. In any given case, if one of the specified number of days occur, add to it the *highest number of days* in the table, provided any table shall have been completed since the commencement of the year. Then subtract the *Varuda Sesha*, and as many *Matha Vakya*, as may be.

The number of *Vakyas* subtracted will indicate the month in which a given phenomenon will occur, and the remainder will show the *time in the month.*

22. If the number of given days be less than the first tabular number of days, set down the aphelion longitude as *Puruva Vakya*, and the first longitude from the table as *Apara Vakya*, and proceed as before.

Aphelion Langitudes of the five Planets.

23. That of Mars is 3*s.* 28°.
" Mercury is 8*s.* 00.
" Jupiter is 6*s.* 00.
" Venus is 3*s.* 00.
" Saturn is 7*s.* 26°.

Change of Druvam.

24. From the days, &c. passed in *Cali Yuga*, subtract as many *Sodya Vakya* as may be, and add to the remainder the length of the year. If, from this sum, any one of the *Sodya Vakya* can be taken, there will be a change of *Druvam*, (i. e. the longitude of aphelion.)

To determine when the change of *Druvam* will take place:—

Having subtracted, from the sum before named, all the *Sodya Vakyas* which can be taken from it, subtract the remainder from the *length of the year*. From the last remainder, subtract as many *Matha Vakya* as may be. The number of *Matha Vakya* subtracted will indicate the *month*, and the remainder the *time in the month*, when the change will take place.

For the places of Raku and Kethu.

25. From *Sutta Tinam* subtract 1,600,066, and divide the remainder by 6792, and the next remainder by 566; the last quotient will be *signs*, and the last remainder, reduced, will be *degrees* and *minutes*.

Then divide the first remainder (from *Sutta Tinam*) by 5936, and the quotient will be *minutes*, which are to be subtracted from the signs, degrees, &c. above found. Subtract this remainder from 12*s*. and the result will be *Raku's true longitude*.

To this add 6*s*. and it will give *Kethu's true longitude*.

NOTE. The number 6792 is nearly the number of days in one revolution. Elsewhere this number has been stated to be 6795. The 566 is the number of days in which the nodes are passing through one sign.

The division by 5936 is founded on this proportion:—

As 5936 days : 1′ : : Kandam : correction required.

26. To determine when *Raku* will enter a new sign.

Rejecting the signs in the true longitude, reduce the degrees, &c. to *seconds*, and divide them by 191. The result will be *days*; and the remainder, reduced, will be *Nalikies*. From these *days* and *Nalikies* subtract as many *Matha Vakya* as may be.

The number of *Matha Vakya* taken will indicate the month, and the remainder, the time in the month, when the transit will occur.

NOTE. This is founded on the following proportion:—

As 191′ : the degrees &c. : : 60 days : number of days &c. required.

ECLIPSES.

A Translation of Sayantamalei.

1. My attempt to explain, in Tamil, the *Sayantamalei* respecting *the Dragon's hiding the full moon and the sun,* (in lunar and solar eclipses), treated of by one who equalled the lotus-born Brahma (in erudition,) would seem as ridiculous as the attempt of an ant to follow in the train of elephants.

2. If the moon be in opposition at night, or in conjunction in the day time, when the sun is in the sign in which *Raku* or *Kethu* is, or in the preceding or succeeding sign, there may be an eclipse. On this supposition, calculate the mean places of the sun, the moon, the moon's apogee, and of *Raku* or *Kethu*, at sunrise of that day.

Multiply, respectively, their *mean motions* for a *Nalikei* by the number of *Nalikeis* elapsed from sunrise to the time of conjunction or opposition, agreeably to the *Siddhanta System*, which begins the day at sunrise.

The Moon's mean motion for a Nalikei is,			13′ 10″.
The Sun's	do.	do.	1′ 0″.
That of the Moon's apogee			0′ 6¾″.
Raku or Kethu			0′ 3″.

3. Add these several products to their respective mean places, and you will have their mean places for the given time, at conjunction or opposition. Reduce these mean places to their *true ones.*

To determine the true motions of the Sun and Moon.

From the sun's mean longitude subtract the longitude of the sun's apogee = 2*s*. 18°, and call the remainder *Ravi Kendra,* (i. e. sun's anomaly.)

From the mean longitude of the moon, subtract the longitude of her apogee, and the remainder is *Sasi Kendra,* (or moon's anomaly.)

NOTE. Hindu Astronomers consider the change of the sun's apogee to be only 1′ in 517 years. Hence they regard the longitude of the apogee as a constant quantity.

4. Notice whether the anomaly fall within 3*s.* of apogee, on either side. Then with the complement of the anomaly, if it be in *Bhuja,* (see note p. 10,) take the *Manta Jya* from the proper table, and write this equation as *seconds.* If it be in *Kodi,* use the anomaly as the argument.

In the case of both sun and moon, when the anomaly falls within 3*s.* on either side of the apogee, subtract the *seconds* above found from 57′. But if the anomaly be greater, *add* the *seconds* to this quantity.

The result in either case is the *Radius Vector*, or true distance.

Note. For explanation of this process, see remark under *Manta Jya.*

5. Multiply the sun and moon's mean motions, respectively, which are 59′ and 784′, by 57, and divide these products by their respective *Radius Vectors,* (=1st term in the proportions below,) and the quotients will be the true daily motions of the sun and moon.

Note. This depends on the principle, that the motion of a body in its orbit varies inversely as its distance. Hence,—

Tab. rad.=3438′ : mean mo. :: $\frac{1}{\text{true dist}}$: $\frac{1}{\text{true motion}}$.

Or, true tab. rad.=3438′∓equation of the centre: mean motion :: 3438′ : true motion.

Dividing the first and third terms by 60, we have:—

$\frac{\text{True tab.}}{60}=57\frac{3}{10}\mp\frac{\text{equation}}{60}$: mean motion :: $57\frac{3}{10}$: true motion.

Neglecting the $\frac{3}{10}$ in the 1st and 3d terms, as the author does, we have it as in Nos. 4 and 5. The equation being in *minutes,* $\frac{\text{equation}}{60}$ will be *seconds.*

6. Write down the true motions of the sun and moon in separate places.

Take out the anomalistic equation for the sun's mean longitude.

Multiply this equation by $1\frac{3}{4}$, and from the product subtract two. What remains is called *Pranan.*

7. Divide the *Pranan*, for the moon, by 27, and the quotient will be in *minutes*; and for the sun, divide it by 6, and the quotient will be *seconds*.

These results [which should be applied to the true longitudes (see No. 3.) of the sun and moon] are *subtractive* when the sun is within 6 signs of Aries, provided the opposition or conjunction happen within 10 *Nalikies* (4 hours) after sun-rise or sun-set; but *additive*, if more than 20 *Nalikies* (8 hours) from sun-rise or sun-set.

Note. This is a complex process, including reduction to the lat. of the place, correction for refraction, and the ascensional difference. The number $1\frac{3}{4}$ is the length of the gnomonic shadow, in angulas, at the place of observation. The number 2 subtracted, seems to be a correction for the other number.

The process for the *sun*, depends on the principle:—

$360° : 59' \ 8'' =$ ☉'s mean daily motion :: ☉'s equa. cent. : required equation.

Divide the 1st and 2d terms by 60, and we have:—

$6' : 1''$ nearly :: ☉'s equa. cent : equa. required.

For the moon:—

$360°$: ☽'s mean motion :: ☉'s equa.cent : equation required,—or dividing by ☽'s mean motion,—

$27' : 1'$ :: ☉'s equa. cent : equation required.

8. If the sun be within 6 signs of Libra, reverse the preceding operation; i. e. add those which were subtractive, and subtract those which were additive, in the other case.

If the conjunction or opposition take place within 10 *Nalikies* (4 hours) of mid-day or mid-night, *no equation is required.*

Call the longitudes, thus corrected, the *third equated longitudes.*

9. Take the equation as before from the sun's Table, and divide it severally by 27 and 6; the former will give minutes for the moon, and the latter seconds for the sun.

Subtract these results from the sun and moon's *third equated longitude*, if they be within 6 signs of Aries; but if they be within 6 signs of Libra, *add* them.

The longitudes thus corrected are called *fourth equated longitudes.*

Note. This equation always depends on the anomalistic equation of the sun, and is employed to reduce the mean to the true meridian.

For these numbers see Note under No. 7.

10. Reduce the signs, degrees, &c. of the moon's 4th equated longitude to *minutes*, and divide them by 800; the quotient will show how many of the Nacshastras have elapsed from *Aspati.*

Multiply the remainder by 60 and divide the product by the moon's true daily motion, and the quotient will show how many *Nalikeis* will have elapsed in the Nacshastra that is passing before the eclipse happens.

Note. The number 800 is minutes,—$800' = 13°. 20'$ =the length of a mean Nacshastra.

11. From the Moon's 4th equated longitude, subtract that of the sun, and reduce the remainder to *minutes.*

Divide this by 720, ($=12°.$ = a mean Tithi), and the quotient will be the number of Tithies completed.

In case there be a remainder:—When the quotient amounts to 15, it is called *Viruttakalei*; but when only 14, the quotient is called *Uvakkalei.*

12. If it be *Uvakkalei*, subtract it from $720'$, and the remainder shows how many minutes remain to complete the 15th Tithi.

If it be *Viruttakalei*, it shows how many minutes are passed in the first Tithi.

Ascertain whether the remainder, which is called *Tithisedam*, is *Uvakkalei* or *Viruttakalei.*

Take the relative motion of the sun and moon. Multiply the *Tithisedam* by sixty.

13. Divide this product by the relative motion, and the quotient will be *Nalikeis.*

Multiply the remainder by 60, and divide it by the above divisor, and the result will be *Vinalikeis.*

Add the *Nalikeis* and *Vinalikeis* thus found, to the assumed time of conjunction or opposition, and you will have *Suttaparuvam*, (i. e. the true time of conjunction or opposition.)

To the 4th equated longitudes of the sun and moon, add the number of the *Nalikeis* and *Vinalikeis*, above found,—the former with the *minutes*, and the latter with the *seconds*.

14. Add also the Tithisedam to the moon's 4th equated longitude.

If it be *Uvakkalei*, all are *additive*, but if it be *Viruttakalei*, all the above results are *subtractive*, i. e. the *Nalikeis* and *Vinalikeis* should be subtracted from the time of conjunction or opposition, and from the 4th equated longitudes of the sun and moon; and the *Tithisedam* from the moon's 4th equated longitude.

The longitudes of the sun and moon thus corrected, are called respectively *Samaravi* and *Samasantiran*; i. e. *true longitudes* of the sun and moon at the time of true conjunction or opposition.

Thus far the process is common to both solar and lunar eclipses.

Solar Eclipse.

15. Divide the *Pranan* (see No. 6.) by 6, and the quotient will be *Vinalikeis*. This is to be added to, or subtracted from 15 Nalikeis, according as the Sun is within or beyond 6 signs from Aries. The sum or difference is *half the duration of the day*.

NOTE. As the *Pranan* is an arc of the equator expressed in *minutes*, dividing by 6, simply reduces it to *Vinalikeis* of time.—The 15 Nalikeis are the mean length of half a day.

16. Subtract the length of the day from 60 *Nalikeis* and the *remainder* is the *duration of the night*.

Add half the length of the night to the length of the day, and the result will be the number of Nalikeis, &c. from sunrise to midnight.

17. Take the difference between *half the duration* of the day and the true time of conjunction. This is called *Vivaram*. (i. e. time between *noon* and *conjunction*.)

Take the equation from *Lampitha Jya*, corresponding to the Nalikei in Vivaram.

Lampitha Jya.

Table of equation for the Moon's Parallax in Longitude.

Nadi.	Vinadi.	Nadi.	Vinadi.	Nadi.	Vinadi	Nadi.	Vinadi.
1	42	5	160	9	213	13	225
2	82	6	180	10	218	14	225
3	112	7	192	11	224	15	225
4	145	8	204	12	220		

NOTE. *Lampitham* is the Moon's parallax in longitude, expressed in time. This may be evinced by multiplying these quantities by the motion of the moon in a *Vinadi*, which will give *seconds.*

The proportional equation for the *Vinalikei* of *Vivaram,* (if any) is found as directed in the next paragraph.

18. Take the *difference* between the above equation and the next succeeding one in the Table, and multiply it into the *Vinalikies* of *Vivaram.* The product divided by 60 will give the proportional equation required. The whole equation is called *Lampitha Jya palam.*

19. Add the computed *Lampitha Jya palam* to the *Vivaram* before found; multiply the sum by 6, and the product of the Nalikeis will be degrees, and that of the Vinalikeis, minutes.

Subtract the whole product from the *Samaravi*, before calculated, if the conjunction happen in the forenoon; but add it to the same, if in the afternoon. Add, also, says the Commentary, the *Ayana Salanam,* (i. e. the arc comprised between the Vernal Equinoctial point and the first point in the sydereal zodiac.)

The last result is called *Lampitha Arukkan,* (i. e. the longitude of the *nonagesimal point.*)

20. If this *Lampitha Arukkan* be less than 6 signs, this point will have northern declination, and if more than 6 signs, southern declination.

Take the equation from the sun's *Manta Jya*, using *Lampitha Arukkan*, reduced to the table, as an argument, and divide it by 7; the quotient will be *minutes.*

Multiply the remainder by 60, and divide the product by the above divisor, and the quotient will be *seconds.*

The minutes and seconds thus found will be *Arukka Vikshepam.*

Note. What is here called *Arukka Vikshepam* is the moon's parallax in latitude. This is considered to be equal to $\frac{1}{7}$th of the equation of the sun's centre, as taken out above.

21. Multiply the *Lampitha Jya palam* by 13, and *subtract* the product from the *Sama Śantiran,* if the conjunction happen before noon; but if after noon, *add* it; the difference or sum thus found, is *Lampitha Santiran* (i. e. the moon's longitude corrected for parallax.)

Note. The *Lampitha Jya palam* being in time (Vinalikeis), the motion of the moon for this time is found by multplying by 13 = ☽'s motion in 1 *vinadi.*

22. From the *Lampitha Santiran* subtract the longitude of the node, and ascertain whether the remainder be less or more than 6 signs from the node.

Bring this remainder to *Bhuja* (if it be in *Kodi*), and reduce it to *minutes.*

Divide the number of minutes by 13, and the quotient will give the moon's *Vikshepam,* or latitude.

The *Nitya Vikshepam* (or parallax for zenith distance of equator) is 7′. This is the same as $1\frac{3}{4}$ (=the length of the equinoctial shadow)×4=7′.

Note. The division by 13 expresses the assumed fact, that the latitude of the moon is one-thirteenth of the moon's distance from the node.

This is on the principle, viz:—

3438′ (=tab. rad.) : 270′ (=sin. 4° 30′=incl. of ☽'s orbit to the ecliptic) : : sin. ☽'s dist. from node : sin. ☽'s lat. Instead of sin. lat. and sin. ☽'s dist. they take lat. and dist.

Lat.=$\frac{1}{13}$× ☽'s dist. from the node, nearly.

The reason for taking 4 times the gnomonic shadow, for the parallax of zenith distance of equator, is the assumption, that *one ankula* (= $\frac{1}{12}$th of the gnomonic shadow) gives 4′ of parallax.

23. The *Nitya Vikshepam* is always south.

If the three calculated *Vikshepam* be of one kind, the sum is to be written *south*. But if it so happen, that two of the *Vikshepam* are of one kind, and one of another, the difference between the one and the sum of the other two, will be of the same direction as the greater.

The *sum* or the *difference* thus found is called the *Sutta Vikshepam* (i. e. the apparent distance of the centres of the sun and moon.)

Note. *Nitya Vikshepam* is parallax for the zenith distance of the equator. This is always *south*, because the latitude is *north*. This parallax fixes the latitude of the place at 8° 18′, which is the latitude of *Anuradhapura*, the ancient capital of Ceylon; as, also, that of *Ramiseram*.

24. To obtain the apparent *semi-diameters* of the sun and moon:—

Multiply the true motions of the moon and sun each by 16′, and divide the products by their respective mean motions, and the quotient will be the semi-diameters.

Add the two semi-diameters together; the sum is called *Sampatkarttam*.

If this *Sampatkarttam* be sufficient to allow the *Sutta Vikshepam* to be subtracted from it, there will be an eclipse; but if not, there will be none.

Note. Here 16′ is taken as the mean apparent semi-diameter of the moon or sun. The true apparent semi-diameter is supposed to vary as the true motion of the body.

25. From the remainder obtained by subtracting the *Sutta Vikshepam* from the *Sampatkarttam*, take successively 1, 2, 3, 6, 8, and 12, and set down the number of *subtractions*.

If any one of these numbers cannot be subtracted, multiply the remainder from the preceding subtractions by 60, and divide the product by the next number, which could not be subtracted.

Note. These numbers 1, 2, &c. are, in fact, *digits*, and the number taken shows the number of entire digits eclipsed, and the remainder, the fraction of a digit.

26. The quotient found will be in *Vinalikeis*, and the

sum of the subtractions before made, will be in *Nalikeis*. These quantities thus found make up the duration of the eclipse.

If the duration be six *Nalikeis*, the eclipse will be total.

For the *beginning of the eclipse*, subtract half its duration from the time of conjunction; and for the *end*, add the same.

27. Take the difference between the time of the beginning of the eclipse as above found, and *half the duration of the day*, and with this, as an argument, take the correction from the *Lampitha Jya*, reckoning one *Jya* for a *Nalikei*, and subtract this quantity from the time of the beginning, if it happen before noon; but if after noon, add it to the same. The result will give the apparent time of the beginning of the eclipse.

Take the difference between the time when the eclipse ends, as above found, and half the duration of the day; with this difference, take the correction as before, and subtract it from the time the eclipse ends, if it happen in the forenoon; and *add* it to the same, if in the afternoon. The result will be the apparent time at which the eclipse *ends*.

The commentary goes on further to state, that "if the *Sutta Vikshepam* be found to be *south*, the south-west limb of the sun will be first eclipsed; but if it be *north*, the north-west limb will be first eclipsed."

28. To project a solar eclipse:—With a cord of as many *ankulas* in length as there are minutes in the *Sampatkarttam*, describe a circle. Then at the centre of this circle, inscribe another, whose radius shall correspond to the sun's apparent radius. This circle will show the sun's disk. From the same centre set off the *Sutta Vikshepam*, and from the end of this line, describe a circle with the moon's apparent semi-diameter as radius. The part of the sun's disk cut by that of the moon will represent the portion of the sun's disk eclipsed.

Lunar Eclipse.

29. Subtract from *Sama Santiran* (No. 14.) the true longitude of the node, and if the remainder (☽'s distance from node,) be less than six signs, the moon will have

south declination; but if it be more than six signs, she will have northern declination.

Bring the whole to *Bhuja*, reduce it to minutes, and divide by 13; the quotient will give the moon's latitude, or *Santira Vikshepam.*

30. Multiply the moon's true motion by 16, and divide the product by her mean motion, (See No. 5) the result will give her *apparent semi-diameter.*

To determine the apparent semi-diameter of the earth's shadow:—

Multiply the moon's apparent semi-diameter by 5, and half the product will be the semi-diameter of the shadow, called *Raku Tekam.*

The sum of the apparent semi-diameters of the moon and shadow is called *Sampatkarttam.*

31. From the *Sampatkarttam* subtract the *Santira Vikshepam*, and from the remainder take successively 1, 1, 2, 3, 4, 5, 6, 8, 12, and 14, and the number of subtractions, added together, will give the *duration* of the eclipse in *Nalikeis.*

If this number be 10, there will be a total eclipse of the Moon.

32. *To ascertain the beginning of the eclipse, subtract* half the duration of the eclipse, from the true time of opposition; and for its *end,* add it to the same.

The Commentary states, that if the moon be in north declination, her north-east limb will be first eclipsed; but if she be in south declination, her south-east limb will be first eclipsed.

To project a lunar eclipse:—

Describe a circle with the *Sampatkarttam,* as directed in solar eclipses; and from its centre inscribe another, with the moon's apparent radius; and from the same centre set off *Santira Vikshepam,* in the direction in which the eclipse begins; and from its end describe a circle with the apparent radius of the shadow. The part of the moon's disk included in the shadow, will represent the portion of the disk eclipsed.

VAKYA KARANA.

Eclipses by the Vakya Process.

1. From the *Sutta Tinam*, subtract 1,600,984·

Divide the remainder successively by 12372, 3031, and 248, and set down the quotients. The last remainder is the argument for *Attei Vakyam*, (i. e. tabular longitude of the moon for the given day, See Tab. I.)

Multiply the following numbers, respectively, by the above quotients; 9s. 27° 48′ 10″; 11s. 7° 31′ 1″; 27° 44′ 6″.

Add these three products together with 7s. 2° 0′ 7″, and the result is the *Sasi Druvam* (longitude of ☽'s apogee.) Add to this the *Attei Vakyam*, and you will have the moon's true longitude.

The moon's true daily motion may be found from the *Panchanka Vakya*, (See Table I.), corresponding with the *Attei Vakyam*.

NOTE. For the explanation of these numbers, see notes on pp. 6, 7, and 8.

The epoch of the system is April, 1282 A. D., as determined from the *Kandam*.

2. *Sun's Longitude.*

Set down the number of *months* passed from the beginning of the year, and the *day* of the month, as *signs* and *degrees*.

Subtract the *Sankranti Nalikeis and Vinalikeis* (time from sunrise at which the month ends,) as minutes and seconds, if the beginning of the month happen in the day time; but if it begin at night, *add* the difference between it and 60 *Nadis*.

Take the *Yokkiathi* (Table XIV.) for the given day from the table, and *subtract* it, if the signs be within seven of Pisces; but if not, *add* it; and it will give the sun's *true longitude*.

The daily motion in the table for each month, should be taken as the true daily motion of the sun for that day.

3. To make the correction called *Senakala Sankaram*.

The quotients elicited in the divisions by 3031 and 248 (in No. 1.) are to be multiplied respectively by 32 and 8; and the difference between the products taken.

Divide this difference by 60, and the quotient will be *Vinadis*.

If the product from the quotient of 3031 be greater than the other, the *Vinadis* are *subtractive*; but if less, they are *additive*.

Take the difference between 13° 11′ (the moon's mean daily motion,) and the moon's true daily motion, and if the mean be greater than the true, the signs of these *Vinadis* are to be reversed.

Multiply the *Vinadis* by the difference between the mean and true daily motions, and divide by 60, and the resulting quotient by 60, and the second quotiont is the correction called *Senakala Sankaram* in *minutes*.

Note. This correction is for errors arising from the use of the numbers 3031 and 248, regarded as multiples of complete revolutions of the moon from apogee.

4. Apply this result to the moon's true longitude, according to the signs, *plus* or *minus*. The longitude thus corrected is called *Pusantara Santiran*. If there be no correction, the moon's true longitude is to be considered the *Pusantara Santiran*.

5. To calculate the Precession of the Equinoxes:—

From the years expired in *Cali Yuga* subtract 3600, and set down the remainder in two places. Divide one of them by 121, and subtract the quotient from the other and divide the remainder by 60, and this will give the precession of the equinoxes. Add this to the sun's true longitude, and the sum will be *Sayana Ravi*.

Note. The number 3600 subtracted, brings us to A. D. 499. At this time the moveable and fixed signs were regarded as coincident. The author supposes the years of the *Kandam* here obtained to stand for *minutes*. But he further supposes that a minute a year is too much for the precession, and hence subtracts $\frac{1}{121}$th part from the whole, and then reduces the remainder to degrees. This gives the precession for a year $=59''.51$.

6. Observe whether *Sayana Ravi* be within six signs of Aries or of Libra, and reduce it to *Bhuja*, (see p. 10.)

From the *Bhuja Vakya*, inserted below, take the number corresponding to the number of *signs* in the *Sayana Ravi* reduced, and set it down above the degrees, minutes,

&c. of the same, and below the whole write down the next number in the Table.

Multiply the degrees, &c. of the middle quantity by the number below; then reduce the product to the higher denomination, and divide it by 30, and the quotient will be *Vinadis.*

Add the last found quantity to the number set above, and you will have *Sara Vinadi* (i. e. the ascensional difference.)

BHUJA VAKYA.—*Table of Ascensional differences.*

Signs.	As. differ.
1	48
2	38
3	16

NOTE. The ascensional differences are given for each of the three signs following Aries and Libra. The process directed is for the proportion of the same for the degrees, minutes, &c. When the third quantity in the table is the multiplier in the process, the result is to be added to the *sum* of the 1st and 2nd quantities (=86) in the table; because, the second and third quantities are the *differences* between the proper quantities for the whole distances.

7. If there be no sign in *Sayana Ravi,* take the first of the ascensional differences in the table, and by this multiply the degrees, &c. of longitude, and proceed as before; and the result will be *Sara Vinadi.*

In either case, the *Sara Vinadi* is *additive* or *subtractive* according as the *Sáyana Ravi* is within six signs of Aries or of Libra; and applied to 30 *Nalikeis,* will give the *duration of the day.*

Set down half the *Sara Vinadi,* with its proper sign, for future use.

8. To find the difference of longitude:—

If the first meridian be East of Caruvoor (Caroor,) *subtract* the difference found; but if west, *add* the same. In the present case it is 16 *yojanas* to the East. Therefore multiply this number by 60 and divide the product by 55; the quotient is the *correction* for the difference of longitude in *Vinadis,* which is to be subtracted.

NOTE. *Caroor* or *Caruvoor,* the place for which the calculation is made, is in latitude 10° 53′ N., and longitude 78° 4′ E. Hence, the reduction to the first meridian brings us near the meridian of *Ramiseram.* This is one of the most noted astronomical points among the Hindus. —It had an Observatory; and it is taken as the *first meridian* in many of the astronomical systems extant. Its latitude is 9° 18′ 7″ N.; and longitude 79° 22′ 5″ E.

9. To find the correction called *Toru Vivaram*:—

Mark the sun's longitude *minus* or *plus*, according as it is within six signs of Geminii or of Sagittarius.

From the *Toru Vakya* take the number corresponding to the number of signs in the sun's longitude, and put it above the degrees, &c. of the said longitude. Then take the difference between this quantity from the table and the next below it, and place it below the degrees, &c.

Multiply the degrees, &c. in the middle quantity, by the quantity set below them, and divide the product by 30.

Then if the first of the *Vakyas* set down be the greater of the two, the result last obtained is to be subtracted from it; but if the first *Vakya* be the less of the two taken out, the result is to be added to it. This will give what is called *Toru Vivara Vinadi.*

If the two *Vakyas* be equal, no correction is had, and the first quantity from the table is the *Toru Vivara Vinadi.*

Toru Vakya.—Equation Table.

1	16
2	7
3	5
4	15
5	21
6	21
7	16
8	6
9	4
10	14
11	20
12	21

Note. This equation table, in its construction, depends simply on the equation of the centre. The numbers in the first column are signs, those in the second are *Vinadis*, giving the equation required at the end of each sign, or end of eaeh month of the Hindu year· The process, as directed in the text, for a fraction of a sign, is obvious.

10. The *Toru Vivara Vinadi*, half the ascensional difference (Sara Vinadi,) and the difference of the longitude (as found in No. 8.), combined together according to their signs, constitute what is called *Sarattathi Vinadi.*

Set down the *Sarattathi Vinadi* in two places, and multiply one by the true daily motion of the moon, and the other, by that of the sun. Divide the product by 60, and the resulting quotients each again by 60, and the last quotient will be *minutes.*

Apply these minutes to the longitudes of the sun and moon, and you will have their true longitudes.

If there be no result in the above process, the longitudes for the sun and moon before found, will be the true longitudes.

Note. The first division by 60 depends on the proportion:—

60ந. (length of a day) : daily motion :: *Sarattathi Vinadi* : the proportion of daily motion. The second division by 60 is for reduction. The 60ந. is first reduced to *Vinadis*, which is compensated by the final division by 60.

11. From the true longitude of the moon, subtract that of the sun, and find the number of complete *Tithis* passed. Reduce the remainder to minutes, and multiply them by 60, and divide the product by the difference between the daily motions of the sun and moon; and the quotient will be *Nadis.* Reduce this remainder to *Vinadis.* The *Nadis* &c. thus found, are called *Tinathi.*

Tinathi subtracted from 60ந. gives the time of conjunction or opposition.

Note. The process here depends on the proportion:— Rel. daily motion : 60ந :: remainder here found : correction. *Tinathi* is the correction for the time of conjunction or opposition, reckoning from sun-rise.

12. Multiply the *Tinathi* by the daily motions of the sun and moon, and divide both products by 60, and the resulting quotients again by 60, and the last quotients will be *minutes.*

Subtract these minutes, in the case of the moon, from the apparent longitude of the moon, if it be greater than that of the sun; but if not, *add* them.

Apply, on the same principles, the minutes found for the sun, to the longitude of the sun. The longitudes thus derived are called *Samakkrakam.*

Compute the longitude of the node from the rules given in *Parakitham,* (see p. 26.). Thus far the computation is common both to solar and lunar eclipses.

Note. This reference to *Parakitham* shows, that this system is the more modern of the two; which will also appear from a comparison of the dates of the two works, as given on pp. 10 and 37.

Solar Eclipses.

Oblique ascension of the point of the ecliptic in the horizon, at the time of conjunction.

13. To the *Samakkrakam* of the sun add the precession of the equinoxes.

Set down the signs in the same, and under the signs set down the difference between 30° and the degrees, &c. of the *Samakkrakam*, and take from the *Rasi Vakya* the number next below that indicated by the number of signs, and multiply the difference above found by this number from the table, and reduce the same to signs, &c.

Convert the time of conjunction (No. 11.) into degrees, &c. by multiplying by 6, (6°=Nadi), and reduce the same to signs, &c. From this subtract the former result; and from the remainder subtract successively as many of the tabular numbers following the one taken out, as may be, and increase the number of signs by as many units as there are subtractions made.

If the number of signs found exceed 12, reject the 12s. and keep the remainder.

Multiply this remainder by 30, and divide the product by the number following the one last taken from the table; the quotient will be *degrees.* Multiply the remainder by 60, and divide by the last divisor for the *minutes.* These degrees and minutes together with the signs found, constitute *Sayana Ayana Lagna.* i. e. *Oblique ascension of the point of the ecliptic rising.*

Rasi Vakya.—*Right ascensions of the signs of the Zodiac.*

1	254 வி.
2	280
3	315
4	331
5	318
6	302
7	302
8	318
9	331
10	315
11	280
12	254

Note. These numbers are *Vinadis*, and express the times in which the signs severally occupy in rising.—The process for the remainder, here directed, depends on the following proportion: —Tab. No. : 30° :: rem. : proportional part.

14. Subtract three signs from *Sayana Ayana Lagna*; the remainder is called *Kopona Lagna*. Subtract the precession of the equinoxes from this, and the remainder is called *Ishda Lagna*.

15. The *Akkara (Nitya) Vikshepam* is 8′ 3″, and is always additive.

16. If the *Kopona Lagna* be within six signs of Aries, it is northern, and subtractive; but if within six signs of Libra, it is southern and additive.

Reduce it to *Bhuja*, as usual, and bring the signs to degrees. Divide the degrees, &c. by 15, and take such a number from *Nyan Vakya*, as is indicated by the number in the *quotient*, and add to it all the preceeding numbers in the table.

Multiply the remaining degrees and minutes by the number next following in the table; then raise the product to the next higher denomination, and divide by 15, as before; the quotient, which will be in *Vinadis*, must be added to the sum last found. Multiply the remainder by 60 and divide by 15; and the highest denomination will be *Tatpareis*. The *Vinadis* and *Tatpareis* thus found, are called *Nyan*.

If the degrees in the first instance cannot be divided by

15, multiply the degrees and minutes by the first number in the table, and proceed as before.

Multiply the *Nyan* by 6, and the product is called *Vil.*

NYAN VAKYA.—*Increments of Moon's Latitude.*

1	11 வி.	
2	10	30 த
3	9	
4	7	
5	4	
6	1	30

NOTE. The *Nyan* is the increment of moon's latitude for each successive 15° from the node, expressed in *Vinadis*, &c. The numbers in the first column denote so many arcs of the ecliptic of 15° each. The *Vinadis* and *Tatpareis* are reduced to minutes and seconds in the multiplication by 6.

17. Divide *Vil* by 13, which gives minutes. Multiply the remainder by 60 and divide by 13 again, which gives seconds. The minutes and seconds thus found constitute *Sittiluttei.*

Add or subtract *Sittiluttei* from *Nitya Vikshepam*, according as *Kopona Lagna* is marked plus or minus.

If *Nitya Vikshepam* and *Sittiluttei* be both plus, or both minus, add them. If one be plus and the other minus, subtract the less from the greater; the sum or difference, thus found, will have the corresponding sign, and is called *Nathi.*

NOTE. The division by 13 is explained by the fact, that the moon's parallax in latitude, is taken to be $\frac{1}{13}$th of her latitude, as above assumed.

18. Take the difference between the apparent longitude of the sun at conjunction and *Kopona Lagna*, reduce the remainder to *Bhuja*, bring the signs to degrees, and divide them by 6.

Take that number from the *Lampitha Vakya* (see p. 32,) which is indicated by the last found quotient, and, finding the difference between this and the next following number in the table, multiply, by this difference, the remainder elicited in the division by 6 in the last paragraph, and divide the product by 6. Add or subtract this result from the number first taken from the table, according as it is less or greater than, the number next following.

The sum or difference thus found is called *Lampana Vinadi.*

Note. The first division by 6 in this process is to reduce the degrees to *Nadis*, because the numbers in the first column in the table are *Nadis*. The second division by 6 is on the principle:——Tab. unit = 1 ɪ = 6° : diff. found :: the degrees, &c. : proportion required.

19. If the number of degrees be less than 6, multiply it by the first number in the table, and divide by 6; the quotient is the *Lampana Vinadi*, as before.

If this be divided by 60, it will be in *Nadis*.

20. If the highest denomination in *Nathi* be less than 12, the above found *Lampana Vinadi*, is to be taken as the true one; if it be greater, muttiply it by 2, when it does not exceed 24; by 8, when it is less than 36; and by 18, when it exceeds this number.

This result is to be multiplied into the *Lampana Vinadi*, before found, and divided by 12, if *Nathi* was multiplied by 2; by 24, if it was multiplied by 8; and by 36, if multiplied by 18.

Subtract this quotient from the *Lampana Vinadi*, and the remaidder is the true *Lampana Vinadi*.

Note. This is a correction for *Lampana Vinadi* (moon's parallax in longitude) which, as determined above, was found to be too great. But the error is so small as not to be regarded, if *Nathi* be less than 12 minutes.

21. Add the true *Lampana Vinadi* to the true time of conjunction, if it be in the afternoon; but if it be in the forenoon, subtract it; and if it be at mid-day or mid-night, half of it must be added.

The sum or difference thus derived, is the apparent time of conjunction, called *Lampana Paruvantam*, in *Nadis* and *Vinadis*.

22. Multiply the true *Lampana Vinadi* by the true daily motion of the moon, and the highest denomination will be in *minutes*; which are to be added to, or subtracted from, the sun's *Samakkrakam*, according as the true *Lampana Vinadi* were added to, or subtracted from, the true time of conjunction. The result is called *Lampana Santiran*, i. e. *Apparent longitude of the moon*.

23. From *Lampana Santiran* subtract the longitude of the node; and if the remainder be within 6 signs of Aries,

mark it as *northern* and *subtractive*; but if it be within six signs of Libra, mark it as *southern* and *additive*. Reduce it then to *Bhuja*, and bring it to degrees. Divide the degrees by 15, and find out the *Nyan*, as before, (see No. 16). Multiply the *Nyan* by 6, and you will have the *Vil*.

Divide the *Vil* by 21, and the quotient will be in *minutes*; and the remainder multiplied by 60, and divided by 21, will give *seconds* Add these minutes and seconds to the *Vil*, and the sum is called the *Moon's Lampana Vikshepam*, i. e. *Moon's apparent latitude.*

NOTE. This addition of the $\frac{1}{21}$th part of *Vil* (which may be considered as the moon's tabular latitude,) is made, because in the construction of the *Nyan* table, the assumed inclination of the moon's orbit is too small.

24. Take the difference between *Lampana Santira Vikshepam* and *Nathi*, when one of them is *additive* and the other *subtractive*; but when both are additive or subtractive, take their sum The result is called *Puda Nathi* (i. e. apparent distance of the centres of the sun and moon at conjunction.)

25. Divide the true daily motion of the moon by 25; multiply the remainder by 60, and divide by the same quantity, the quotient is called *Santira Mandalam* (i. e. moon's apparent diameter, in minutes and seconds.)

NOTE. The 25 is here used on the principle,—that $\frac{1}{25}$th part of the daily motion of the moon=moon's apparent diameter.

26. Multiply the true daily motion of the sun by 5, and divide the product by 9; multiply the remainder by 60, and divide by the same quantity; and the quotient is called *Surya Mandalam*; (i. e. sun's apparent diameter, in minutes and seconds.)

NOTE. The 5 and 9 are here used on the principle,—that $\frac{5}{9}$th of the sun's daily motion=sun's apparent diameter.

27. Half the sum of the apparent diameters of the sun and moon is called *Seiyoga Telam.*

If *Puda Nathi* cannot be subtracted from *Seiyoga Te-*

lam, there will be no eclipse; but if it can be subtracted, there will be an eclipse. The remainder from this subtraction is called *Krasankulam.*

28. The square of *Seiyoga Telam* is called *Seiyoga Tela Vatkam.*

The square of the *Puda Nathi* is called *Puda Nathi Vatkam.*

Subtract the latter square from the former, and extract the square root of the remainder, as follows:—

Mark the odd number of places, enumerating from unit's place, as *Vatkams,* and, the even number, as *Avatkams.* Take the square root of the first *Vatkam;* e. g. the square root of 1 is 1; of 4 is 2; of 9 is 3; of 16, 4, &c.

Subtract the square of this root from the first period, and put the remainder with the next *Avatkam,* as the dividend; double the root for the divisor, and see how often the divisor is contained in the dividend, and put the root in the quotient; square the whole root and subtract it from the whole number, and repeat the process as before.

Note. This gives half the relative orbit of the moon during the eclipse, which is one of the legs of a right angled triangle; the other leg is the latitude of the moon at conjunction. Half the sum of the semi-diameters is the hypothenuse.

29. Divide the root by the relative motion of the sun and moon for a *Nadi,* and the quotient will be *Nadis.* Multiply the remainder by 60, and divide by the same divisor; and the quotient will be *Vinadis.* The *Nadis* and *Vinadis* are called *Tithiarttam.* i. e. half the duration of the eclipse.

Substract *Tithiarttam* from the apparent time of conjunction, for the beginning of the eclipse; but for the end, add the same. The apparent time of conjunction is the middle of the eclipse.

Lunar Eclipse.

30. Having calculated as far as *Samakkrakam,* divide the moon's daily motion by 25 (see Note in No. 25), and the quotient will be in *Angulas;* multiply the remainder by 60, and divide by the same divisor, the quotient will be in *Viangulas.* The *Angulas* and *Viangulas.* thus

found, are the *Suntira Mandalam,* (i. e. the apparent diameter of the moon.)

31. Multiply the moon's apparent diameter by 5, take half the product and add one; the sum is *Raku Mandalam,* (i. e. the *apparent diameter of the earth's shadow.*)

32. Subtract the longitude of the node, from the moon's *Samakkrakam,* and observe, that if the remainder (dist. fr. node) fall within six signs of Aries, it is *northern*. Reduce this to *Bhuja,* and bring the signs to degrees.

Divide these degrees by 15, and take that number from *Nyan Vakya,* which is indicated by the number in the quotient, and to it add all the preceeding quantities in the table. Then take the next following quantity from the table, and multiply the degrees, &c. by it, and divide the product by 15; then add the quotient to the sum above obtained. The whole is *Nyan.*

33. Multiply *Nyan* by 6 for the *Vil.* Divide the *Vil* by 21, and add the quotient to the *Vil*; the sum is the *moon's latitude,* north or south, according as the nodal distance is north or south. (see No. 23, Note.)

34. Half the apparent diameters of the moon and shadow, is called *Seiyoga Telam.*

From *Seiyoga Telam* subtract the moon's latitude, the remainder is called *Krasankulam.* If the moon's latitude be greater than the sum of the semi-diameters of the moon and shadow, there will be no eclipse.

35. Square the *Seiyoga Telam*; square, also, the moon's latitude Subtract the latter square from the former, and extract the square root of the remainder.

Divide the root by the relative motion of the moon for one *Nadi,* and the result will be *Nadis.* Multiply the remainder by 60, and divide by the same, and the result will be *Vinadis.* These *Nadis* and *Vinadis* constitute *Tithiarttam,* (i. e. *half the duration of the eclipse.*) Subtract *Tithiarttam* from the time of opposition, for the beginning of the eclipse; but for the *end,* add it. The time of opposition is the *middle* of the eclipse.

SYSTEM OF ECLIPSES

COMPILED BY

VISVANATHA SASTRI, SON OF NARAYANA SASTRI,

Batticotta, Jaffna, Ceylon, A. D. 1788.

Principles common to Solar and Lunar Eclipses.

1. An Eclipse may be expected in those months when the sun is in or near to the sign in which *Raku* or *Kethu* is. If, in those months, a *conjunction* of the sun and moon occur in the day time, there may be a solar eclipse; but if an *opposition* occur at night, there may be a lunar eclipse.

2. Set down the *Sutta Tinam* to the time of sun-rising on the day in which the conjunction or opposition of the sun and moon occurs. From this *subtract* 1,774,192; the remainder is called *Kandam*. This *Kandam* should be considered as beginning on *Monday*.

NOTE. The subtraction here required, is, as in other authors, for the purpose of reducing the period, by casting out complete revolutions of the sun. The *Kandam* commences about the year of the birth of the compiler. This makes the epoch of the system A. D. 1756. The work, however, was not compiled till A D. 1788, as mentioned above.

3. Divide the *Kandam* successively by 12,372; 3,031, and 248; and set down the *quotients*, marking also their respective divisors. The last remainder will be the *Kethu Vakya*; i. e. an argument for the *Panchanka Vakya*.

Multiply, by the quotients found above, the following numbers respectively, viz: 9s. 27° 48′ 10″; 11s. 7° 31′ 1″; 27° 44′ 6″.

Take the sum of these three results and add to it 2s. 1° 14′ 27″, which is the *Mula Druvam*, or *moon's epoch longitude*; and you obtain *Sasi Druvam*, i. e. the longitude of the moon's apogee at the beginning of the *Panchanka Vakya*.

NOTE. For explanation of these numbers, and the process, see pp. 6, 7, and 8.

4. To the *Sasi Druvam* add the *Attei Vakya*, the moon's tabular longitude, and the correction called *Maniyathi*, (see Table XV.); the sum will be the *moon's longitude.*

5. To make the correction called *Senakala*:—

Multiply the quotients, elicited in the above divisions by 3031 and 248, by 8 and 32 respectively; and subtract the first product from the second. Divide the remainder by 60, and the quotient will be *Vinadis*.

Take the difference between the true daily motions of the moon, and the mean, which is 791′, and multiply the above *Vinadis* by it. The product will be *seconds*. Divide this by 60 for *minutes*. To the moon's longitude above found, apply this result by addition or subtraction, according as the mean motion is less or greater than the true one. The result will be the *Sutta Santiran*, i. e. *moon's corrected longitude.*

The moon's true daily motion must be taken from the *Panchanka Vakya*.

Note. The numbers 3031 and 248 are multiples of the moon's anomalistic revolution,—in the first there is an error of 8 *Tatpareis*; and in the second of 32 *Tatpareis*. Hence the correction here directed.

6. To calculate the *sun's longitude*:—

Set down the number of *months* passed, and the *day* of the month, as so many *signs* and *degrees*. From this sum subtract the *Sankirama Nalikeis* and *Vinalikeis*, considering them as *minutes* and *seconds*, if the beginning of the month happen in the day time; but if the month begin at night, add to that sum the difference between these *Nalikeis*, &c. and 60 *Nalikeis*.

From the *Yokyathi Vakya*, (see Table XIV.) take the equation corresponding to the given day, and subtract it from the above result, if it falls within 7 signs of *Pisces*; but if it be within 5 signs of *Libra*, it must be added to the same. The result obtained will be the sun's *Pudam*, or true longitude.

The daily motion given in the table for each month, is to be considered as the true daily motion of the sun for any day of that month.

NOTE. The term *Sankirama* marks the time from sun-rise to the transit of the sun to a new sign; i. e. the moment at which the given month commences.

7. Subtract the sun's true longitude from the *Sutta Santiran*, and find the number of complete *Tithis* passed; reduce the remainder to minutes, and multiply them by 60. Divide this product by the difference of the daily motions of the sun and moon, and the quotient will be *Nalikeis*. Multiply the remainder by 60, and divide by the same divisor, for *Vinalikeis*. The *Nadis* and *Vinadis* thus obtained are called *Prathami Nadi* and *Vinadi*. The difference between this result and 60 *Nalikeis*, will be *Sutta Paruva Nadi* and *Vinadi*, i. e. the time of conjunction or opposition of the sun and moon.

8. To calculate the *longitude* of *Raku*, i. e. ascending node:—

Divide the *Kandam*, in No. 2. by 6795, and reject the quotient. Multiply the remainder by 12, and divide by the same divisor; the quotient will be *signs*. Reduce the remainder to degrees and minutes by multiplying by 30 and 60, and dividing each product by the same divisor.

Divide the same *Kandam* by 813, and the quotient will be *minutes*. These minutes must be added to the above found result. Take the sum of this quantity and 7s. 18° 45′, which is *Raku's* epoch longitude, and subtract it from 12s; the remainder will be *Raku's* longitude for sun-rise of the given day.

Divide by 19 the number of *Nalikeis* intervening between the time of sun-rise and the time of conjunction or opposition; the result will be *minutes*. Subtract these minutes from the longitude above found, and the remainder will be the longitude of *Raku* for the instant of conjunction or opposition.

NOTE. The division by 6795 casts out complete revolutions of the node, as this number expresses the number of days in one revolution. The division by 12 is on the principle,—

One rev.=12s. : days in the same=6795 :: remaining days : signs, &c. passed in the current revolution.

The division by 813, which is days, is a correction for the revolution, which is given too large.—The division by

19 is explained by the fact assumed, that *Raku's* motion in 19 *Nadis* is one minute.

9. To calculate the *precession* of the equinoxes:—

Divide the number of years passed in *Cali Yuga* by 615, and the quotient will be *signs*. Multiply the remainder by 30 and 60 successively, and divide each product by the same divisor; the result will be *degrees* and *minutes*.

Reduce the signs, &c. to *Bhuja*, as usual; and take out the equation from *Yutta Nathi Vakya*.

This equation, raised to the higher denominations, will be the *Ayana Pudam*, i. e. the precession of the equinoxes.

YUTTA NATHI VAKYA.—*Table of Precessions.*

3° 45′	min.	3° 45′	min.	3° 45′	min.
1	91′	9	783	17	1284
2	182	10	859	18	1324
3	274	11	933	19	1359
4	362	12	1002	20	1388
5	450	13	1068	21	1410
6	537	14	1129	22	1426
7	621	15	1185	23	1436
8	703	16	1238	24	1440

NOTE. This process for the precession is based on the ingenious device which was first given in the *Surya Sidhanta*, in which the equinoxes are supposed to move in an epicycle, whose centre is at the beginning of the fixed zodiac. A revolution in the epicycle is effected in 7,380 years. The table embraces a quadrant of the epicycle, occupying a period of 1845 (615×3) years. The amount of precession = 24°.—At the beginning of *Cali Yuga*, the precession is assumed to be nothing, which accords with the *Surya Sidhanta*. But the period of the epicycle is here given greater than in that work. The rate of precession is not uniform, and consequently gives erroneous results. The precession for the epoch of the system (A. D. 1756) is nearly correct; and errors of opposite kinds arise, as we proceed either way from this epoch, in the use of the table. The numbers in the first column, are expressive of the usual tabular units of 3° 45′ each. The other numbers give the precession in minutes of a degree. An examination of this table confirms the correctness of the epoch of the system, as determined from the Kandam.

10. To calculate the *Ascensional Difference*:—

To the sun's longitude (in No. 6.) add the precession of the equinoxes above found, and ascertain whether this quantity falls within six signs of Aries or Libra, and reduce it to *Bhuja*, if it be in *Kodi*.

If this reduced quantity be less than a sign, multiply it by 48; then reduce the product to the higher denomination, and divide by 30. The resulting quotient is called *Sara Vinadi*, or Ascensional Difference.

When the reduced quantity is greater than one sign, but less than two, multiply the degrees and minutes of the same by 38, and find out the *Sara Vinadi* as before, remembering to increase the result by 48 *Vinadis*.

When it exceeds two signs, the degrees and minutes of the same must be multiplied by 16, and the result, found as before, must be added to 86 *Vinadis*.

Note. The process in this article is preparatory to the next. The numbers refer to the differences between 30 *Nalikeis*, and the length of the day at given longitudes of the sun.

When the sun is in the first of Aries, the day is just 30 *Nalikeis*.

When its longitude=1s. the day=30ந.+48வி.
" =2s. " =30ந.+86வி.
" =3s. " =30ந.+102வி.

Hence, the 1st subtracted fr. the 2d.=38 } Nos. found
2nd " 3d.=16 } in the text.

The process depends on this proportion:—

30° : the given difference :: degrees, &c. of longitude : proportional difference.

11. *For the Duration of the day*:—

To 30 *Nalikeis* add the ascensional difference found, if the sun's longitude be within six signs of Aries; but subtract the same when it is otherwise. The sum or difference found will be the duration of the day, called *Tivamanam.*

12. Multiply the *Sara Vinadi* (found as in No. 10.) by the true daily motions of the sun and moon, and divide each of the products twice by 60 successively. Add the last found quantities, respectively, to the true longitudes of the sun and moon. The sums are called the *Samakkrakam* of the sun and moon.

The computation thus far is common both to solar and lunar eclipses.

Solar Eclipses.

13. Take the difference between the time of conjunction and half the duration of the day, and with it, as an argument, take out the equation from the *Lampitha Vakya*, and divide it by 60; the result will be *Nalikeis* and *Vinalikeis.* To the time of conjunction, apply the equation, by addition or subtraction, according as it is in the P. M. or A. M. The result will be *Lampana Puruvam*, or the apparent time of conjunction.

14. Apply the same equation to the *Samakkrakam*, as directed in the preceeding article, regarding the *Nalikeis* as *minutes*, and *Vinalikeis*, as *seconds* The result is called *Lampana Ravi*, or sun's apparent longitude for the time of conjunction.

15. Take the difference between half the duration of the day, and the time of apparent conjunction, and convert the remainder to degrees, &c. by multiplying by 6, and dividing by 60 and 30. *Subtract* this result from *Lampana Ravi*, if the time of conjuction occur in the forenoon; but if it occur in the afternoon, *add* it to the same. The sum of this result and the precession of the equinoxes, is called *Sayana Ravi*, i. e. the longitude of the nonagesimal.

16. If the *Sayana Ravi* be within six signs of Aries, mark it as *northern*; but if it be within six signs of Libra, mark it as *southern.*

Having reduced the *Sayana Ravi* to *Bhuja*, as usual, find out the equation from the sun's *Manta Jya Vakya*, and divide it by 7; the quotient will be *Ankulas.*

Multiply the remainder by 60 and divide the product by the same divisor, the quotient will be *Viankulas*. These *Ankulas* and *Viankulas*, are called the northern or southern (as the case may be) *Ravi Vikshepam*.

NOTE. For the explanation of this process see page 33.

17. Multiply the equation, found in Art. 13, by 13; and the product, divided by 60, will be *minutes* and *seconds*.

Subtract this result from the *Samakkrakam*, if the time of conjunction be in the fore-noon; but if it be in the afternoon, it must be *added*. The last result is called *Lampana Sama Santiran*, i. e. the apparent longitude of the moon at conjunction.

NOTE. See Note under No. 21, page 33.

18. From *Lampana Sama Santiran*, subtract the longitude of *Raku*, and mark the remainder as *northern* or *southern*, according as it is less or greater than six signs.

Reduce the same remainder to *Bhuja*, if it be in *Kodi*, and bring it to minutes. Divide these minutes by 13, the quotient will be *Ankulas*; multiply the remainder by 60, and divide by the same divisor, and the quotient will be *Viankulas*. The result is the moon's *Vikshepam*, or *latitude*, either north or south, according as before marked.

NOTE. See Note under No. 22, p. 33.

19. The *Nitya Vikshepam* is always south, being equal to 8′.

NOTE. This is to reduce the *parallax* of the moon to the latitude of the place of the author, Batticotta; which is about 9° 45′ north. See Note under No. 23, page 34.

20. If the three *Vikshepam* be of one kind, i. e. either northern or southern, *add* them together; but if they be of different kinds, take their difference. The sum or difference found, is called *Puda Vikshepam*, being northern or southern, according to the quality of the greater of the *Vikshepam*.

21. Multiply the sun's true daily motion by 5, and divide the product by 18; the quotient will be *Ankulas*. Multiply the remainder by 60, and divide the product by the same divisor, for *Viankulas*. The result will be the

Ravi Mandalarttam, i. e sun's apparent semi-diameter.

22. Divide the moon's true daily motion by 50, the quotient will be *Aukulas*; reduce the remainder to *Viankulas*. The result will be the *Santira Mandalarttam*, i.e. moon's apparent semi-diameter

Note. See No. 25, p. 46; where the process is for the *diameters*. Hence the difference in the numbers.

23. The sum of the apparent semi-diameters of the sun and moon is called *Sampatkarttam*. If from this the *Puda Vikshepam* cannot be subtracted, there will be no eclipse. But if it can, then subtract the *Puda Vikshepam* from the *Sampatkarttam*, and the remainder is called *Krasangulam*, being northern or southern, as is *Puda Vikshepam*.

24. From the *Krasangulam*, subtract successively, 1, 2, 3, 6, 8, and 12, and the number of subtractions will be *Nalikeis*. Multiply the remainder by 60, and divide the product by the number next greater than the one subtracted, and the quotient will be *Vinalikeis*. The result is called *Tithi Nalikeis* and *Vinalikeis*. Half of this result is called *Tithiarttam*.

25. Add *Tithiarttam* to *Lampana Ravi* for the *beginning*, and *subtract* the same for the end, of the eclipse. *Lampana Paruvam* is the time of the *middle* of the eclipse.

26. The sun's apparent semi-diameter doubled will be the apparent diameter of the sun. Ascertain what part of this is the *Krasankulam*, and it will give the magnitude of the eclipse. If $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, or $\frac{3}{4}$ of the sun's disk is eclipsed, while the *Krasankulam* is northern, the eclipse will commence on the north-west limb of the sun, and end on the north-east limb. But if the *Krasankulam* be southern, it will commence on the south-west, and end on the south-east, limb. If the eclipse be total, it will begin on the western, and end on the eastern limb.

Lunar Eclipses.

27. From the longitude of *Raku*, subtract that of the moon, and the remainder is called *Pathuna Santiran*, or

distance of the moon from the node. Ascertain whether it is less or greater than six signs, and reduce it to *Bhuja*, if it be in *Kodi*. Divide the number of minutes contained in the result by 13, and the quotient will be *Angulas*. Multiply the remainder by 60, and divide as before, for *Viangulas*. These *Angulas* and *Viangulas* are the moon's latitude, either northern or southern, according as the *Pathúna Santiran* is less or greater than six signs.

28. Divide the moon's daily motion by 50, and the quotient will be *Angulas*; multiply the remainder by 60, and divide as before for *Viangulas*. The result is called *Santira Mandalarttam*, the moon's apparent semi-diameter.

29. Multiply the moon's apparent semi-diameter by 5, and take half the product for *Rahu Mandalarttam*, the apparent semi-diameter of the shadow.

NOTE. This is on the supposition that $2\frac{1}{2}$ ☽'s *semi-diameter* = semi-diameter of the shadow.

30. The sum of the semi-diameters of the moon and shadow is called *Sampatkarttam*.

If this be less than the moon's latitude, there will be no eclipse. But if greater, subtract the latitude from the *Sampatkarttam*, and the remainder will be *Krasankulam*.

The *Krasankulam* is to be considered northern, when the moon's latitude is south; and southern, when that is north.

31. From the *Krasankulam* subtract successively 1, 1, 2, 3, 4, 6, 7, 11, and 16. If any of these numbers cannot be subtracted, the remainder must be multiplied by 60, and divided by the number next to the last subtracted; the quotient will be *Vinalikeis*. The number of the above subtractions added together, will be *Nalikeis*. These *Nalikeis* and *Vinalikeis* express the duration of the eclipse. Half of this is called *Tithiarttam*.

For the beginning of the eclipse, subtract *Tithiarttam* from the true time of opposition; and for the end, add the same to it. The true time of opposition is that of the middle of the eclipse.

In order to ascertain the time from sunset, the duration of the day must be subtracted from the time of the eclipse.

32. Multiply the apparent semi-diameter of the moon by 2, and ascertain what part of this is the *Krasankulam*. The result will be the magnitude of the eclipse.

33. If the *Krasankulam* is northern, while the eclipse is partial, the eclipse will commence on the north-eastern limb, and end on the north-western.

If the *Krasankulam* be southern, the south-eastern limb of the moon will be first eclipsed, and the eclipse will end on the south-western. If the eclipse be total, it will commence on the eastern, and end on the western limb.

HINDU ASTRONOMICAL TABLES,

BEING

A TRANSLATION OF THE TABLES GIVEN IN TAMIL IN THE BODY OF THIS WORK.

TABLE I. PANÇHANKA VAKYA,

Giving the longitude of the moon from Apogee, and the daily motion, for 248 days.

Day.	☽'s Longitude.			☽'s mo. for day.	Day.	☽'s Longitude.			☽'s mo. for day.	Day.	☽'s Longitude.			☽'s mo. for day.
	s.	°	′			s.	°	′			s.	°	′	
1	0	12	3	723	33	2	10	4	761	65	4	12	35	828
2	0	24	9	726	34	2	23	0	776	66	4	26	34	839
3	1	6	22	733	35	3	6	12	792	67	5	10	44	650
4	1	18	44	742	36	3	19	39	807	68	5	24	59	855
5	2	1	19	755	37	4	3	21	822	69	6	9	17	658
6	2	14	9	770	38	4	17	15	834	70	6	23	36	859
7	2	27	13	784	39	5	1	20	845	71	7	7	51	855
8	3	10	33	800	40	5	15	33	853	72	7	21	58	847
9	3	24	9	816	41	5	29	51	858	73	8	5	55	837
10	4	7	58	829	42	6	14	10	859	74	8	19	40	825
11	4	21	58	840	43	6	28	27	857	75	9	3	10	810
12	5	6	8	850	44	7	12	37	850	76	9	16	25	795
13	5	20	25	857	45	7	26	39	842	77	9	29	24	779
14	6	4	44	859	46	8	10	30	831	78	10	12	8	764
15	6	19	2	858	47	8	24	7	817	79	10	24	39	751
16	7	3	15	853	48	9	7	29	802	80	11	6	58	739
17	7	17	22	847	49	9	20	35	786	81	11	19	8	730
18	8	1	17	835	50	10	3	26	771	82	0	1	13	725
19	8	15	1	824	51	10	16	2	756	83	0	13	15	722
20	8	28	29	808	52	10	28	26	744	84	0	25	19	724
21	9	11	42	793	53	11	10	40	734	85	1	7	27	728
22	9	24	40	778	54	11	22	46	726	86	1	19	43	736
23	10	7	23	763	55	0	4	49	723	87	2	2	10	747
24	10	19	52	749	56	0	16	52	723	88	2	14	49	759
25	11	2	10	738	57	0	28	58	726	89	2	27	43	774
26	11	14	19	729	58	1	11	10	732	90	3	10	53	790
27	11	26	24	725	59	1	23	31	741	91	3	24	18	805
28	0	8	26	722	60	2	6	5	754	92	4	7	58	820
29	0	20	30	724	61	2	18	52	767	93	4	21	52	834
30	1	2	38	728	62	3	1	55	783	94	5	5	56	844
31	1	14	55	737	63	3	15	14	799	95	5	20	8	852
32	1	27	23	748	64	3	28	47	813	96	6	4	26	858

Day.	☽'s Longitude. s.	°	'	☽'s mo. for day.	Day.	☽'s Longitude. s.	°	'	☽'s mo. for day.	Day.	☽'s Longitude. s.	°	'	☽'s mo. for day.
97	6	18	45	859	134	10	29	26	752	171	2	28	20	764
98	7	3	2	857	135	11	11	46	740	172	3	11	19	779
99	7	17	13	851	136	11	23	58	732	173	3	24	34	795
100	8	1	17	844	137	0	6	3	725	174	4	8	4	810
101	8	15	8	831	138	0	18	5	722	175	4	21	49	825
102	8	28	47	819	139	1	0	8	723	176	5	5	46	837
103	9	12	10	803	140	1	12	16	728	177	5	19	53	847
104	9	25	18	788	141	1	24	30	734	178	6	4	8	855
105	10	8	11	773	142	2	6	56	746	179	6	18	27	859
106	10	20	48	757	143	2	19	33	757	180	7	2	45	858
107	11	3	14	746	144	3	2	26	773	181	7	17	0	855
108	11	15	28	736	145	3	15	34	788	182	8	1	10	850
109	11	27	36	728	146	3	28	57	803	183	8	15	9	839
110	0	9	39	723	147	4	12	36	819	184	8	28	57	828
111	0	21	41	722	148	4	26	27	831	185	9	12	30	813
112	1	3	46	725	149	5	10	31	844	186	9	25	49	799
113	1	15	58	732	150	5	24	42	851	187	10	8	52	783
114	1	28	18	740	151	6	8	59	857	188	10	21	39	767
115	2	10	50	752	152	6	23	18	859	189	11	4	13	754
116	2	23	36	766	153	7	7	36	858	190	11	16	34	741
117	3	6	37	781	154	7	21	48	852	191	11	28	46	732
118	3	19	54	797	155	8	5	52	844	192	0	10	52	726
119	4	3	26	812	156	8	19	46	834	193	0	22	55	723
120	4	17	12	826	157	9	3	26	820	194	1	4	58	723
121	5	1	11	839	158	9	16	51	805	195	1	17	4	726
122	5	15	19	848	159	10	0	1	790	196	1	29	18	734
123	5	29	34	855	160	10	12	55	774	197	2	11	42	744
124	6	13	52	858	161	10	25	34	759	198	2	24	18	756
125	6	28	10	858	162	11	8	1	747	199	3	7	9	771
126	7	12	25	855	163	11	20	17	736	200	3	20	15	786
127	7	26	33	848	164	0	2	25	728	201	4	3	37	802
128	8	10	32	839	165	0	14	29	724	202	4	17	14	817
129	8	24	18	826	166	0	26	31	722	203	5	1	5	831
130	9	7	50	812	167	1	8	36	725	204	5	15	7	842
131	9	21	7	797	168	1	20	46	730	205	5	29	17	850
132	10	4	8	781	169	2	3	5	739	206	6	13	34	857
133	10	16	54	766	170	2	15	36	751	207	6	27	53	859

Day.	☽'s Longitude. s. ° '	☽'s mo. for day.	Day.	☽'s Longitude. s. ° '	☽'s mo. for day.	Day.	☽'s Longitude. s. ° '	☽'s mo. for day.
208	7 12 11	858	222	1 13 25	725	236	7 21 36	857
209	7 26 24	853	223	1 25 34	729	237	8 5 46	850
210	8 10 29	845	224	2 7 52	738	238	8 19 46	840
211	8 24 23	834	225	2 20 21	749	239	9 3 35	829
212	9 8 5	822	226	3 3 4	763	240	9 17 11	816
213	9 21 32	807	227	3 16 2	778	241	10 0 31	800
214	10 4 44	792	228	3 29 15	793	242	10 13 35	784
215	10 17 40	776	229	4 12 43	808	243	10 26 25	770
216	11 0 21	761	230	4 26 27	824	244	11 9 0	755
217	11 12 49	748	231	5 10 22	835	245	11 21 22	742
218	11 25 6	737	232	5 24 29	847	246	0 3 35	733
219	0 7 14	728	233	6 8 42	853	247	0 15 41	726
220	0 19 18	724	234	6 23 0	858	248	0 27 44	723
221	1 1 20	722	235	7 7 19	859			

Note. For explanation of the mode of construction and use of this Table, see pp. 5, 6, and 7, of this work.

TABLE II. ☉'s Manta Jya.

Equation of the ☉'s centre.
Argument. ☉'s mean anom.

3° 45'	+6s. −0s.	+7s. −1s.	+8s. −2s.	
1	8'	72'	116'	8
2	17	78	119	7
3	25	85	122	6
4	33	91	124	5
5	41	97	126	4
6	49	102	128	3
7	57	107	129	2
8	64	112	129	1
	−5s +11s	−4s +10s	−3s +9s	3° 45'

TAB. III. ☽'s Manta Jya.

Equation of ☽'s centre.
Arg. Moon's mean anom.

3° 45'	+6s. −0s.	+7s. −1s.	+8s. −2s.	
1	20'	167'	270'	8
2	39	183	278	7
3	59	198	285	6
4	78	213	291	5
5	97	226	295	4
6	115	239	298	3
7	133	250	300	2
8	150	261	301	1
	−5s +7s	− 4s + 8s	−3s +9s	3° 45'

Note. These two tables, as well as those of the equation of the orbits of the other planets following, are explained on the same general principles. A full account of their formation is given in the *Asiatic Researches*, Vol. II. pp. 249—252. The fundamental principle is contained in the following statement;—

"If we now proceed to the consideration of the equations of the centre, we find that the Hindus, like Ptolemy and the earlier European astronomers, employ eccentric circles, and epicycles. In the eccentric they suppose the eccentricity equal to the sine of the greatest equation of the centre; and, generally, the sine of the equation of the centre is equal to the sine of the greatest equation×sine of the anomaly. This fundamental principle is common to the Greeks and Indians. The latter, as well as the former, substitute an epicycle for the eccentric, the radius of the epicycle being equal to the eccentricity. But the Hindus modify their calculation in a peculiar way, the necessity or advantage of which it is not easy to see. The equation of the centre of the sun being 130′ 32″, the Indians say,—

'Radius=3438′ : eccentricity=130′ 32″ :: 360° : 13° 40′=circumference of the epicycle. This circumference they call the *parithi ansam*; they take on it an arc equal to the mean anomaly. The sine and cosine of this anomaly in the little circle are in a given ratio with the sine and cosine of the same arc in the greater circle."

This gives very nearly a correct formula for the equations of the planets generally. "But in the case of the sun and moon they adopt a peculiar artifice; they adopt, in fact, a variable eccentricity; they augment the circumference of the epicycle by 20′×sin. mean anomaly (marked *m.a.*), which is the same as augmenting the radius by 3′ 11″×sin. m.a; the eccentricity becomes then, generally

=133′ 43″—3′ 11″×sin. m.a; hence the equation of the centre=(133′ 43″—3′ 11″×sin. m.a) ×sin. m.a.

=133′ 43″×sin. m.a—3′ 11″×sin.^{2} m.a.

"The lunar equation is calculated by the same method; and, though the equation is double that of the sun, with the same empirical correction 3′ 11″×sin^2 m.a, which seems very extraordinary. But it is remarkable that these formulae represent the equations in question with great accuracy; in fact, with much greater accuracy than the Indians could use, their tables of sines being only calculated for every $3°\frac{3}{4}$."

The process required in No. 4. p. 28, may be explained by the principles here assumed. The taking of *Kodi* or the complement of *Bhuja*, is virtually taking the *cosine*, instead of the *sine*, of the mean anomaly. It is manifest that the radius Vector is equal to the radius of the eccentric + cosine of mean anomaly.

The form of the tables here given, in which the signs, as well as degrees, of the argument are given, removes the necessity of reducing the mean anomaly to *Bhuja* as directed in the text.

TABLE IV.

Mars' Manta Jya.

Equation of the orbit.

Arg. Mars' mean longitude—Aphelion.

3° 45′	+6s. —0s.	+7s. —1s.	+8s. —2s.	
1	40′	388′	682′	8
2	81	430	708	7
3	124	472	729	6
4	167	513	747	5
5	211	552	761	4
6	255	588	771	3
7	300	622	777	2
8	344	653	780	1
	—5s. +11s	—4s. +10s	—3s. + 9s	3° 45′

Note. This, like the *Manta Jya* of all the superior planets, is properly the equation to the centre.

TABLE V.

Mars' Makara and Katki Jya.

Parallax of the orbit.

Arg. Sun's longitude—Mars' longitude.

3° 45′	+ 0s.	+ 1s.	+ 2s.	+ 3s.	+ 4s.	+ 5s.	
1	90′	791′	1447′	1953′	2352′	2198′	8
2	179	875	1525	2014	2382	2084	7
3	267	950	1600	2077	2398	1932	6
4	356	1044	1674	2134	2404	1737	5
5	443	1126	1746	2188	2400	1476	4
6	531	1209	1816	2237	2370	1193	3
7	618	1290	1886	2282	2342	837	2
8	705	1358	1952	2322	2282	434	1
	11s. —	10s. —	9s. —	8s. —	7s. —	6s. —	3° 45′

Note. Here, as in the case of all the superior planets, the *Makara or Katki Jya* equations are for the purpose of reducing heliocentric longitude to geocentric. The numbers give the annual parallax of the planet, in minutes of a degree.

In the body of this work the aphelion of Mars, as well as that of the other planets, is erroneously considered as fixed. The motion of the aphelion for 100 years is, for

Mars	1° 51′ 40″
Jupiter	1° 34′ 33″
Saturn	1° 50′ 7″

Some Hindus have given the motion of Apsides; for

Mars	1′ in 980 years.
Jupiter	1′ in 222 years.
Saturn	1′ in 5128 years.

TABLE VI.—Mercury's Manta Jya.

Equation of Sun's longitude.

Arg. ☉'s mean long. —Aphelion of Mer.

3° 45′	+6s. —0s.	+7s. —1s.	+8s. —2s.	
1	19′	141′	201′	8
2	38	151	205	7
3	55	161	208	6
4	72	170	210	5
5	88	178	212	4
6	103	185	214	3
7	116	191	214	2
8	129	196	215	1
	—5s. +11	—4s. +10	—3s. +9s.	3° 45′

Note. The use of this table is to equate the sun's longitude for the eccentricity of the planet's orbit, preparatory for the next table.

TABLE VII. Mercury's Makara and Katki Jya.

The Elongation.

Arg. Mercury's long.—☉'s equated long.

3° 45′	+ 0s.	+ 1s.	+ 2s.	+ 3s.	+ 4s.	+ 5s.	
1	63′	520′	952′	1197′	1273′	931′	8
2	125	595	988	1221	1257	845	7
3	187	650	1029	1242	1237	752	6
4	248	703	1078	1259	1207	646	5
5	308	754	1114	1272	1171	533	4
6	368	805	1148	1280	1125	409	3
7	425	853	1168	1284	1070	278	2
8	483	900	1197	1281	1006	141	1
	11s. —	10s. —	9s. —	8s. —	7s. —	6s. —	3° 45′

Note. By the aid of this table, as in that for Venus, the geocentric longitude of the planet, corrected for the centre, is obtained from the heliocentric longitude as previously determined from the *Kandam,* as directed on pp 14, 15. In the text the aphelion of Mercury is considered as stationary, which is an important error—the motion in 100 years being 1° 33′ 45″ direct. Hence the *aphelion* (see p. 15. No. 5.) at this time (1848) should be about 7s. 9° 27′. Some Hindu Astronomers have given a small motion to Mercury's aphelion,—viz: 1′ in 544 years. For the aphelion of Venus, they give 1′ in 374 years.

TABLE VIII. JUPITER'S MANTA JYA.

Equation of the Orbit.
ARGUMENT. Jupiter's mean longitude—Aphelion.

3° 45′	+6s. —0s.	+7s. —1s.	+8s. —2s.	
1	20′	180′	305′	8
2	40	199	321	7
3	60	217	324	6
4	81	234	331	5
5	101	250	337	4
6	121	266	341	3
7	141	280	343	2
8	161	293	344	1
	+11s — 5s	+10s — 4s	+9s —3s	3° 45′

See Note under Tab. IV.

TABLE IX. JUPITER'S MAKARA AND KATKI JYA.

Parallax of the Orbit.
ARGUMENT. ☉'s longitude.—Jupiter's longitude.

3° 45′	+ 0s.	+ 1s.	+ 2s.	+ 3s.	+ 4s.	+ 5s	
1	38′	316′	533′	637′	615′	398′	8
2	74	348	554	644	600	357	7
3	111	378	573	647	581	312	6
4	147	408	589	649	558	264	5
5	183	436	604	648	533	216	4
6	217	462	617	645	504	165	3
7	251	487	628	638	482	111	2
8	284	511	637	628	437	56	1
	11s. —	10s. —	9s. —	8s. —	7s. —	6s. —	3° 45′

See Note under Table V.

TABLE X.
Venus' Manta Jya.

Equa. of ☉'s long.
Arg. ☉'s mean long. —Aph. of Venus.

3° 45'	+6s —0s	+7s —1s	+8s —2s	
1	11'	69'	85'	8
2	21	73	85	7
3	30	76	85	6
4	38	79	86	5
5	46	81	86	4
6	51	82	86	3
7	59	83	86	2
8	64	84	86	1
	—5s +11	—4s +10	—3s +9s	3° 45'

See Note under Tab. VI.

TABLE XI.
Venus' Makara and Katki Jya.

Argument. Venus' longitude—Sun's equated longitude.

3° 45'	+ 0s.	+ 1s	+ 2s.	+ 3s.	+ 4s.	+ 5s.	
1	95'	845'	1559'	2129'	2641	2657'	8
2	190	937	1645	2204	2684	2561	7
3	285	1028	1729	2276	2720	2424	6
4	380	1119	1811	2347	2747	2230	5
5	473	1209	1894	2413	2762	1967	4
6	527	1297	1974	2485	2767	1618	3
7	660	1386	2052	2535	2752	1167	2
8	753	1474	2129	2592	2717	616	1
	11s —	10s. —	9s —	8s —	7s. —	6s, —	3° 45'

See Note under Table VII.

TAB. XII. Saturn's Manta Jya.

Equation of the Orbit
Arg. Sat. mean long.—Aphelion.

3° 45'	+ 6s — 0s	+ 7s — 1s	+ 8s — 2s	
1	26'	268'	486'	8
2	53	299	506	7
3	82	330	512	6
4	112	360	536	5
5	142	389	547	4
6	173	416	555	3
7	205	442	559	2
8	236	464	561	1
	— 5s + 11	— 4s + 10	— 3s + 9s	3° 45'

See Note under Table IV.

TABLE XIII. Saturn's Makara and Katki Jya.

Parallax of the Orbit.
Arg. Sun's long—Saturn's true long.

3° 45'	+ 0s	+ 1s	+ 2s	+ 3s	+ 4s	+ 5s	
1	22'	185'	298'	343'	318'	201'	8
2	45	202	308	344	309	180	7
3	65	218	317	345	298	157	6
4	88	234	324	344	285	134	5
5	109	249	331	341	271	109	4
6	129	262	335	338	252	83	3
7	148	276	340	335	239	56	2
8	168	287	343	326	226	28	1
	11s —	10s —	9s —	8s —	7s —	6s —	3° 45'

See Note under Table V.

REMARK. From inspection of the above Tables and the process in which they are used, it seems evident, that the sun was considered as the centre of the planetary orbs; but it is not so manifest, whether these ancient Philosophers entertained the true Copernican system, or one like that of Tycho Brahe, which swings the sun, with all his attendants, around the earth as centre of the whole. There is much reason, however, to think, that some of the former Astronomers of India were acquainted with the true solar system, though so directly and fatally opposed to the Puranic views of this subject.

TABLE XIV. YOKYATHI.

Equation of the Sun's Longitude.

D.	Sittirei.	Veikasi.	Ani.	Adi.	Avani.	Puratasi
1	1′ 28″	2′ 31″	3′ 1″	3′ 0″	2′ 20″	1′ 16″
2	2 56	5 3	6 2	6 1	4 39	2 32
3	4 24	7 34	9 3	9 1	6 59	3 48
4	5 52	10 5	12 4	12 2	9 19	5 5
5	7 20	12 37	15 6	15 2	11 38	6 1
6	8 48	15 8	18 7	18 2	13 58	7 37
7	10 16	17 39	21 8	21 3	16 18	8 53
8	11 45	20 11	24 9	24 3	18 37	10 9
9	13 13	22 42	27 10	27 3	20 57	11 25
10	14 41	25 13	30 11	30 4	23 16	12 42
11	16 20	27 52	33 14	33 0	25 25	13 47
12	18 6	30 15	36 21	35 55	27 27	14 46
13	19 51	33 18	39 28	38 49	29 29	15 44
14	21 37	36 1	42 35	41 44	31 32	16 43
15	23 23	38 44	45 41	44 38	33 34	17 42
16	25 8	41 27	48 48	47 13	35 36	18 41
17	26 53	44 10	51 55	50 27	37 38	19 40
18	28 39	46 53	56 2	53 22	39 41	20 38
19	30 25	49 36	58 19	56 17	41 43	21 37
20	32 10	52 19	1° 1 16	59 11	43 45	22 36
21	34 4	55 6	1 4 22	1° 2 0	45 39	23 22
22	36 13	58 1	1 7 21	1 4 37	47 18	23 46
23	38 22	1° 0 55	1 10 17	1 7 14	48 57	24 10
24	40 30	1 3 50	1 13 12	1 9 51	50 36	24 34
25	42 39	1 6 44	1 16 8	1 12 29	52 15	24 58
26	44 48	1 9 39	1 19 3	1 15 6	53 54	25 22
27	46 57	1 12 33	1 21 59	1 17 43	55 34	25 47
28	49 6	1 15 28	1 24 55	1 20 20	57 13	26 11
29	51 14	1 18 23	1 27 50	1 22 57	0 58 52	26 35
30	53 23	1 21 17	1 30 46	1 25 34	1 0 31	26 59
31	55 32	1 24 12	1 33 41	1 28 12	1 2 10	27 22
32			1 36 38			
m m	59′	58′	57′	57′	57′	58′

Yokyathi, *continued*.

Equation of the Sun's Longitude

Day	Atpasi.	Kartikei.	Markali.	Tei.	Masi.	Pankuni.
1	8″	57″	1′ 12″	1′ 22″	25″	19″
2	15	1′ 54	2 24	2 44	50	37
3	23	2 51	3 37	4 6	1′ 16	56
4	31	3 49	4 49	5 29	1 41	1′ 15
5	38	4 46	6 1	6 51	2 6	1 33
6	46	5 43	7 13	8 13	2 31	1 52
7	54	6 40	8 25	9 35	2 56	2 11
8	1′ 2	7 37	9 38	10 57	3 22	2 30
9	1 9	8 34	10 50	12 19	3 47	2 48
10	1 17	9 33	12 2	13 35	4 12	3 7
11	1 31	10 36	13 26	14 39	4 37	3 50
12	1 44	11 40	14 50	15 42	5 2	4 32
13	1 58	12 43	16 15	16 46	5 28	5 15
14	2 12	13 46	17 39	17 49	5 53	5 58
15	2 25	14 50	19 3	18 53	6 18	6 40
16	2 39	15 53	20 27	19 56	6 43	7 23
17	2 53	16 56	21 51	21 00	7 8	8 6
18	3 7	18 0	23 16	22 3	7 34	8 49
19	3 20	19 3	24 40	23 7	7 57	9 31
20	3 34	20 6	26 4	24 6	8 24	10 14
21	3 48	21 9	27 22	25 4	8 43	11 15
22	4 2	22 13	27 41	26 1	9 2	12 15
23	4 16	23 16	29 59	26 59	9 22	13 16
24	4 30	24 19	31 17	27 56	9 41	14 17
25	4 43	25 23	32 35	28 54	10 00	15 18
26	4 57	26 26	33 54	29 51	10 19	16 18
27	5 11	27 29	35 12	30 49	10 38	17 19
28	5 25	28 34	36 30	31 46	10 58	18 20
29	5 39	29 36	37 49	32 44	11 17	19 20
30	5 53		39 0		11 36	20 21
31						
m.m.	59′	60′	61′	61′	61′	60′

Note. *Yokyathi* gives the equation of the sun's motion, assumed at the rate of 1 degree a day, to the true motion for every day in the year. As the sun enters a new sign at the commencement of each month, the foregoing equations are not to be added,—the equation for any given fraction of the current month being all that is required.

The table gives at once the equation to the centre, and the correction of the error in the assumed rate of 1 degree a day for the sun's motion.

For the use of the table see pp. 8, 37, and 50.
The mean daily motion for each month is given at the bottom of the page, and marked *m.m.*

TABLE XV. MANIYATHI.

Equation for reducing the moon's place to the time of sunrise on the prime meridian.

Day	Sitterei.	Veikasi.	Ani.	Adi.	Avani.	Purattasi
1	20′ 48″	14′ 50″	9′ 54″	7′ 2″	8′ 6″	11′ 12″
2	20 37	14 41	9 49	7 4	8 12	11 23
3	20 25	14 31	9 43	7 6	8 17	11 35
4	20 14	14 21	9 38	7 8	8 23	11 46
5	20 2	14 12	9 32	7 10	8 29	11 58
6	19 50	14 2	9 26	7 12	8 35	12 10
7	19 39	13 52	9 21	7 14	8 41	12 21
8	19 27	13 43	9 15	7 15	8 46	12 33
9	19 15	13 33	9 9	7 17	8 52	12 45
10	19 4	13 23	9 4	7 19	8 58	12 56
11	18 52	13 13	8 58	7 21	9 4	13 8
12	18 41	13 4	8 53	7 23	9 10	13 19
13	18 29	12 54	8 47	7 25	9 15	13 31
14	18 17	12 44	8 42	7 27	9 21	13 43
15	18 6	12 35	8 36	7 29	9 27	13 54
16	17 54	12 25	8 30	7 31	9 33	14 6
17	17 43	12 15	8 25	7 33	9 39	14 17
18	17 31	12 6	8 19	7 35	9 44	14 29
19	17 19	11 56	8 13	7 37	9 50	14 41
20	17 8	11 46	8 8	7 39	9 56	14 52
21	16 56	11 37	8 2	7 41	10 2	15 4
22	16 43	11 27	7 56	7 43	10 8	15 16
23	16 33	11 17	7 51	7 44	10 13	15 27
24	16 21	11 8	7 45	7 46	10 19	15 33
25	16 10	10 58	7 40	7 48	10 25	15 50
26	15 58	10 48	7 34	7 50	10 31	16 2
27	15 46	10 39	7 28	7 52	10 37	16 14
28	15 35	10 29	7 23	7 54	10 42	16 25
29	15 23	10 19	7 17	7 56	10 48	16 37
30	15 11	10 9	7 11	7 58	10 54	16 48
31	15 0	10 0	7 6	8 0	11 0	17 0
32			7 0			

Maniyathi, *continued*.

Day	Atpasi.	Kartikei.	Markali.	Tei.	Masi.	Pankuni.
1	17′ 8″	21′ 14″	28′ 4″	29′ 58″	28′ 54″	25′ 50″
2	17 16	21 29	28 8	29 56	28 48	25 40
3	17 24	21 43	28 12	29 54	28 42	25 30
4	17 32	21 58	28 16	29 52	28 36	25 20
5	17 40	22 12	28 20	29 50	28 30	25 10
6	17 48	22 27	28 24	29 48	28 24	25 00
7	17 56	22 41	28 28	29 46	28 18	24 50
8	18 4	22 56	28 32	29 44	28 12	24 40
9	18 12	23 10	28 36	29 41	28 6	24 30
10	18 20	23 25	28 40	29 39	28 0	24 20
11	18 28	23 39	28 44	29 37	27 54	24 10
12	18 36	23 54	28 48	29 35	27 48	24 00
13	18 44	24 8	28 52	29 33	27 42	23 50
14	18 52	24 23	28 56	29 31	27 36	23 40
15	19 0	24 37	29 00	29 29	27 30	23 30
16	19 8	24 52	29 4	29 27	27 24	23 20
17	19 16	25 6	29 8	29 25	27 18	23 10
18	19 24	25 21	29 12	29 23	27 12	23 00
19	19 32	25 35	29 16	29 21	27 6	22 50
20	19 40	25 50	29 20	29 19	27 0	22 40
21	19 48	26 4	29 24	29 17	26 54	22 30
22	19 56	26 19	29 27	29 14	26 48	22 20
23	20 4	26 33	29 32	29 12	26 42	22 10
24	20 12	26 48	29 36	29 10	26 36	22 00
25	20 20	27 2	29 40	29 8	26 30	21 50
26	20 28	27 17	29 44	29 6	26 24	21 40
27	20 36	27 31	29 48	29 4	26 18	21 30
28	20 43	27 46	29 52	29 2	26 12	21 20
29	20 52	28 00	29 56	29 0	26 6	21 10
30	21 0		30 20		26 0	21 0
31						

Note. The term *Maniyathi* is a Sanscrit numerical phrase, pointing to the *first number* in the table, and expressing the numerical power of the syllables.

It means 20, &c. The quantities in the table depend on the difference of longitude between the place of calculation and the prime meridian, and of the times of the apparent rising of the sun in the two places. As they are always *additive*, the site of the table must be west of the prime meridian. And, by comparison, we are led to Caroor, or some place near it, as the birth place of the system before us.

The argument for the table is the given day of the month.

For the use of the table see pp. 8 and 50.

SODYA VAKYA.

TAB. XVI. Mars.

Sodya. Days. Nal.	*Druvak-karam.* ′
1,552,827 35	—402
634,089 9	+ 5
132,589 21	" 27
28,857 41	" 133
17,158 38	—104
11,699 4	+638
Synodic rev.	780 days

TAB. XVII. Mercury.

Sodya. Days. Nal.	*Druvak-karam.* ′
1,592,740 22	— 33
16,801 54	+ 1
4,750 53	+149
2,549 15	—447
Synodic rev.	116 days.

TAB. XVIII. Jupiter.

Sodya. Days. Nal.	*Druvak-karam.* ′
1,570,425 17	—261
974,875 26	+ 1
125,648 50	— 9
65,018 17	+133
30,315 17	— 7
21,539 48	—619
4387 43	+274
Synodic rev.	399 days.

TABLE XIX. Venus.

Sodya. Days. Nal.	*Druvak-karam.* ′
1,561,937 44	+ 18
437,945 9	+ 0
174,593 7	+ 29
88,756 53	— 58
44,962 23	+2103
2,919 37	— 144
Synodic rev	584 days.

TABLE XX. SATURN.

Sodya.		Druvak-karam.
Days	Nal.	′
1,589,474	18	—326
570,534	8	+ 5
182,994	23	— 13
21,551		+ 43
10,964	32	+481
Synodic rev.		398 days.

NOTE. The *Sodya* quantities are multiples of the Synodic periods of the several planets. By subtracting these quantities from the *Sutta Tinam*, we, of course, cast out complete synodic revolutions.

The *Druvakkaram* gives the longitudinal distance of the sun or the planet, in minutes, from the first of Aries at the end of these synodic periods. These quantities may be either before (to the west) or after, the first of Aries—the former being marked minus (—), and the latter plus (+). The periods are so devised, that the *Druvakkaram* is always a comparatively small quantity. These quantities added, as directed in the text, (see p. 21, No 2.) form the *Druvam*, i. e. the longitudinal distance of the planet at the close of the last *Sodya Vakya* subtracted.

For the mode of using these tables, see p. 21.

EXPLANATION OF PARIVIRUTTI VAKYA.

These Tables are properly a continuation of the *Sodya Vakya*,—as they take up the process where it is left in the preceding Tables. The first column marked *days*, contains the *Varuda Sesha*, which is the argument for the Table, (see No. 3, p. 21.)—The second column, is the amount of true longitude for the *Varuda Sesha*, reckoned from the beginning of the current synodic revolution of the planet. The third column, marked *correction*, is the equation of the orbit for each degree of the *Druvam*, (see No. 4, p. 21.)

As the *Katha Parivirutti* (see No. 3, p. 21.) determines which of the tables is to be used, it manifestly, also, determines the order of connection between the two sets of tables, the *Sodya and Parivirutti Vakya*. As successive synodic revolutions of the planet must commence at different points in the ecliptic, the longitudes for any given number of days in different revolutions, must vary accordingly.

For the mode of using these Tables, see pp. 21—25.

TABLE XXI.

Mars' Parivirutti, No. 1.

Days.	Geo. Long.			Cor.	Days	Geo. Long			Cor.
	s.	°	′	′		s.	°	′	′
40	4	23	35	— 7	400	11	5	57	+ 41
80	5	18	50	— 6	410	11	3	18	" 40
120	6	14	19	— 4	420	11	1	22	" 34
150	7	3	50	— 1	sta'y 430	11	0	40	" 29
180	7	23	54	+ 3	440	11	1	12	" 27
210	8	14	33	" 7	450	11	3	1	" 22
230	8	28	18	" 9	465	11	7	30	" 16
250	9	12	5	" 11	480	11	13	6	" 13
270	9	25	18	" 12	495	11	20	6	" 9
285	10	4	51	" 13	510	11	27	47	" 5
300	10	13	48	" 14	530	0	7	39	" 3
315	10	21	56	" 15	550	0	20	0	— 2
330	10	29	6	" 19	570	1	1	41	— 4
340	11	3	7	" 22	600	1	29	29	— 4
350	11	6	30	" 25	630	2	7	20	— 7
360	11	8	37	" 28	660	2	25	35	— 7
Ret. 370	11	9	55	" 33	700	3	20	31	— 6
380	11	9	48	" 37	740	4	15	52	— 7
390	11	8	16	" 40	780	5	11	35	— 6

TABLE XXII.

Mars' Parivirutti, No. 2.

Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
40	6	7	42	— 2	400	1	14	33	+ 2
80	7	4	53	— 0	410	1	11	37	" 5
120	8	3	35	+ 5	420	1	8	8	" 2
150	8	25	50	" 8	430	1	4	10	" 1
180	9	18	12	" 9	440	1	2	10	" 1
210	10	10	29	" 9	sta'y450	1	0	51	—4
230	10	24	58	" 9	465	1	1	25	—5
250	11	9	13	" 10	480	1	4	27	—7
270	11	23	15	" 11	495	1	9	1	—7
285	0	3	35	" 12	510	1	14	55	—7
300	0	13	7	" 10	530	1	23	59	—9
315	0	22	13	" 10	550	2	4	46	—8
330	1	0	24	" 9	570	2	15	6	—7
340	1	5	4	" 8	600	3	2	18	—7
350	1	9	25	" 7	630	3	20	23	—7
360	1	12	48	" 6	660	4	8	52	—7
370	1	15	8	" 6	700	5	4	0	—6
380	1	16	32	" 4	740	6	0	7	—4
Ret. 390	1	16	7	" 4	780	6	27	40	+1

TABLE XXIII.

Mars' Parivirutti, No. 3.

Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
40	7	26	53	+ 5	400	2	22	22	—25
80	8	27	26	" 8	410	2	18	51	—25
120	9	8	20	" 8	420	2	15	1	—22
150	10	21	10	" 8	430	2	11	58	—23
180	11	13	57	" 9	sta'y440	2	9	48	—22
210	0	6	24	" 9	450	2	9	12	—17
230	0	20	52	" 7	465	2	10	30	—15
250	1	4	43	" 4	480	2	14	6	—13
270	1	17	45	" 1	495	2	19	18	—12
285	1	26	52	— 1	510	2	25	11	—10
300	2	5	18	— 3	530	3	5	29	— 8
315	2	12	41	— 6	550	3	16	16	— 8
330	2	19	6	— 8	570	3	27	36	— 6
340	2	22	26	—11	600	4	15	11	— 7
350	2	25	11	—14	630	5	3	34	— 6
360	2	26	56	—16	660	5	22	41	— 4
Ret.390	2	27	37	—16	700	6	19	56	+ 0
385	2	26	55	—12	740	7	19	15	" 5
390	2	25	12	—23	780	8	20	3	" 10

TABLE XXIV.

Mars' Parivirutti, No. 4.

Days.	Geo. Long. s.	°	′	Cor. °	′	Days.	Geo. Long. s.	°	′	Cor. ′
40	9	21	22	+	7	400	3	18	57	—26
80	10	22	25	"	7	410	3	15	47	" 22
120	11	23	26	"	7	420	3	13	31	" 21
150	0	16	3	"	5	sta'y 430	3	12	25	" 20
180	1	7	42	"	2	440	3	12	37	" 16
210	1	27	52	—	0	450	3	14	18	" 14
230	2	10	27	"	4	465	3	17	53	" 13
250	2	22	15	"	6	480	3	23	11	" 12
270	3	3	11	"	8	495	3	29	38	" 12
285	3	10	50	"	10	510	4	6	51	" 9
300	3	17	29	"	11	530	4	17	20	" 8
315	3	23	15	"	14	550	4	28	34	" 7
330	3	27	35	"	14	570	5	10	30	" 5
340	3	29	32	"	17	600	5	29	34	" 2
Ret. 350	4	0	21	"	19	630	6	20	2	+ 2
360	4	0	4	"	20	660	7	11	48	" 4
370	3	28	31	"	23	700	8	12	25	" 7
380	3	25	50	"	25	740	9	13	39	" 7
390	3	22	34	"	24	780	10	14	49	" 7

TABLE XXV.

Mars' Parivirutti, No. 5.

Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor
	s.	°	′	′		s.	°	′	′
40	11	16	11	+ 7	400	4	17	4	—26
80	0	16	38	+ 4	410	4	15	46	—22
120	1	15	18	— 0	sta'y420	4	15	35	—18
150	2	5	22	— 4	430	4	16	10	—16
180	2	24	14	— 8	440	4	18	28	—14
210	3	12	7	— 8	450	4	21	21	—13
230	3	23	30	— 8	465	4	26	53	—10
250	4	4	20	— 9	480	5	3	38	— 8
270	4	14	35	— 9	495	5	11	20	— 5
285	4	21	19	—10	510	5	19	47	— 2
300	4	27	8	—12	530	6	1	54	— 1
315	5	1	25	—14	550	6	15	0	+ 3
Ret.330	5	3	42	—18	570	6	28	51	+ 5
340	5	3	38	—21	600	7	20	45	+ 7
350	5	2	21	—23	630	8	13	31	+ 8
360	4	29	52	—25	660	9	6	33	+ 8
370	4	26	28	—27	700	10	7	22	+ 7
380	4	22	48	—28	740	11	7	29	+ 7
390	4	19	38	—27	780	0	8	56	+ 4

TABLE XXVI.

Mars' Pariviruttti, No. 6.

Days.	Geo. Long.			Cor	Days.	Geo. Long.			Cor.
	s.	°	′	′		s.	°	′	
40	1	7	51	— 1	sta'y400	5	21	22	— 7
80	2	4	57	— 3	410	5	21	59	— 6
120	3	0	32	— 7	420	5	23	55	— 3
150	3	19	3	— 7	430	5	26	51	— 1
180	4	7	10	— 7	440	6	0	35	+ 1
210	4	24	40	— 8	450	6	5	0	" 4
230	5	5	40	— 9	465	6	12	44	" 4
250	5	15	56	—10	480	6	21	23	" 6
270	5	25	6	—11	495	7	0	50	" 7
285	6	0	55	—11	510	7	10	53	" 8
300	6	5	33	—11	530	7	24	52	" 10
315	6	7	18	—11	550	8	9	18	" 10
Ret.330	6	8	35	—12	570	8	24	3	" 9
340	6	7	12	—12	600	9	16	16	" 8
350	6	4	22	—13	630	10	8	53	" 8
360	6	0	41	—14	660	11	1	44	" 8
370	5	26	50	—14	700	0	1	39	" 4
380	5	23	43	—13	740	1	0	12	— 1
390	5	21	51	— 8	780	1	27	18	— 4

TABLE XXVII.

Mars' Pariviirutti, No. 7.

Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
40	2	23	22	— 6	sta'y400	7	17	7	+28
80	3	18	44	— 7	410	7	18	3	" 25
120	4	13	48	— 7	420	7	20	13	" 23
150	5	2	10	— 7	430	7	23	35	" 22
180	5	19	56	— 7	440	7	27	34	" 18
210	6	7	8	— 6	450	8	2	19	" 16
230	6	18	25	— 5	465	8	10	1	" 15
250	6	28	51	— 3	480	8	19	9	" 14
270	7	8	44	— 1	495	8	28	29	" 12
285	7	15	20	+ 3	510	9	8	8	" 11
300	7	21	2	+ 5	530	9	21	47	" 11
315	7	25	26	+10	550	10	5	52	" 11
330	7	27	46	" 14	570	10	20	13	" 9
Ret. 340	7	28	2	" 19	600	11	11	51	" 7
350	7	27	28	" 25	630	0	3	5	" 3
360	7	24	58	" 30	660	0	25	38	— 1
370	7	22	1	" 32	700	1	19	57	— 6
380	7	19	25	" 31	740	2	15	45	— 6
390	7	17	37	" 28	780	3	11	13	— 7

TABLE XXVIII.

Mars' Pariviirutti, No 8.

Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	′	′		s.	°	′	′
40	4	6	55	— 6	400	10	23	48	+ 39
80	5	2	9	— 7	410	10	21	51	“ 32
120	5	27	25	— 6	sta'y 420	10	1	4	“ 28
150	6	15	51	— 4	430	10	1	51	“ 26
180	7	4	50	— 1	440	10	3	45	“ 25
210	7	4	7	— 3	450	10	5	43	“ 22
230	8	7	55	+ 5	465	10	12	37	“ 19
250	8	20	5	“ 9	480	10	29	47	“ 16
270	9	2	36	“ 12	495	10	28	54	“ 13
285	9	11	41	“ 14	510	11	6	31	“ 10
300	9	20	10	“ 16	530	11	18	34	“ 6
315	9	27	50	“ 18	550	0	1	57	“ 3
330	10	4	10	“ 0	570	0	13	24	“ 1
340	10	7	28	“ 4	600	1	2	4	— 4
350	10	9	43	“ 26	630	1	20	32	— 5
Ret 360	10	10	49	“ 29	660	2	9	0	— 7
370	10	10	37	“ 32	700	3	3	31	— 7
380	10	9	1	“ 35	740	3	29	16	— 6
390	10	6	28	“ 39	780	4	24	51	— 7

TABLE XXIX.

Mars' Pariviritti, No. 9.

Days.	Geo. Long. s.	°	′	Cor. ′	Days.	Geo. Long. s	°	′	Cor. ′
40	5	20	26	— 6	400	0	21	38	+ 20
80	6	16	32	— 3	410	0	18	51	" 20
120	7	14	43	+ 1	420	0	15	41	" 18
150	8	4	56	" 5	430	0	13	1	" 15
180	8	26	46	" 7	440	0	11	20	" 13
210	9	18	47	" 10	sta'y450	0	11	0	" 7
230	10	3	14	" 10	465	0	12	40	" 4
250	10	17	20	" 10	480	0	16	23	" 1
270	11	0	57	" 11	495	0	21	40	— 3
285	11	10	53	" 12	510	0	27	57	" 5
300	11	20	26	" 13	530	1	7	27	" 6
315	11	29	31	" 15	550	1	17	51	" 7
330	0	8	43	" 15	570	1	28	48	" 7
340	0	12	40	" 16	600	2	15	56	" 8
350	0	12	42	" 16	630	3	3	45	" 7
360	0	20	5	" 17	660	3	21	13	" 6
370	0	22	26	" 18	700	4	17	16	" 7
Ret.380	0	23	39	" 17	740	5	12	50	" 5
390	0	23	25	" 18	780	6	9	18	" 3

TABLE XXX.

Mars' Parivirutti, No. 10.

Days.	Geo. Long.			Cor.		Days.	Geo. Long.			Cor.
	s.	°	'	°	'		s.	°	'	'
40	7	7	9	+	1	400	2	10	4	—17
80	8	6	33	"	6	410	2	6	39	—18
120	9	7	10	"	8	420	2	2	48	—18
150	9	29	57	"	8	430	1	29	8	—17
180	10	22	31	"	8	440	1	26	47	—18
210	11	14	51	"	9	sta'y450	1	25	35	—15
230	11	29	40	"	8	465	1	26	14	—14
250	0	4	1	"	8	480	1	29	18	—13
270	0	27	43	"	6	495	2	4	2	—11
285	1	7	28	"	5	510	2	10	7	—10
300	1	16	36	"	3	530	2	19	40	— 9
315	1	24	48	"	1	550	2	29	58	— 9
330	2	2	2	—	3	570	3	11	9	— 7
340	2	6	3	—	4	600	3	28	46	— 7
350	2	9	24	—	7	630	4	36	52	— 7
360	2	11	49	—	9	660	5	5	33	— 6
370	2	13	11	—	11	700	6	1	39	— 3
Ret 380	2	13	32	—	16	740	6	29	40	+ 1
390	2	12	29	—	16	780	7	29	16	" 5

TABLE XXXI.

Mars' Parivirutti, No. 11.

Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
40	9	2	29	+ 8	400	3	8	34	—28
80	10	1	12	" 9	410	3	3	59	—27
120	11	2	12	" 8	420	3	2	14	—25
150	11	25	17	" 8	430	2	29	56	—22
180	0	17	44	" 5	sta'y 440	2	29	21	—19
210	1	9	5	" 2	450	3	0	1	—17
230	1	22	25	— 1	465	3	2	56	—14
250	2	4	59	— 3	480	3	7	43	—11
270	2	16	36	" 6	495	3	13	55	—10
285	2	24	41	" 7	510	3	20	59	— 9
300	3	1	56	" 8	530	4	1	17	— 9
315	3	8	14	" 11	550	4	12	14	— 8
330	3	13	18	" 13	570	4	23	45	— 7
340	3	15	42	" 16	600	5	11	58	— 5
350	3	17	23	" 18	630	6	1	22	— 2
Ret. 360	3	17	39	" 20	660	6	22	4	+ 1
370	3	16	48	" 24	700	7	21	32	" 7
380	3	14	52	" 26	740	8	22	31	" 6
390	3	11	59	" 27	780	9	23	47	" 7

TABLE XXXII.

Mars' Parivirutti, No. 12.

Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor
	s.	°	′	′		s.	°	′	′
40	10	25	4	+ 8	400	4	5	56	—25
80	11	24	13	+ 7	410	4	3	50	—23
120	0	26	12	+ 4	sta'y420	4	2	52	—21
150	1	17	20	— 1	430	4	3	1	—17
180	2	7	8	— 4	440	4	4	22	—16
210	2	25	38	— 7	450	4	6	38	—16
230	3	7	17	— 8	465	4	11	30	—12
250	3	18	18	— 9	480	4	17	40	—10
270	3	28	35	—12	495	4	24	44	— 9
285	4	5	37	—11	510	5	2	38	— 7
300	4	11	50	—12	530	5	13	59	— 0
315	4	16	54	—13	550	5	26	13	— 2
330	4	20	7	—17	570	6	9	16	+ 1
340	4	20	55	—19	600	7	0	10	+ 4
350	4	20	35	—20	630	7	22	20	+ 7
Ret 360	4	28	50	—26	660	8	15	12	+ 8
370	4	15	55	—28	700	9	16	18	+ 7
380	4	12	31	—28	740	10	11	22	+ 7
390	4	8	58	—28	780	11	18	35	+ 5

TABLE XXXIII.

Mars' Parivirutti, No. 13.

Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
40	0	18	48	+ 3	400	5	6	16	—17
80	1	17	10	— 4	sta'y410	5	6	17	—13
120	2	13	42	— 5	420	5	7	28	—11
150	3	2	30	— 7	430	5	9	44	—28
180	3	20	34	— 7	440	5	12	51	— 7
210	4	8	14	— 7	450	5	16	42	— 4
230	4	19	31	— 8	465	5	23	39	— 2
250	5	0	4	— 9	480	6	1	33	+ 1
270	5	8	30	—10	495	6	10	29	+ 3
285	5	15	40	—12	510	6	20	2	+ 5
300	5	20	27	—17	530	7	3	40	+ 7
315	5	23	35	—18	550	7	17	45	+ 8
Ret. 330	5	24	16	—17	570	8	2	41	+ 9
340	5	23	3	—19	600	8	24	56	+ 9
350	5	20	42	—20	630	9	17	36	+ 9
360	5	17	11	—22	660	10	10	28	+ 8
370	5	13	16	—22	700	11	11	13	+ 7
380	5	9	57	—21	740	0	11	8	+ 3
390	5	7	26	—21	780	1	9	31	— 1

TABLE XXXIV.

Mars' Pariviirutti, No. 14.

Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	′	′		s.	°	′	′
40	2	6	31	— 5	400	6	21	51	+15
80	3	1	58	— 7	sta'y410	6	23	17	+13
120	3	27	8	— 7	420	6	25	49	+12
150	4	15	40	— 7	430	6	29	19	+12
180	5	3	33	— 8	440	7	3	43	+12
210	5	20	39	— 8	450	7	8	39	+12
230	6	1	26	— 6	465	7	17	3	+13
250	6	11	41	— 6	480	7	26	10	+12
270	6	20	54	— 4	495	8	5	50	+12
285	6	26	53	— 4	510	8	15	50	+11
300	7	1	42	— 3	530	8	29	52	+10
315	7	4	50	+ 1	550	9	13	58	+ 9
Ret. 330	7	5	43	+ 5	570	9	28	43	+ 9
340	7	4	47	+ 6	600	10	20	33	+ 9
350	7	2	31	+10	630	11	12	31	+ 6
360	6	29	23	+11	660	0	4	32	+ 4
370	6	25	56	+11	700	1	2	18	+ 1
380	6	23	13	+15	740	1	28	47	— 5
390	6	21	54	+14	780	2	24	32	— 7

TABLE XXXV.

Mars' Parivirutti, No. 15.

Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	′	′	•	s.	°	′	′
40	3	20	6	— 7	400	9	3	11	+34
80	4	15	33	— 7	sta'y410	9	2	10	" 30
120	5	10	23	— 7	420	9	2	54	" 26
150	5	28	43	— 6	430	9	4	41	" 24
180	6	16	53	— 4	440	9	7	30	" 21
210	7	5	6	— 1	450	9	11	14	" 19
230	7	17	12	+ 1	465	9	18	5	" 17
250	7	29	3	" 5	480	9	25	58	" 15
270	8	10	33	" 9	495	10	4	47	" 12
285	8	18	48	" 12	510	10	14	8	" 12
300	8	26	15	" 16	530	10	27	10	" 10
315	9	2	54	" 18	550	11	10	26	" 7
330	9	8	0	" 22	570	11	23	48	" 5
340	9	10	22	" 28	600	0	13	42	" 1
Ret. 350	9	11	35	" 32	630	1	3	7	" 2
360	9	11	32	" 36	660	1	22	5	— 6
370	9	10	10	" 39	700	2	17	14	— 7
380	9	7	49	" 49	740	3	12	29	— 7
390	9	5	9	" 41	780	4	8	9	— 7

TABLE XXXVI. & XXXVII.

Mercury's Parivirutti.

No. 1.					No. 2.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
8	7	13	55	−3	8	11	6	44	+1
17	7	27	14	“3	16	11	20	43	“2
24	8	9	29	“2	24	0	3	50	“3
30	8	17	31	“2	30	0	12	4	“3
36	8	23	57	“1	36	0	19	40	“4
40	8	27	5	“2	40	0	23	36	“3
43	8	28	24	“2	43	0	25	8	“5
Ret. 46	8	29	0	“2	Ret. 46	0	26	2	“5
49	8	27	33	“2	49	0	25	56	“5
52	8	26	55	“2	52	0	24	46	“7
55	8	24	40	“2	55	0	22	52	“7
58	8	21	48	“2	58	0	19	58	“8
61	8	19	16	“2	61	0	17	19	“7
64	8	17	27	“2	64	0	15	26	“7
sta'y 67	8	16	48	“2	sta'y 67	0	14	33	“7
70	8	17	5	“1	70	0	14	51	“6
73	8	18	20	“1	73	0	15	14	“6
76	8	20	22	“1	76	0	18	10	“5
80	8	24	5	“1	80	0	22	3	“4
86	9	1	25	“1	86	0	29	33	“4
92	9	1	0	“0	92	1	10	29	“3
Im. 100	9	23	6	“0	100	1	21	48	“3
108	10	7	14	“0	108	2	6	5	“2
116	10	21	53	+1	116	2	21	2	“1

TABLE XXXVIII. & XXXIX.

Mercury's Parivirutti.

No. 3.					No. 4.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
8	3	5	54	+ 1	8	6	28	14	— 4
16	3	20	3	+ 1	16	7	11	28	— 4
24	4	3	6	+ 0	24	7	23	30	" 3
30	4	11	48	+ 0	30	8	1	21	" 3
36	4	19	2	— 0	36	8	7	44	" 3
40	4	22	46	— 0	40	8	10	41	" 3
43	4	24	54	— 1	43	8	11	48	" 3
46	4	25	59	— 1	Ret. 46	8	12	25	" 4
Ret. 49	4	26	8	— 1	49	8	11	52	" 4
52	4	25	18	— 1	52	8	10	20	" 4
55	4	23	28	— 1	55	8	7	53	" 4
58	4	20	53	— 1	58	8	5	16	" 4
61	4	18	7	— 1	61	8	2	32	" 4
64	4	15	57	— 1	64	8	0	52	" 4
67	4	14	27	— 1	sta'y 67	8	0	11	" 4
sta'y 70	4	14	2	— 1	70	8	0	28	" 3
73	4	14	43	— 1	73	8	1	41	" 3
76	4	16	17	— 1	76	8	3	45	" 2
80	4	19	28	— 1	80	8	7	32	" 2
86	4	26	7	— 1	86	8	14	48	" 1
92	5	4	18	— 2	92	8	23	25	" 1
100	5	16	48	— 2	Im. 100	9	6	24	" 0
108	6	0	11	— 3	108	9	20	28	" 0
116	6	14	17	— 3	116	10	5	10	" 0

TABLE XL. & XLI.

Mercury's Parivirutti.

No. 5.						No. 6.					
Days.	Geo. Long.			Cor.		Days.	Geo. Long.			Cor.	
	s.	°	'		'		s.	°	'		'
8	10	19	45	+	1	8	2	18	52	+	2
16	11	3	30	"	1	16	3	3	5	+	1
24	11	16	2	"	1	24	3	16	3	+	1
30	11	24	48	"	2	30	3	24	48	+	1
36	0	1	39	"	3	36	4	2	0	+	1
40	0	4	56	"	3	40	4	5	40	—	0
43	0	6	27	"	4	43	4	7	35	"	0
Ret. 46	0	7	11	"	4	46	4	8	42	"	0
49	0	6	51	"	5	Ret. 49	4	8	48	"	0
52	0	5	28	"	5	52	4	7	51	"	0
55	0	3	8	"	6	55	4	5	56	"	0
58	0	0	23	"	6	58	4	8	18	"	0
61	11	27	47	"	5	61	4	0	31	"	0
64	11	26	0	"	5	64	3	28	28	"	0
sta'y 67	11	25	32	"	5	67	3	27	6	"	0
70	11	25	39	"	5	sta'y 70	3	22	55	"	0
73	11	27	13	"	4	73	3	27	40	"	0
76	11	29	35	"	4	76	3	29	19	"	0
80	0	3	41	"	4	80	4	2	42	"	1
86	0	11	5	"	4	86	4	9	31	"	1
92	0	20	35	"	4	92	4	18	48	"	1
100	1	4	11	"	4	Im. 100	5	0	25	"	1
108	1	18	26	"	3	108	5	14	4	"	2
116	2	3	50	"	2	116	5	28	25	"	2

TABLE XLII. & XLIII.

Mercury's Pariviruttis.

No. 7.					No. 8.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	′	′		s.	°	′	′
8	6	12	41	— 3	8	10	2	57	— 0
16	6	26	10	— 4	16	10	16	41	— 0
24	7	7	48	— 4	24	10	29	15	+ 1
30	7	15	38	— 4	30	11	7	26	+ 1
36	7	21	50	— 5	36	11	13	8	+ 2
40	7	24	42	— 5	40	11	17	2	+ 4
43	7	25	51	— 5	43	11	18	23	+ 3
Ret. 46	7	26	21	— 5	Ret. 46	11	18	51	+ 3
49	7	25	42	— 5	49	11	18	. 8	+ 3
52	7	24	8	— 5	52	11	16	31	+ 4
55	7	21	41	— 6	55	11	14	1	+ 4
58	7	18	51	— 6	58	11	11	24	+ 4
61	7	16	10	— 6	61	11	8	47	+ 4
64	7	14	40	— 5	64	11	8	23	+ 3
sta'y 67.	7	13	58	— 5	sta'y 67	11	6	57	+ 3
70	7	14	16	— 5	70	11	7	38	+ 3
73	7	15	29	— 4	73	11	9	11	+ 3
76	7	17	29	— 3	76	11	11	32	+ 3
80	7	21	12	— 3	80	11	15	40	+ 3
86	7	28	25	— 2	86	11	23	31	+ 3
92	8	7	0	— 2	92	0	2	41	+ 3
Im. 100	8	19	53	— 1	Im. 100	0	16	20	+ 4
108	9	3	52	— 1	108	0	1	5	+ 4
116	9	18	30	— 0	116	1	16	22	+ 3

TABLE XLIV. & XLV.

Mercury's Parivirutti.

No. 9.					No. 10.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
8	2	1	29	+ 3	8	5	26	42	— 2
16	2	15	52	“ 2	16	6	9	51	— 3
24	2	28	58	“ 2	24	6	12	4	— 3
30	3	7	37	“ 2	30	6	29	54	— 4
36	3	14	45	“ 1	36	7	6	14	— 5
40	3	18	22	“ 1	40	7	9	5	— 6
43	3	20	12	“ 1	43	7	10	20	— 6
46	3	21	9	“ 1	Ret. 46	7	10	40	— 8
Ret. 49	3	21	8	“ 1	49	7	10	3	— 8
52	3	20	35	“ 1	52	7	8	28	— 8
55	3	18	4	“ 1	55	7	6	0	— 8
58	3	15	21	“ 1	58	7	3	7	— 8
61	3	12	36	“ 1	61	7	0	41	— 8
64	3	10	42	“ 1	64	6	28	57	— 7
67	3	9	31	“ 1	sta'y 67	6	28	11	— 6
sta'y 70	3	9	28	“ 1	70	6	28	27	— 6
73	3	10	23	“ 1	73	6	29	38	— 5
76	3	12	12	“ 1	76	7	1	33	— 5
80	3	15	42	“ 0	80	7	5	13	— 4
89	3	22	42	— 0	86	7	12	20	— 3
92	4	1	6	— 0	92	7	20	49	— 3
Im. 100	4	13	54	— 1	Im. 100	8	3	34	— 2
108	4	27	42	— 1	108	8	17	28	— 1
116	5	12	5	— 1	116	9	1	58	— 1

TABLE XLVI. & XLVII.

Mercury's Pariviruttī.

No. 11.						No. 12.					
Days.	Geo. Long.			Cor.		Days.	Geo. Long.			Cor.	
	s.	°	'		'		s.	°	'		'
8	9	16	18	—	0	8	1	13	54	+	4
16	9	29	52	"	0	16	1	28	21	"	3
24	10	12	15	"	0	24	2	11	31	"	3
30	10	20	15	"	0	30	2	20	11	"	2
36	10	26	34	+	1	36	2	27	16	"	2
40	10	29	22	+	1	40	3	0	45	"	2
43	11	0	32	+	1	43	3	2	33	"	2
Ret. 46	11	0	45	+	2	Ret. 46	3	3	22	"	2
49	10	29	54	+	2	49	3	4	10	"	2
52	10	28	2	+	2	52	3	1	52	"	3
55	10	25	26	+	2	55	2	29	54	"	3
58	10	22	51	+	2	58	2	27	3	"	3
61	10	20	24	+	2	61	2	24	23	"	3
64	10	19	15	+	2	64	2	22	26	"	3
sta'y 67	10	17	1	+	2	sta'y 67	2	21	35	"	2
70	10	19	42	+	2	70	2	21	45	"	2
73	10	21	22	+	2	73	2	22	53	"	2
76	10	23	51	"	2	76	2	24	51	"	1
80	10	28	0	"	2	80	2	28	28	"	1
86	11	5	56	"	2	86	3	5	42	"	1
92	11	16	0	"	2	92	3	14	14	"	0
Im. 100	11	28	38	"	3	Im. 100	3	27	14	—	0
108	0	13	23	"	3	108	4	11	10	—	0
116	0	28	46	"	4	116	4	25	46	—	1

TABLE XLVIII. & XLIX.

Mercury's Parivirutti.

No. 13.					No. 14.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor
	s.	°	'	'		s.	°	'	'
8	5	10	0	— 1	8	8	29	45	— 1
16	5	23	30	— 2	16	9	13	15	— 1
24	6	6	8	— 2	24	9	25	26	— 0
30	6	13	7	— 3	30	10	3	16	— 0
36	6	20	29	— 3	36	10	9	24	— 0
40	6	23	24	— 5	40	10	11	58	— 0
43	6	24	42	— 5	Ret. 43	10	12	57	— 0
Ret. 46	6	25	13	— 6	46	10	11	0	— 0
49	5	24	33	— 8	49	10	11	58	— 0
52	6	23	1	— 7	52	10	10	0	— 1
55	6	20	32	— 7	55	10	9	20	— 1
58	6	17	44	— 7	58	10	4	34	— 1
61	6	15	12	— 7	61	10	2	33	— 1
64	6	13	30	— 6	64	10	1	21	— 1
sta'y 67	6	12	42	— 5	sta'y 67	10	1	14	— 1
70	6	12	54	— 5	70	10	2	7	— 1
73	6	14	26	— 5	73	10	3	54	— 1
76	6	15	58	— 5	76	10	6	25	— 1
80	6	19	33	— 5	80	10	10	41	— 1
86	6	26	32	— 4	86	10	18	34	— 1
92	7	4	52	— 4	92	10	27	42	+ 1
100	7	17	30	— 3	100	11	11	31	+ 2
108	8	1	12	— 2	108	11	25	51	+ 3
116	8	15	33	— 1	116	0	11	4	+ 3

TABLE L. & LI.

Mercury's Parivirutti.

No. 15.					No. 16.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
8	0	26	10	+ 4	8	4	23	38	— 1
16	1	10	26	+ 4	16	5	7	22	— 1
24	1	23	45	+ 4	24	5	19	50	— 1
30	2	2	24	+ 3	30	5	27	56	— 2
36	2	9	27	+ 3	36	6	4	24	" 3
40	2	12	48	+ 3	40	6	7	20	" 3
43	2	14	24	+ 3	43	6	8	43	" 4
Ret. 46	2	15	6	+ 4	Ret. 46	6	9	13	" 4
49	2	14	48	+ 4	49	6	8	43	" 4
52	2	13	25	+ 4	52	6	7	8	" 5
55	2	11	6	+ 4	55	6	4	41	" 5
58	2	8	16	+ 4	58	6	1	51	" 6
61	2	5	44	+ 4	61	5	29	18	" 5
64	2	4	3	" 4	64	5	27	37	" 5
sta'y 67	2	3	21	" 4	sta'y 67	5	26	51	" 5
70	2	3	45	" 3	70	5	27	5	" 4
73	2	5	2	" 3	73	5	28	17	" 4
76	2	7	15	" 3	76	6	0	12	" 4
80	2	11	6	" 2	80	6	3	51	" 4
86	2	18	32	" 1	86	6	10	53	" 4
92	2	27	20	" 1	92	6	19	11	" 4
100	3	20	25	" 0	100	7	1	41	" 4
108	3	24	30	" 0	108	7	15	14	" 3
116	4	9	10	" 0	116	7	29	27	" 2

TABLE LII. & LIII.

Mercury's Parivirutti.

No. 17.					No. 18.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	′	′		s.	°	′	′
8	8	13	30	−2	8	0	8	33	+3
16	8	26	47	" 1	16	0	22	33	" 4
24	9	8	47	" 1	24	1	5	46	" 4
30	9	16	28	" 1	30	1	14	10	" 5
36	9	22	21	" 1	36	1	21	12	" 5
40	9	24	50	" 1	40	1	24	26	" 5
Ret. 43	9	25	40	" 0	43	1	25	52	" 5
46	9	25	32	" 0	Ret. 46	1	26	22	" 6
49	9	14	18	" 1	49	1	25	45	" 6
52	9	22	16	" 1	52	1	24	13	" 6
55	9	19	29	" 1	55	1	21	45	" 7
58	9	16	48	" 1	58	1	18	54	" 7
61	9	14	51	" 1	61	1	16	32	" 6
sta'y 64	9	13	51	" 0	64	1	15	6	" 6
67	9	14	2	" 0	67	1	14	44	" 5
70	9	14	49	" 0	sta'y 70	1	15	24	" 5
73	9	16	40	" 0	73	1	16	57	" 3
76	9	19	14	" 0	76	1	19	20	" 4
80	9	23	34	" 0	80	1	23	25	" 3
86	10	1	30	" 0	86	2	1	10	" 2
92	10	10	37	+1	92	2	10	10	" 2
100	10	24	7	+1	100	1	23	26	" 1
108	11	8	37	+2	108	3	7	42	" 1
116	11	23	43	+2	116	3	22	18	" 0

TABLE LIV. & LV.

Mercury's Parivirutti.

No. 19.					No. 20.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	′	′		s.	°	′	′
8	4	7	0	— 0	8	7	27	24	— 3
16	4	20	48	— 0	16	8	10	30	— 2
24	5	3	20	— 1	24	8	22	21	— 2
30	5	11	26	— 1	30	8	29	53	— 2
36	5	17	55	— 1	36	9	5	34	— 2
40	5	20	55	— 2	40	9	27	53	— 1
43	5	22	28	— 2	43	9	8	38	— 1
Ret. 46	5	22	44	— 3	Ret. 46	9	8	18	— 1
49	5	22	10	— 3	49	9	6	57	— 1
52	5	20	28	— 3	52	9	4	50	— 2
55	5	18	13	— 3	55	9	2	34	— 2
58	5	15	22	— 3	58	8	29	23	— 2
61	5	12	50	— 3	61	8	27	20	— 2
64	5	11	14	— 3	64	8	26	31	— 1
sta'y 67	5	10	31	— 3	sta'y 67	8	26	37	— 1
70	5	10	53	— 3	70	8	20	35	— 1
73	5	12	8	— 3	73	8	29	41	— 1
76	5	14	10	— 2	76	9	2	17	— 0
80	5	17	54	— 4	80	9	6	38	— 0
86	5	25	0	— 3	86	9	14	35	— 0
92	6	3	28	— 3	92	9	23	44	— 0
100	6	16	0	— 4	100	10	7	10	— 0
108	6	29	30	— 4	108	10	21	35	— 0
116	7	13	30	— 3	116	11	6	31	— 1

TABLE LVI. & LVII.

Mercury's Pariviritti.

No. 21.					No. 22.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
8	11	21	11	+ 2	8	3	20	43	+ 1
16	0	5	5	+ 2	16	4	4	3	+ 0
24	0	17	50	+ 3	24	4	16	36	+ 0
30	0	26	7	+ 4	30	4	24	45	+ 0
36	1	2	41	+ 5	36	5	1	20	+ 0
40	1	5	36	+ 6	40	5	4	12	— 1
43	1	6	52	+ 6	43	5	5	35	— 1
Ret. 46	1	7	14	+ 7	Ret. 46	5	5	55	— 1
49	1	6	20	+ 8	49	5	5	17	— 2
52	1	4	27	+ 8	52	5	3	41	— 2
55	1	1	52	+ 8	55	5	1	10	— 2
58	0	29	7	+ 8	58	4	28	18	— 2
61	0	27	1	+ 8	61	4	25	56	— 2
64	0	25	45	+ 7	64	4	24	22	— 1
sta'y 67	0	25	10	+ 6	sta'y 67	4	24	48	— 1
70	0	26	37	+ 6	70	4	24	14	— 1
73	0	28	25	+ 5	73	4	25	36	— 1
76	1	1	3	+ 5	76	4	27	43	— 1
80	1	5	28	+ 4	80	5	1	33	— 2
86	1	13	24	+ 3	86	5	8	50	— 2
92	1	22	41	+ 3	92	5	17	33	— 2
100	2	6	11	+ 2	100	6	0	8	— 3
108	2	20	41	+ 1	108	6	13	47	— 3
116	3	5	36	+ 1	116	6	27	51	— 4

TABLE LVIII. & LIX.

Jupiter's Parivirutti.

No. 1.					No. 2.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
30	6	6	28	—4	30	7	7	14	— 4
60	6	12	10	“5	60	7	12	52	— 4
90	6	16	38	“5	90	7	17	13	— 4
110	6	18	41	“5	110	7	19	8	“ 4
130	6	19	44	“6	Ret. 130	7	20	2	“ 4
Ret. 150	6	19	48	“6	150	7	19	47	“ 4
165	6	18	48	“6	165	7	18	48	“ 4
175	6	17	48	“6	175	7	17	48	“ 5
184	6	16	33	“7	185	7	16	53	“ 5
195	6	15	24	“7	195	7	15	12	“ 5
204	6	14	12	“7	204	7	14	3	“ 5
214	6	12	56	“7	214	7	12	48	“ 5
224	6	11	52	“6	224	7	11	48	“ 5
234	6	11	3	“6	234	7	11	8	“ 5
sta'y 249	6	10	15	“6	249	7	10	28	“ 5
269	6	10	25	“6	sta'y 269	7	10	47	“ 4
289	6	11	41	“5	289	7	12	12	“ 4
309	6	13	49	“5	309	7	14	36	“ 4
339	6	18	6	“5	339	7	19	25	“ 3
369	6	24	8	“5	369	7	25	26	“ 3
399	7	0	50	“4	399	8	2	5	“ 4

TABLE LX. & LXI.

JUPITER'S PARIVIRUTTI.

No. 3.					No. 4.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
30	8	8	38	— 2	30	9	11	11	+ 5
60	8	14	20	— 2	60	9	17	26	" 2
90	8	17	44	— 1	90	9	22	3	" 2
110	8	20	39	— 1	110	9	24	6	" 3
Ret. 130	8	21	31	— 1	Ret. 120	9	25	4	" 3
150	8	21	11	— 1	150	9	24	50	" 3
165	8	20	8	— 1	165	9	23	48	" 3
175	8	19	3	— 1	175	9	22	44	" 3
185	8	17	56	— 1	185	9	21	30	" 3
195	8	16	25	— 1	195	9	20	4	" 3
204	8	55	11	— 1	204	9	18	50	" 3
214	8	13.	59	— 1	214	9	17	35	" 3
224	8	13	0	— 1	224	9	16	36	" 3
234	8	12	22	— 1	234	9	15	56	" 3
sta'y 249	8	11	53	— 1	sta'y 249	9	15	28	" 3
269	8	12	21	— 1	269	9	16	0	" 3
289	8	13	15	— 1	289	9	17	40	" 3
309	8	16	27	— 1	309	9	20	17	" 3
339	8	21	34	— 0	339	9	25	33	" 3
369	8	27	52	— 0	369	10	2	0	" 3
399	9	4	42	+ 1	399	10	9	10	" 4

TABLE LXII. & LXIII.

Jupiter's Parivirutti.

No. 5.						No. 6.					
Days.	Geo. Long.			Cor.		Days.	Geo. Long.			Cor.	
	s.	°	′		′		s.	°	′		′
30	10	16	10	+	4	30	11	21	52	+	5
60	10	22	3	+	4	60	11	28	16	"	5
90	10	27	6	+	5	90	0	3	19	"	5
110	10	29	29	+	5	110	0	5	42	"	5
Ret. 130	11	0	41	"	5	130	0	7	6	"	6
150	11	0	36	"	6	Ret. 150	0	7	14	"	6
165	10	29	42	"	6	165	0	6	30	"	4
175	10	28	40	"	6	175	0	5	36	"	6
185	10	27	31	"	6	185	0	4	27	"	6
195	10	26	8	"	6	195	0	3	6	"	7
204	10	24	50	"	6	204	0	1	48	"	7
214	10	23	34	"	6	214	0	0	29	"	7
224	10	22	52	"	6	224	11	29	22	"	6
234	10	21	45	"	6	234	11	28	26	"	6
sta'y 249	10	21	12	"	6	sta'y 249	11	27	47	"	6
269	10	21	37	"	5	269	11	28	0	"	6
289	10	23	8	"	5	289	11	28	25	"	5
309	10	25	45	"	5	309	0	1	50	"	5
339	11	1	3	"	5	339	0	6	59	"	5
369	11	7	28	"	5	369	0	13	22	"	5
399	11	14	40	"	5	399	0	20	30	"	5

TABLE LXIV. & LXV.

Jupiter's Parivirutti.

No. 7.					No. 8.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	′	′		s.	°	′	′
30	0	27	41	+ 5	30	2	3	3	+ 3
60	1	4	8	+ 5	60	2	9	29	+ 3
90	1	9	24	+ 5	90	2	14	41	+ 2
110	1	11	51	" 5	110	2	17	14	+ 2
140	1	13	27	" 5	130	2	18	51	+ 2
Ret. 150	1	13	48	" 5	Ret. 150	2	19	17	+ 2
165	1	13	12	" 6	165	2	18	45	+ 2
175	1	12	25	" 6	175	2	18	3	+ 2
185	1	11	16	" 6	185	2	17	2	+ 2
195	1	10	4	" 6	195	2	15	47	+ 3
204	1	0	48	" 6	204	2	14	33	+ 3
214	1	7	52	" 6	214	2	13	10	+ 3
224	1	6	12	" 6	224	2	11	55	+ 2
239	1	5	14	" 6	234	2	10	54	+ 2
249	1	4	22	" 6	249	2	9	55	+ 2
sta'y 269	1	4	21	" 5	sta'y 269	2	9	44	+ 2
289	1	5	35	" 5	289	2	10	45	+ 2
309	1	7	50	" 4	309	2	12	47	+ 1
339	1	12	48	" 4	339	2	17	21	+ 1
369	1	19	0	" 4	369	2	24	24	+ 1
399	1	26	7	" 3	399	3	0	8	+ 1

TABLE LXVI. & LXVII.

JUPITER'S PARIVIRUTTI.

No. 9.						No. 10.					
Days.	Geo. Long.			Cor.		Days.	Geo. Long.			Cor.	
	s.	°	′		′		s.	°	′		′
30	3	7	0	+	0	30	4	9	11	—	3
60	3	13	11	"	1	60	4	15	5	—	4
90	3	18	14	"	1	90	4	19	56	—	4
110	3	20	41	—	1	110	4	22	12	"	5
130	3	22	11	"	1	130	4	23	28	"	5
Ret. 150	3	22	35	"	1	Ret. 150	4	23	42	"	5
165	3	22	0	"	2	165	4	23	4	"	5
175	3	21	18	"	2	175	4	22	14	"	5
185	3	20	17	"	2	185	4	21	14	"	6
195	3	19	42	"	2	195	4	19	59	"	6
204	3	17	51	"	2	204	4	18	41	"	6
214	3	16	28	"	2	214	4	17	25	"	6
224	3	15	14	"	2	224	4	16	16	"	6
234	3	14	11	"	2	sta'y 234	4	15	16	"	5
249	3	13	11	"	2	249	4	14	21	"	5
sta'y 269	3	12	59	"	2	269	4	14	13	"	5
289	3	13	54	"	2	289	4	15	13	"	5
309	3	15	50	"	2	309	4	17	8	"	5
339	3	20	17	"	2	339	4	21	34	"	4
369	3	26	2	"	3	369	4	27	18	"	4
399	4	2	33	"	3	399	5	3	11	"	4

TABLE LXVIII.

JUPITER'S PARIVIRUTTI.

No. 11.											
Days.	Geo. Long.			Cor.		Days.	Geo. Long.			Cor.	
	s.	°	′		′		s.	°	′		′
30	5	10	12	—	5	204	5	18	30	—	7
60	5	15	59	"	5	214	5	17	12	—	7
90	5	20	32	"	5	224	5	16	7	—	7
110	5	22	37	"	5	234	5	15	13	—	6
130	5	23	45	"	6	sta'y 249	5	14	26	—	6
Ret. 150	5	23	48	"	6	269	5	14	28	—	6
165	5	23	0	"	6	289	5	15	37	—	5
175	5	22	7	"	6	309	5	17	42	—	5
185	5	21	1	"	7	339	5	22	17	—	5
195	5	19	47	"	7	369	5	28	3	—	5
						399	6	6	31	—	5

TABLE LXIX. & LXX.

Venus' Parivirutti.

No. 1.							No. 2.						
Days.	Geo.Long			Cor.			Days.	Geo.Long			Cor.		
	s.	°	'					s.	°	'			
40	4	29	00	— 1	— 1		40	11	26	14	—0	— 0	
80	6	8	20	— 0	— 0		80	1	15	45	" ½	" 0	
110	7	15	5	— ½	— 0		110	2	22	5	" 1	" ½	
140	8	21	35	+ 1	+1½		140	3	27	31	" 1	" 1½	
160	9	15	54	" 1	" 1		160	4	20	49	" 0	" 2	
180	10	9	49	" 1	" 2		180	5	11	31	" 0	" 1	
195	10	27	12	" 0	" 2		195	6	0	44	" 0	" 0	
210	11	13	44	" 0	" 1		210	6	16	53	" 0	" 0	
220	11	24	17	" 0	" 2		220	6	27	6	" 0	" 0	
230	0	4	6	" 0	" 1½		230	7	6	40	" 0	" 0	
238	0	11	36	" 0	" 0		238	7	13	26	" 1	" 0	
246	0	17	56	— 0	— 0		246	7	19	34	" 1	" 0	
252	1	22	22	— 0	— 0		252	7	23	24	" 2	" 0	
258	1	26	0	— 0	— 0		258	7	26	20	" 2	" 0	
264	0	28	44	— 0	— 0		264	7	28	15	" 3	" 0	
Ret. 270	0	0	18	— 1	— 0		Ret. 270	7	28	55	+4	+ 1	
276	0	0	30	— 1	— 0		276	7	27	56	" 5	" 1	
282	0	28	58	— 1	— 0		282	7	25	16	" 7	" 1	
288	0	25	48	— 1	— 0		288	7	11	23	" 8	" 1½	
296	0	20	13	—1½	— 0		296	7	15	51	" 8	" 1	
302	0	16	21	—1½	— 0		302	7	12	54	" 8	" 1	
308	0	13	37	—1½	— 0		sta'y 308	7	11	22	" 7	" 1½	
sta'y 314	0	12	31	— 2	— 0		314	7	11	43	" 6	" 1½	
320	0	13	00	—1½	— 0		320	7	13	19	" 5	" 1	
326	0	14	51	—1½	— 0		326	7	16	2	" 5	" 2	
332	0	17	42	— 2	— 0		332	7	19	54	" 4	" 2	
338	0	21	29	— 2	— 0		338	7	24	24	" 3	" 2	
346	0	27	33	— 2	—1½		346	8	1	5	" 3	" 2	
354	1	4	8	— 2	—1½		354	8	8	38	" 2	" 2	
364	1	13	35	—2½	— 1		364	8	18	45	" 1	" 2½	
374	1	23	35	— 2	— 1		374	8	29	22	" 1	" 2	
389	2	9	19	—1½	— 2		389	9	15	57	" 0	" 2	
404	2	25	51	— 1	— 2		404	10	2	58	" 0	" 1	
424	3	18	45	— 0	— 1		424	10	26	12	" 0	" 0	
444	4	12	30	— 0	— 1		444	11	19	56	" 0	" 0	
474	5	18	45	— 0	— 0		474	0	26	7	—0	— 1	
504	6	25	33	— 1	— 0		504	2	2	26	" ½	" 1	
544	8	15	33	—2½	— 1		544	3	20	53	" ½	" 1	
584	10	6	18	— 0	— 1		584	5	10	21	" 0	" 0	

TABLE LXXI. & LXXII.

Venus' Parivirutti.

No. 3.						No. 4.					
Days.	Geo. Long			Cor		Days.	Geo. Long			Cor.	
	s.	°	'				s.	°	'		
40	7	0	10	+ 0	+ 0	40	2	25	14	+ 1	+ 0
80	8	19	56	" 2	" ½	80	3	7	37	" 1	+ 0
110	9	27	31	" 1	" 1½	110	5	1	58	" 0	+ 1
140	11	4	20	" 0	" 1	140	6	8	8	" 0	+ 0
160	11	28	12	" 0	" ½	160	7	1	52	" 0	+ 0
180	0	21	34	— 0	— 0	180	7	25	17	" ½	+ 0
195	1	8	38	" 0	" 0	195	8	12	6	" 1½	+ 0
210	1	24	58	" 1	" 0	210	8	27	35	" 2	+ 1
220	2	5	26	" 1	" 0	220	9	9	10	" 2	+ 1
230	2	15	6	" 2	" 0	230	9	18	12	" 2	+ 2
238	2	22	18	" 3	" 1	238	9	26	44	" 2	+ 3
246	2	28	24	" 3	" 1	246	10	3	24	" 2	+ 3
252	3	2	30	" 4	" 1½	252	10	7	54	" 2	+ 4
258	3	5	36	" 5	" 2	258	10	11	35	" 2	+ 4½
264	3	7	47	" 4	" 3	264	10	14	18	" 2	+ 5
Ret. 270	3	8	40	" 6	" 3	Ret. 270	10	15	55	" 2	+ 6
276	3	7	57	" 7	" 5	276	10	15	2	" 2	+ 8
282	3	5	32	" 8	" 7	282	10	14	25	" 2	" 8
288	3	1	45	" 8	" 8	286	10	11	17	" 2	" 8
296	2	25	54	" 8	" 8	296	10	5	42	" 1½	" 8
302	2	22	20	" 7	" 8	302	10	2	2	" 1	" 7
308	2	19	58	" 6	" 6	308	0	29	34	" 1	" 5
sta'y 314	2	19	17	" 4	" 6	sta'y 314	9	28	41	" 2	" 4½
320	2	20	7	" 3	" 5	320	9	29	26	" 1½	" 3
326	2	22	16	" 3	" 4½	326	10	1	25	" 0	" 2
332	2	25	29	" 2	" 4	332	10	4	24	" 0	" 2
338	2	29	34	" 1	" 4	338	10	8	14	" 0	" 1
346	3	5	30	" 1	" 3	346	10	14	30	" 0	" 1
354	3	12	54	" 1	" 2	354	10	21	16	" 0	" 0
364	3	22	32	" 0	" 1½	364	11	0	54	" 0	" 0
374	4	3	1	" 0	" 1	374	11	11	8	" 0	" 0
389	4	19	24	" 0	" 0	389	11	27	20	" 0	" 0
404	5	6	30	+ 0	+ 0	404	0	14	12	" 1	" 0
424	5	29	53	" 1½	" 0	424	1	7	18	" 2	" 0
444	6	23	44	" 1	" 2	444	2	0	38	" 1½	" 1
474	8	0	31	" 1½	" 1	474	3	6	0	" 1	" 1½
504	9	8	3	" 1	" 1½	504	4	12	25	" 0	" 1
544	10	27	56	" 0	" 1½	544	6	1	50	" 0	" 0
584	0	17	40	" 0	" 0	584	7	21	46	" 1	" 0

TABLE LXXIII.

Venus' Parivirutti.

No. 5.

Days.	Geo.Long s.	°	'	Cor.		Days.	Geo.Long s.	°	'	Cor.	
40	9	12	25	—0	— 1	296	5	1	27	—0	—1½
80	11	2	30	—0	— 0	302	4	28	30	—0	" 0
110	0	9	14	—0	— 0	sta'y308	4	27	7	—0	" 1
140	1	15	31	—1	— 0	314	4	27	20	—0	" ½
160	2	9	18	—2	— 0	320	4	29	21	—0	" ½
180	3	2	17	—2	— 1	326	5	1	45	—0	" 0
195	3	18	54	—2	—1½	332	5	5	30	—0	" 0
210	4	4	30	—1	— 2	338	5	9	59	—0	" 0
220	4	14	27	—1	—2½	346	5	16	18	—0	" 0
230	4	23	48	—½	— 2	354	5	23	50	—½	" 0
238	5	8	25	—½	— 2	364	6	3	43	—1	" 0
246	5	6	24	—0	— 2	374	6	14	16	—1	" 0
252	5	10	8	—0	— 2	389	7	0	48	—1	" 0
258	5	12	59	—0	— 2	404	7	18	12	—2	" 0
264	5	14	45	—0	— 2	424	8	12	6	—1	" 1½
Ret. 270	5	15	8	—0	— 2	444	9	6	26	—1	" 1½
276	5	13	58	—0	— 2	474	10	13	0	—0	" 1
282	5	11	5	—0	— 2	504	11	19	44	—0	" 0
288	5	7	4	—0	— 2	544	1	9	6	—1	" 0
						584	2	28	8	—1	" 1

TABLE LXXIV. & LXXV.

Saturn's Parivirutti.

No. 1.					No. 2.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
30	7	29	26	— 6	30	8	10	43	— 7
60	8	2	10	— 7	60	8	13	22	— 8
85	8	3	47	— 8	85	8	14	54	— 8
110	8	4	48	“ 8	110	8	15	40	— 8
Ret. 130	8	5	20	“ 8	Ret. 130	8	15	40	— 9
150	8	4	7	“ 8	150	2	15	18	— 9
165	8	3	37	“ 8	165	8	14	14	— 9
175	8	2	40	“ 8	175	8	13	35	— 9
185	8	1	58	“ 8	185	8	12	48	— 9
193	8	1	13	“ 8	193	8	12	9	— 9
203	8	0	8	“ 8	203	8	11	23	— 9
213	7	28	48	“ 8	213	8	10	47	— 9
228	7	29	2	“ 8	228	8	10	0	— 9
sta'y 248	7	28	22	“ 8	248	8	9	35	— 8
268	7	28	38	“ 7	sta'y 268	8	9	43	— 8
293	7	29	30	“ 7	293	8	10	38	— 8
318	8	1	7	“ 7	318	8	12	20	— 9
348	8	3	55	“ 7	348	8	15	6	— 8
378	8	6	20	“ 7	378	8	18	31	— 8

TABLE LXXVI. & LXXVII.

Saturn's Parivirutti.

No. 3.					No. 4.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
30	8	21	50	—8	30	9	2	57	— 8
60	8	24	29	“ 8	60	9	5	33	“ 8
85	8	25	56	“ 9	85	9	7	20	“ 8
Ret. 110	8	26	47	“ 9	110	9	7	40	“ 8
130	8	26	37	“ 9	Ret. 130	9	7	42	“ 8
150	8	26	3	“ 9	150	9	6	51	“ 8
165	8	25	8	“ 9	165	9	5	58	“ 9
175	8	24	6	“ 9	175	9	5	15	“ 9
185	8	23	37	“ 9	185	9	4	27	“ 9
193	8	22	59	“ 9	193	9	3	48	“ 9
203	8	22	14	“ 9	203	9	3	4	“ 9
213	8	21	38	“ 9	213	9	2	28	“ 9
228	8	20	56	“ 9	228	9	1	51	“ 9
sta'y 248	8	20	33	“ 9	sta'y 248	9	1	26	“ 9
268	8	20	48	“ 8	268	9	1	41	“ 9
293	8	21	30	“ 8	293	9	2	44	“ 8
318	8	23	23	“ 3	318	9	4	26	“ 8
348	8	26	12	“ 8	348	9	7	21	“ 7
378	8	29	40	“ 7	378	9	10	52	“ 7

TABLE LXXVIII. & LXXIX.

Saturn's Parivirutti.

No. 5.					No. 6.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	′	′		s.	°	′	′
30	9	14	8	— 7	30	9	25	35	— 5
60	9	16	31	“ 7	60	9	28	7	“ 5
85	9	18	8	“ 7	85	9	29	34	“ 5
Ret. 110	9	18	46	“ 7	110	9	29	59	“ 5
130	9	18	38	“ 7	Ret. 130	10	0	0	“ 5
150	9	17	53	“ 8	150	9	29	13	“ 5
165	9	16	58	“ 8	165	9	28	16	“ 5
175	9	16	14	“ 8	175	9	27	30	“ 5
185	9	15	25	“ 8	185	9	26	40	“ 5
193	9	14	47	“ 8	193	9	26	2	“ 6
203	9	14	5	“ 8	203	9	25	20	“ 6
213	9	13	28	“ 8	213	9	24	45	“ 6
228	9	12	51	“ 7	sta'y 228	9	24	9	“ 6
sta'y 248	9	12	34	“ 7	248	9	23	53	“ 6
268	9	12	51	“ 7	268	9	24	12	“ 5
293	9	13	56	“ 7	293	9	25	22	“ 4
318	9	15	44	“ 6	308	9	28	17	“ 4
348	9	18	48	“ 6	348	10	0	20	“ 4
378	9	22	14	,, 6	378	10	3	50	“ 4

TABLE LXXX. & LXXXI.

Saturn's Pariviirutti.

No. 7.							No. 8.						
Days.	Geo. Long.			Cor.			Days.	Geo. Long.			Cor.		
	s.	°	'		'			s.	°	'		'
30	10	7	18	—	4		30	10	19	32	—	1
60	10	9	56	—	3		60	10	22	13	"	1
85	10	11	25	—	3		85	10	23	42	+	1
Ret. 110	10	11	57	—	3		Ret. 110	10	24	20	"	1
130	10	11	48	—	3		130	10	24	11	"	1
150	10	11	1	—	3		150	10	23	22	"	1
165	10	9	58	—	3		165	10	22	22	"	1
175	10	9	16	—	3		175	10	21	35	"	1
185	10	0	22	—	3		185	10	20	33	"	1
193	10	7	47	—	3		193	10	20	5	"	1
203	10	6	58	—	3		203	10	19	22	"	1
213	10	6	29	—	3		213	10	18	44	"	1
228	10	5	52	—	3		228	10	18	11	"	1
sta'y 248	10	5	40	—	3		sta'y 248	10	17	58	"	1
268	10	6	3	—	2		268	10	18	22	"	1
293	10	7	25	—	3		293	10	19	40	"	1
318	10	9	12	—	3		318	10	21	58	"	1
348	10	12	21	—	2		348	10	24	56	"	1
378	10	16	4	—	2		378	10	28	44	"	1

TABLE LXXXII. & LXXXIII.

SATURN'S PARIVIRUTTI.

No. 9.					No. 10.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	′	′		s.	°	′	′
30	11	2	17	+ 2	30	11	15	37	+ 4
60	11	5	3	+ 3	60	11	18	28	+ 4
85	11	6	36	+ 3	85	11	20	8	+ 6
110	11	7	18	+ 3	Ret. 110	11	20	52	+ 6
Ret. 130	11	7	10	+ 3	130	11	20	49	+ 6
150	11	6	4	+ 3	150	11	20	3	+ 6
165	11	5	25	+ 3	165	11	19	4	+ 6
175	11	4	35	+ 3	175	11	18	17	+ 6
185	11	3	43	+ 3	185	11	17	25	+ 6
193	11	3	2	+ 3	193	11	16	44	+ 6
203	11	2	21	+ 3	203	11	16	0	+ 6
213	11	1	45	+ 3	213	11	15	21	+ 6
228	11	1	8	+ 3	228	11	14	44	+ 6
sta'y 248	11	0	55	+ 3	sta'y 248	11	14	28	+ 6
268	11	1	22	+ 3	268	11	14	52	+ 6
293	11	2	37	+ 3	293	11	16	12	+ 6
318	11	4	41	+ 4	318	11	18	16	+ 6
348	11	8	21	+ 4	348	11	21	35	+ 6
378	11	11	55	+ 4	378	11	25	19	+ 6

TABLE LXXXIV. & LXXXV.

Saturn's Pariviruttì.

No. 11.					No. 12.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
30	11	29	26	+ 6	30	0	13	36	+ 7
60	0	2	26	+ 7	60	0	16	43	" 8
85	0	4	8	+ 7	85	0	18	30	" 8
Ret. 110	0	5	1	+ 7	Ret. 110	0	9	34	" 8
130	0	5	0	+ 7	130	0	19	29	" 8
150	0	4	14	+ 8	150	0	18	52	" 9
165	0	3	20	+ 8	165	0	17	56	" 9
175	0	2	31	+ 8	175	0	17	10	" 9
185	0	1	41	+ 8	185	0	16	18	" 9
193	0	0	59	+ 8	193	0	15	36	" 9
203	0	0	12	+ 8	203	0	14	52	" 9
213	11	29	27	+ 8	213	0	14	13	" 9
228	11	28	53	+ 8	228	0	13	26	" 9
sta'y 248	11	28	36	+ 7	sta'y 248	0	13	5	" 9
268	11	28	59	+ 7	268	0	13	22	" 8
293	0	0	16	+ 7	293	0	14	38	" 8
318	0	2	21	+ 7	318	0	16	39	" 8
348	0	5	43	+ 7	348	0	19	45	" 8
378	0	9	43	+ 7	378	0	24	4	" 8

TABLE LXXXVI. & LXXXVII.

Saturn's Parivirutti.

No. 13.					No. 14.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
30	0	27	57	+ 8	30	1	12	17	+ 7
60	1	1	8	" 8	60	1	15	34	" 7
85	1	3	8	" 8	85	1	17	26	" 7
110	1	4	4	" 8	110	1	18	30	" 7
Ret. 130	1	4	9	" 9	Ret. 130	1	18	41	" 8
150	1	3	35	" 9	150	1	18	12	" 8
165	1	2	45	" 9	165	1	17	22	" 8
175	1	1	59	" 9	175	1	16	40	" 8
185	1	1	7	" 9	185	1	15	52	" 8
193	1	0	24	" 9	193	1	15	8	" 8
202	0	29	35	" 9	203	1	13	34	" 8
213	0	28	53	" 9	213	1	14	17	" 8
228	0	28	6	" 9	228	1	12	53	" 8
sta'y 248	0	27	42	" 9	sta'y 248	1	12	15	" 8
268	0	27	57	" 8	268	1	12	25	" 7
293	0	29	7	" 8	293	1	13	28	" 7
318	1	1	5	" 8	318	1	15	24	" 7
348	1	4	23	" 7	348	1	18	37	" 7
378	1	8	21	" 7	378	1	22	31	" 7

TABLE LXXXVIII. & LXXXIX.

SATURN'S PARIVIRUTTI.

No. 15.						No. 16.					
Days.	Geo. Long.			Cor.		Days.	Geo. Long.			Cor.	
	s.	°	′		′		s.	°	′		′
30	1	26	28	+	6	30	2	10	36	+	7
60	1	29	45	"	7	60	2	13	56	"	7
85	2	1	48	"	7	85	2	15	58	"	7
110	2	2	52	"	7	110	2	17	10	"	8
Ret. 130	2	3	0	"	7	Ret. 130	2	17	26	"	8
150	2	2	33	"	8	150	2	17	5	"	9
165	2	1	48	"	8	165	2	16	20	"	9
175	2	1	6	"	8	175	2	15	40	"	9
185	2	0	17	"	8	185	2	14	51	"	9
193	1	29	35	"	8	193	2	14	10	"	9
203	1	28	43	"	8	203	2	12	18	"	9
213	1	27	58	"	8	213	2	12	25	"	9
228	1	27	6	"	8	228	2	11	37	"	9
sta'y 248	1	26	34	"	7	sta'y 248	2	11	0	"	9
268	1	26	42	"	7	268	2	11	5	"	8
293	1	27	41	"	7	293	2	12	2	"	8
318	1	29	35	"	7	318	2	13	52	"	8
348	2	2	41	"	7	348	2	16	58	"	8
378	2	6	36	"	7	378	2	20	52	"	8

TABLE XC. & XCI.

Saturn's Pariviruтti.

No. 17.						No. 18.					
Days.	Geo. Long.			Cor.		Days.	Geo. Long.			Cor.	
	s.	°	'		'		s.	°	'		'
30	2	24	52	+	8	30	3	9	16	+	8
60	2	28	18	"	8	60	3	12	44	"	8
85	3	0	24	"	8	85	3	14	50	"	8
110	3	1	40	"	8	110	3	16	12	"	8
Ret. 130	3	2	2	"	9	Ret. 130	3	16	47	"	8
150	3	1	44	"	9	150	3	16	22	"	9
165	3	1	0	"	9	165	3	15	43	"	9
175	3	8	24	"	9	175	3	15	7	"	9
185	2	29	40	"	9	185	3	14	22	"	9
193	2	28	56	"	9	193	3	13	41	"	9
203	2	28	3	"	9	203	3	12	48	"	9
213	2	27	15	"	9	213	3	11	59	"	9
228	2	26	17	"	9	228	3	11	0	"	9
248	2	25	38	"	9	248	3	10	13	"	8
sta'y 268	2	25	37	"	9	sta'y 278	3	10	7	"	8
293	2	26	32	"	8	293	3	10	59	"	8
318	2	28	17	"	8	318	3	12	41	"	7
348	3	1	20	"	8	348	3	15	38	"	7
378	3	5	12	"	7	378	3	18	25	"	6

TABLE XCII. & XCIII.

SATURN'S PARIVIRUTTI.

No. 19.					No. 20.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	′	′		s.	°	′	′
30	3	23	27	+ 6	30	4	0	17	+ 4
60	3	26	54	" 6	60	4	10	44	" 4
85	3	29	2	" 6	85	4	12	53	" 4
110	4	0	27	" 6	110	4	14	17	" 4
Ret. 130	4	0	54	" 7	Ret. 130	4	14	45	" 4
150	4	0	45	" 7	150	4	14	36	" 4
165	4	0	10	" 7	165	4	14	4	" 4
175	3	29	32	" 7	175	4	13	28	" 4
185	3	28	49	" 7	185	4	12	46	" 4
193	3	28	10	" 7	193	4	12	8	" 4
203	3	27	17	" 7	203	4	11	13	" 4
213	3	26	26	" 7	213	4	10	26	" 4
228	3	25	25	" 7	228	4	9	23	" 4
248	3	24	36	" 7	248	4	8	32	" 4
sta'y 268	3	24	18	" 7	sta'y 268	4	8	21	" 4
293	3	25	12	" 6	293	4	8	59	" 4
318	3	26	27	" 6	308	4	10	30	" 4
348	3	29	39	" 5	348	4	13	15	" 4
378	4	3	20	" 5	378	4	16	47	" 3

TABLE XCIV. & XCV.

SATURN'S PARIVIRUTTI.

No. 21.							No. 22.						
Days.	Geo. Long.			Cor.			Days.	Geo. Long.			Cor.	
	s.	°	′		′			s.	°	′		′
30	4	20	52	+	2		30	5	3	30	—	1
60	4	24	1	"	2		60	5	6	45	—	1
85	4	26	8	"	2		85	5	8	48	"	2
110	4	27	31	"	2		110	5	10	7	"	2
Ret. 130	4	27	51	"	2		130	5	10	35	"	2
150	4	27	53	"	2		Ret. 150	5	10	26	"	2
165	4	27	22	"	2		165	5	9	56	"	2
175	4	26	46	"	2		175	5	9	20	"	2
185	4	26	8	"	2		185	5	8	42	"	2
193	4	25	31	"	2		193	5	8	6	"	2
203	4	24	33	"	2		203	5	7	14	"	2
213	4	23	47	"	2		213	5	6	26	"	2
228	4	22	44	"	2		228	5	5	23	"	2
248	4	22	51	"	2		248	5	4	30	"	2
sta'y 268	4	21	35	"	2		sta'y 268	5	4	16	"	2
293	4	22	12	"	2		293	5	4	45	"	2
318	4	23	37	"	1		318	5	6	10	"	2
348	4	26	16	"	1		348	5	8	44	"	2
378	4	29	44	"	1		378	5	12	6	"	2

TABLE XCVI. & XCVII.

Saturn's Parivirutti.

No. 23.					No. 24.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	′	′		s.	°	′	′
30	5	15	46	—2	30	5	27	37	— 5
60	5	18	55	" 4	60	6	0	45	" 5
85	5	20	56	" 4	85	6	2	34	" 6
110	5	22	12	" 4	110	6	3	56	" 6
Ret. 130	5	22	36	" 4	Ret. 130	6	4	9	" 7
150	5	22	26	" 4	150	6	3	57	" 7
165	5	21	50	" 4	165	6	3	22	" 7
175	5	21	20	" 4	175	6	2	51	" 7
185	5	20	40	" 4	185	6	2	8	" 7
193	5	20	4	" 4	193	6	1	31	" 7
203	5	19	14	" 4	203	6	0	42	" 7
213	5	18	26	" 4	213	5	29	53	" 7
228	5	17	25	" 4	228	5	28	58	" 7
sta'y 248	5	16	33	" 4	248	5	28	17	" 7
268	5	16	18	" 4	sta'y 268	5	27	54	" 7
293	5	16	50	" 4	293	5	28	25	" 6
318	5	18	12	" 4	318	5	29	45	" 6
348	5	20	42	" 4	348	6	2	15	" 6
378	5	24	0	" 4	378	6	5	32	" 6

TABLE XCVIII. & XCIX.

Saturn's Parivirutti.

No. 25.					No. 26.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	'	'		s.	°	'	'
30	6	9	2	— 6	30	6	20	17	— 8
60	6	12	0	— 7	60	6	23	12	— 8
85	6	13	52	— 7	85	6	24	59	— 8
110	6	15	1	— 8	110	6	26	5	— 8
Ret. 130	6	15	20	— 8	Ret. 130	6	26	20	— 9
150	6	15	7	— 8	150	6	26	2	— 9
165	6	14	29	— 8	165	6	25	21	— 9
175	6	13	56	— 8	175	6	24	51	— 9
185	6	13	16	— 8	185	6	24	8	— 9
193	6	12	38	— 8	193	6	23	30	— 9
203	6	11	48	— 8	203	6	22	38	— 9
213	6	11	0	— 8	213	6	21	56	— 9
228	6	10	6	— 8	228	6	21	3	— 9
248	6	9	19	— 8	248	6	20	20	— 9
sta'y 268	6	9	10	— 8	sta'y 268	6	20	10	— 9
293	6	9	32	— 7	293	6	20	47	— 8
318	6	11	2	— 7	318	6	22	8	— 8
348	6	13	33	— 7	348	6	24	42	— 8
378	6	16	48	— 7	378	6	27	57	— 8

TABLE C. & CI.

SATURN'S PARIVIRUTTI.

No. 27.					No. 28.				
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	′	′		s.	°	′	′
30	7	1	15	—8	30	7	12	26	— 7
60	7	4	17	“ 8	60	7	15	23	“ 8
85	7	6	1	“ 8	85	7	17	5	“ 8
110	7	7	2	“ 8	110	7	18	5	“ 8
Ret. 130	7	7	15	“ 9	Ret. 130	7	18	17	“ 8
150	7	6	56	“ 9	150	7	17	51	“ 8
165	7	6	15	“ 9	165	7	17	11	“ 9
175	7	5	38	“ 9	175	7	16	32	“ 9
185	7	4	56	“ 9	185	7	15	49	“ 9
193	7	4	18	“ 9	193	7	15	10	“ 9
203	7	3	30	“ 9	203	7	14	22	“ 9
213	7	2	47	“ 9	213	7	13	41	“ 9
228	7	1	52	“ 9	228	7	12	58	“ 9
248	7	1	11	“ 9	248	7	12	20	“ 8
sta'y 268	7	1	5	“ 8	sta'y 268	7	12	8	“ 8
293	7	1	44	“ 8	293	7	12	51	“ 8
318	7	3	13	“ 8	318	7	14	19	“ 8
348	7	5	47	“ 8	348	7	16	59	“ 8
378	7	9	5	“ 7	378	7	20	22	“ 8

TABLE CII.

SATURN'S PARIVIRUTTI.

No. 29.									
Days.	Geo. Long.			Cor.	Days.	Geo. Long.			Cor.
	s.	°	′	′		s.	°	′	′
30	7	23	48	— 8	193	7	26	12	— 8
60	7	26	40	— 8	203	7	25	24	— 8
85	7	28	20	— 8	213	7	24	42	— 8
110	7	29	18	— 8	228	7	23	52	— 8
Ret. 130	7	29	25	— 8	sta'y 248	7	23	16	— 8
150	7	28	59	— 8	268	7	23	25	— 8
165	7	28	16	— 8	293	7	23	59	— 7
175	7	27	35	— 8	318	7	25	36	— 7
185	7	26	52	— 8	348	7	28	20	— 7
					378	8	1	42	— 7

APPENDIX:

CONTAINING

I. SOME USEFUL PROBLEMS.

II. A GLOSSARY OF THE TERMS OCCURRING IN THIS VOLUME.

PROBLEMS.

Problem I. To find the time of the sun's apparent rising and setting; the latitude of the place and the declination of the sun being given.

If d be equal to the refraction *minus* the parallax, and

$$k = \frac{co.\ lat. + co.\ dec. + (90^\circ + d),}{2}$$ then the value of the hour angle (h) (which is the interval between apparent noon and the time of the apparent rising or setting,) is derived from the following formula:

$$\sin.^2\ \tfrac{1}{2}h = \frac{\sin.\ (k - co.\ lat.)\ \sin.\ (k - co.\ dec.)}{\sin.\ (co.\ lat.)\ \sin.\ (co.\ dec.)}$$

Problem II. To ascertain the time of the moon's passage over the meridian of a given place, by the help of the Nautical Almanac.

The Nautical Almanac gives the time of the moon's passage over the meridian of Greenwich for every day of the year. Take the difference between the meridian passage for the given day and that for the preceding day. Then say,—as $24h.$: this difference :: the difference of longitude between Greenwich and the given place : a fourth term. This fourth term being subtracted from the time of the meridian passage at Greenwich, for the given day, the remainder will be the approximate time of the meridian passage on the same day at the given place. The fourth term of the preceding proportion may be corrected, and a more exact result obtained, by the proportion: as $24h.$: $24h. +$ diffvrence above mentioned :: fourth term obtained : the same corrected.

Problem III. To find the apparent time of the moon's rising or setting on any given day.

Compute the moon's semi-diurnal arc by the formula in Problem I.

If the time of rising is required, subtract the semi-diurnal arc from the time of the meridian passage. If the time of setting is required, add it to the same. The remainder or sum is the approximate time of rising or setting. With the declination corresponding to this approximate time, calculate again the semi-diurnal arc, and correct it by the following proportion; $24h.$+increase of meridian passage (=time of meridian passage for the given day subtracted from that of the following day) : semi-diurnal arc last found :: increase of meridian passage : correction.

Add this correction to the semi-diurnal arc, and apply the sum to the time of the meridian passage, as before directed; the result will be the time of the moon's rising or setting, very nearly.

Note. From new to full moon, or between conjunction and opposition, the moon's setting is required; and from the full to the change, her rising is required.

Problem IV. To find the geocentric longitude of a planet; the heliocentric longitude and latitude, and the radius vectors of the planet and the earth, being given,—

If A=Annual parallax, E=Elongation, and Tang. of $T = P\text{'s } \frac{\text{Rad. vector} \times \cos.\ \text{lat.}}{\odot\text{'s Rad. vector}}$, then $\tan.\ \frac{1}{2}(A-E) = (45^\circ - T) \times \tan.\ \frac{1}{2}(A+E.)$ But $A+E = 180^\circ$—commutation. Therefore the Geo. long., which equals $E+\odot$'s long., may be easily determined.

Problem V. The moon's equatorial parallax and the latitude of a place being given, to find the reduced parallax, and the reduced distance of the place from the north pole.

With the latitude of the place take the reductions from the following table, and subtract them from the parallax and latitude. The remainders are the reduced parallax and latitude. For the reduced polar distance, subtract the reduced latitude from 90°, when it is north; but when it is south, add it to 90°.

Table for the reduction of Parallax and Latitude.

Lat.	Redn. of Parx.	Redn. of Lat.		Lat.	Redn. of Parx.	Redn. of Lat.	
°	"	'	"	°	"	'	"
3	0.0	1	11.8	51	6.7	11	14.1
6	0.1	2	22.7	54	7.2	10	55.7
9	0.3	3	32.1	57	7.8	10	30.0
12	0.5	4	39.3	60	8.3	9	57.4
15	0.7	5	43.4	63	8.8	9	18.3
18	1.0	6	43.7	66	9.2	8	32.9
21	1.4	7	39.7	69	9.7	7	42.0
24	1.8	8	30.7	72	10.0	6	49.9
27	2.3	9	16.1	75	10.3	5	45.4
30	2.7	9	55.4	78	10.6	4	41.0
33	3.3	10	28.3	81	10.8	3	33.5
36	3.8	10	54.3	84	11.0	2	23.7
39	4.4	11	13.2	87	11.1	1	12.3
42	4.9	11	24.7	90	11.1	0	0.0
45	5.5	11	28.7				
48	6.1	11	25.2				

PROBLEM VI. To find the longitude and altitude of the nonagesimal degree of the ecliptic, for a given time and place.

The longitude and altitude of the nonagesimal degree may be computed from the following formulae:—

$\log.\ \cos.\ \frac{1}{2}(h-o) - \log.\ \cos.\ \frac{1}{2}(h+o) = A$

$\log.\ \tan.\ \frac{1}{2}(h-o) + 10 - \log.\ \tan.\ \frac{1}{2}(h+o) = B$

$\log.\ \tan.\ E = A + \log.\ \tan.\ \frac{1}{2}(S - 90^\circ)$

$\log.\ \tan.\ F = \log.\ \tan.\ E + B$

$N = E + F + 90^\circ$

$\log.\ \tan.\ \frac{1}{2}a = \log.\ \cos.\ E + \log.\ \tan.\ \frac{1}{2}(h+o) + \text{ar. co. log. cos. } F - 20$; in which,

h=the reduced distance of the place from the north pole–obtanined as directed in Problem 5.

o=the obliquity of the ecliptic;

S=the siderial time converted into degrees;

N=the longitude of the nonagesimal;

a=the altitude of the nonagesimal.

E and F are auxiliary angles, which are to be taken less than 180°; and less or greater than 90°, according as the sign of their tangent proves to be positive or negative.

PROBLEM VII. To find the moon's parallax in longitude and latitude, and her augmented semi-diameter; the moon's true longitude, latitude, horizontal semi-diameter, and the reduced equatorial parallax, and the longitude and altitude of the nonagesimal degree of the ecliptic, being given.

We have for the resolution of this problem the following formulae:—

log. x=log. D+log. cos. h+ar. co. log. cos. L–10; (1)

c=log. x+log. tan. h–10; (2)

log. w=c+log. sin. k–10; (3)

log. w'=c+log. sin. $(k+w)$–10; (4)

log. P=c+log. sin. $(k+w')$–10; (5)

log. tan. l=log. P+ar. co. log. cos. L+ar. co. log. w +log. sin.$(L-x)$–10; (6)

log. v=log. D+log. cos. h+log. cos. l–10; (7)

log. z.=log. v+log. tan. h+log. tan. l+log. cos. $(k+\frac{1}{2}P)$ –30; (8)

$p=v-z$; (9)

log. r=log. P+ar.. co. log. cos. L+ar. co. log. w+log, cos. l+log. R–10; (10); in which,

D=the reduced equatorial parallax of the moon obtained as in Problem 5.

h=the altitude of the nonagesimal.

L=the true latitude of the moon.

k=the long. of the moon –long. of the nonagesimal.

P=the required parallax in longitude.

l=the approximate apparent latitude of the moon.

p=the required parallax in latitude.

R=the true semi-diameter of the moon.

r=the augmented semi-diameter of the moon.

x, w, w', v, z are auxiliary arcs.

PROBLEM VIII. To construct the Hindu Trigonometrical Table, or Table of Natural sines, called by the Tamulians, *Mula Jya Vakya*.

The precept in the *Surya Sidhanta* for the construction of this table, is as follows:—

"Divide, by 8, the number of minutes contained in a sign=1800; the quotient=252′, is the first *Mula Jya*, (natural sine) or the first of the 24 portions of half the string of the bow, (half the chord of the double arc.) Divide the first *Mula Jya* by 233.506; then subtract the quotient from the 225′, just found, and add the remainder to the first *Mula Jya*, to form the 2d *Mula Jya*=449· Divide this 2d quantity by 233.506, the quotient will be more than $1\frac{1}{2}$; subtract 2′ from the preceding remainder 224′, and add the remainder thus found to the 2d *Mula Jya*, to form the 3d *Mula Jya*=671. Divide this number by 233.506; subtract the quotient=3′, from the last remainder=221′. Add this remainder=219, to the 3d *Mula Jya*, to form the 4th *Mula Jya*=890; and thus continue till you have completed the 24 *Mula Jyas*.

This method is founded upon the following principle:—The second difference of sin. A, or d^2 sin. $A = 4\sin.^2\left(\frac{dA}{2}\right)$ sin. $A = -(\text{chord } A)^2$ sin. A.

In this case $dA = 3^\circ\ 45'$, $\frac{1}{2}dA = 1^\circ\ 52'\ 30''$; and $4\sin.^2 \frac{dA}{2} = 0.00428255 = \frac{1}{233.506}$.

Mula Jya Vakya.

Arcs.		Indian sines.	Modern sines.	Arcs.		Indian sines.	Modern sines.
°	′	′	′	°	′	′	′
0	0	000	000.00	48	45	2585	2584.64
3	45	225	224.85	52	30	2728	2727.35
7	30	449	448.75	56	15	2859	2858.38
11	15	671	670.71	60	0	2978	2977.18
15	0	890	889.81	63	45	3084	3083.28
18	45	1105	1105.02	67	30	3177	3176.06
22	30	1315	1315.57	71	15	3256	3255.31
26	15	1520	1520.48	75	0	3321	3320.68
30	0	1719	1718.87	78	45	3372	3371.69
33	45	1910	1909.91	82	30	3409	3408.44
37	30	2093	2092.77	86	15	3431	3430.38
41	15	2267	2266.66	90	0	3438	3437.75
45	0	2431	2431.08				

The modern sines are here given in a parallel column for the purpose of comparison; from which it will be seen that the Hindu sines, with a few and trifling exceptions, are correct.

A commentator on the *Surya Sidhanta* adds, "the square of the *Mula Jya* (sine) subtracted from the square of the *Trijya* (radius), gives the square of the *Kodijya* (cosine.) Take the *Trijya*=3438′, and containing 24 *Mula Jyas*, its half is the *Mula Jya* of 30°=1719′, which is the 8th *Mula Jya* or 16th *Kodijya*. Multiply, by 3, the square of the *Trijya*, and divide the product by 4; the square root of the quotient is the *Mula Jya* of 2 signs, or 2977′; the square root of half the square of the *Trijya* is the *Mula Jya* of 45°=2431′; which number subtracted from the *Trijya*, leaves the *Utkramajya* (versed sine)=1007. Multiply the *Trijya* by this *Utkramajya*, the square root of half the product is the *Mula Jya* of 22° 30′. Subtract the square of this number from the square of the *Trijya*, the square root of the difference is the *Mula Jya* of 67° 30′,=3177, which is the *Kodi Jya* of 22° 30′, whose *Mula Jya*=1315. This *Mula Jya* and *Kodi Jya* being each subtracted from the radius, leaves the *Utkrama Jya* of each; that is 261′ for 22° 30′; and 2123 for 67° 30′."

From this passage it results clearly, that the Hindus were acquainted with the formulae which follow:

$$R^2 = \sin.^2 A + \cos.^2 A,$$

$$\sin. 30^\circ = \frac{R}{2},$$

$$\sin. \frac{A}{2} = \sqrt{\left(\frac{R \times \text{ver.sin.}A}{2}\right)}$$

$$\sin. 60^\circ = \sqrt{\tfrac{3}{2}} \times R,$$

$$\sin. 45^\circ = \sqrt{\frac{R^2}{2}}.$$

PROBLEM IX. To calculate the transit of the planets in the Hindu zodiac from one constellation to another, by the aid of the N. Almanac.

RULE. In the column of apparent Right ascension, as given for the planets in the Nautical Almanac, seek for the number that is equal to, or next less than what is given in the following table. When it is equal to the tabular number, the day of the month thus taken from the Nautical Almanac, will be the time of the transit for the corresponding sign given in the table. If the numbers be not equal, take the day that stands against the next less number in the Almanac, and apply the proportionate difference to the number of days taken from the Almanac.

TABLE

Giving the Right Ascension in the European sphere corresponding to the beginning of each sign of longitude in the Hindu sphere. It was calculated for 1846.

Transits.	Right Ascension.	Transits.	Right Ascension.
	h. m. s.		h. m. s.
Aries	1 18 30	Libra	13 18 30
Taurus	3 10 7	Scorpio	15 10 7
Geminii	5 9 45	Sagittarius	17 9 45
Cancer	7 18 30	Capricornus	19 18 30
Leo	9 27 15	Aquarius	21 27 15
Virgo	11 26 53	Pisces	23 26 53

Note. The time of the transit thus obtained should be reduced to the place required. For Batticotta Seminary this is done by adding 5h. 20m. 30s.

Problem X. To calculate the transits of the moon from one *Nacshastra* to another.

This problem may be solved in the same manner as the last, by the aid of the following table.

TABLE

Giving the Right Ascension in the European sphere corresponding to the beginning of each *Nacshastra* or Lunar Mansion, in the Hindu sphere. The difference of spheres is assumed=21° 19′ and the obliquity=23° 27′ 32″.

Transits	Right ascen.	Transits.	Right ascen.
	h. m s		h m. s.
Asupathi	1 18 46	Sothi	13 43 56
Parani	2 9 31	Viyakam	14 35 32
Kartikei	3 2 4	Anudam	15 29 49
Rokani [dam	3 56 45	Keddei	16 24 51
Mirukaseeri-	4 53 22	Mulam	17 22 11
Tiruvathirei	5 51 20	Puradam	18 20 14
Punarpusam	6 49 14	Uttiradam	19 17 57
Pusam	7 46 18	Tiruvonam	20 14 13
Ayiliam	8 41 37	Aviddam	21 8 29
Makam	9 34 49	Sathayam	22 0 39
Puram	10 26 2	Purattathi	22 51 9
Uttiram	11 15 48	Uttiraddathi	23 40 22
Attam	12 4 50	Repathi	0 29 19
Sittirei	12 53 56		

NOTE. The time from the Nautical Almanac should be reduced to the place, as in the preceding problem.

PROBLEM XI. To calculate the *Tithis*.

Tithis may be easily determined by the lunar distances from the sun, as given in pages XIII. to XVIII. for each month, in the Nautical Almanac. When the distances are not recorded, take the longitude of the moon by applying the equation of 2d difference, and subtract from it the longitude of the sun. The difference will be the longitude of the *Tithi* for the day.

NOTE. A *Tithi* is a *lunar* day, consisting of the time occupied by the moon in passing on 12° of longitude from the sun.

GLOSSARY

OF

HINDU ASTRONOMICAL TERMS.

அ.

அக்கரராசிகம்—*Akkararasikam*; A constant quantity in Mathematics.

அங்குலம்—*Angkulam*; 1. Finger's breadth; ¾ of an inch; 2. Digit,-one twelfth part of the gnomon, or of any dimension.

அட்சம் or அக்ஷம்—*Adcham or Aksham*; Terrestrial latitude.

அதிசாரம்—*Athisaram*; The passage of a planet through a zodiacal sign in less than the mean time.

அத்தமனம்—*Attamanam*; Heliacal setting of a planet, or immersion.

அநுவக்கிரம்—*Anuvakkiram*; The transit of a planet, in retrogradation, into the preceding sign.

அநுவக்கிரஇஷ்டம்—*Anuvakkira ishda*; The quantity expressed by இஷ்டம் (*Ishda*)—30°.

அந்தரம்—*Antaram*; 1. Difference; 2. Period of time.

அந்தரஆண்டு—*Antara Andu*; Period of time between any given epochs.

அந்தர மத்திம புத்தி—*Antara-mattima-putti*; Difference between the mean and true daily motion.

அந்தரித்தல்—*Antarittal*; To find the difference between two quantities.

அபரவாக்கியம்—*Aparavakyam*; The second of two successive *Vakyas* taken from a table.

அபரானம்—*Aparanam*; Afternoon.

அமாவாசை—*Amavasei*; New moon; conjunction.

அயனம்—*Ayanam*; 1. Equinoctial points. 2. Solstitial points.

அயனஆண்டு—*Ayanaandu*; The year reckoned from the true equinoxes.

அயனகாலம்—*Ayanakalam*; The time of the commencement of the year and months, according to the tropical zodiac. This is commonly called அயனப்பிறப்பு.

அயனசலனம்—*Ayana Salanam*; 1. Amount of *precession of the equinoxes* at any given time. 2. The precession from any given epoch. 3. Difference between the fixed and moveable zodiacs.

அயனபுடம்—*Ayanapudam;* 1. The precession of the equinoxes. 2. Difference between the fixed and moveable zodiacs.

அரித்தல்—*Arittal;* To divide.

அருக்கன்—*Arukkan;* 1. The sun. 2. Aphelion distance.

அருக்கவிக்கேபம்—*Arukka vikkepam;* } Moon's parallax in
அவனதி—*Avanathi;* } latitude.

அலகு—*Alaku;* Unit.

அவர்க்கம்—*Avatkam;* See வர்க்கம், *Valkam.*

அற்றைவாக்கியம்—*Atteivakyam,* The moon's tabular longitude, 248 of which are registered in the *Panchanka Vakya.* It is always to be added to *Mathi Druvam.*

ஆ.

ஆதிஅந்தகாலம்—*Athiantakalam;* } The full duration of
ஆதிஅந்தகாலநாடி—*Athiantakalanadi;* } an eclipse, expressed in *Nalikei, Vinalikei,* &c.

இ.

இஷ்டம்—*Ishdam;* The longitudinal difference between *Druvam* and the end of a given sign.

இஷ்டலக்கினம்—*Ishdalakkinam;* Right ascension of the midheavens, as reckoned from the first point of Aries in the fixed zodiac.

இந்து—*Intu;* The moon.

இரவி—*Ravi;* The sun.

இரவிதேகம்—*Ravi-tekam;* 1. Sun's disk. 2. Apparent semi-diameter of the sun.

இரவிகேந்திரம்—*Ravi-kentiram;* Sun's anomaly.

இராகு—*Raku;* 1. The ascending node. 2. The earth's shadow in lunar eclipses, the same as இராகுதேகம், *Raku-tekam.*

இராசி—*Rasi;* A zodiacal sign.

இருணம்—*Irunam;* Minus, subtractive.

இலக்காந்தரம்-*Lakkantaram;* The number of days between any two tabular numbers in the *Parivirutti.*

இலக்கினம்—*Lakkinam;* 1. The arc of the equator which passes the horizon the same time with each sign of the ecliptic. 2. The right ascension of the rising point.

மத்திமஇலக்கினம்—*Mattima Lakkinam; Lanka*, or the first meridian.

இலக்கினவிக்கேபம்—*Lakkina vikkepam;* Lunar parallax in latitude.

இலம்பனம்—*Lampanam;* } Parallax of moon's longitude.
இலம்பிதம்—*Lampitham;* }

இலம்பனபருவாந்தம்—*Lampana paruvantam;* The apparent time of conjunction.

இலம்பனசந்திரன்—*Lampana Santiran;* Moon's apparent longitude.

இலம்பன சந்திர விக்கேபம்—*Lampana Santira vikkepam*; Moon's latitude corrected for time of conjunction.

இலம்பித அருக்கன்—*Lampitha arukkan*; Longitude of the nonagesimal point.

இலம்பித சா—*Lampitha Jya*; Table of equations for the moon's parallaxes in longitude.

இலம்பிதசாபலம்—*Lampitha Jyapalam*; An equation from the table of the moon's parallax.

ஈ.

ஈதல்—*To divide.*

உ.

உதயம்—*Uthayam*; Emersion, or the heliacal rising of a planet.

உத்தரம்—*Uttaram*; North, northern; higher (as apsis.)

உத்தராயணம்—*Uttarayanam*; Northern solstitial point.

உள்ளமுடையான்—*Ullamudeian*; The translator of the leading system in this volume, into Tamil.

உவாந்தம்—*Uvantam*; } 1. New moon, conjunction.
உவா—*Uva*; } 2. Full moon or opposition.

உற்கிரமச்சா—*Utkirama Jya*; Versed sine.

ஏ.

ஏறிடுதல்; To reduce to a higher denomination.

ஏற்றல்; 1. To multiply. 2. To add.

ஓ.

ஓரை—*Orei*; 1. Sign=30°. 2. An hour.

க.

கக்ஷம்—*Kaksham*; The deferent, or circle which carries the epicycle.

கடிகை—*Kadikei*; The same as *Nalikei*, an Indian hour, of 24 minutes.

கணிதர்—*Kanithar*; 1. Astronomers. 2. Astrologers.

கதபரிவிருத்தி—*Katha parivirutti*; This term expresses the number of synodic revolutions of the planets, completed after the commencement of the *Parivirutti*.

கதிர்நடு—*Kathirnadu*; Sun's mean longitude.

கர்க்கிச்சா—*Katki Jya*; For the superior planets, the parallactic equation of the orbit, for 6 signs from Cancer. For the inferior planets, it is the equation of the elongation for the same.

கலீகரித்தல்—To reduce to *Kaleis*, or minutes.

கலியுகம்—*Kali yuga*; The last of the four great ages of the world. The current *Cali yuga* commenced B C. 3101.

கலை—*Kalei;* Minute of a degree; one sixtieth of a பாகை.

கன்னம்—*Kannam; (Karna* Sans.) 1. The hypothenuse of a right angled triangle. 2. The true distance of a planet from the earth; Radius Vector.

கா.

காறகன்—*Karakan;* Sun's longitude in the fixed zodiac corrected for *Lampanam.*

கி.

கிரகணம்—*Kirakanam;* } An eclipse.
கிராணம்—*Kiranam;* }

சூரியகிரகணம்—*Surya kirakanam;* Solar eclipse.

சந்திரகிரகணம்—*Santira kirakanam;* Lunar eclipse.

கிராந்தி—*Kiranti;* Declination.

கிராந்திமண்டலம்—*Kiranti Mandalam;* Ecliptic.

கிருசாங்குலம்—*Kirasankulam;* The number of digits (ankulam) eclipsed.

கே.

கேது—*Kethu;* Descending node.

கேந்திரம்—*Kentiram;* 1. Anomaly. 2. Argument of an equation.

மந்தகேந்திரம்—*Mantakentiram;* Argument of anomaly.

இரவிகேந்திரம்—*Ravikentiram;* Sun's anomaly.

மதிகேந்திரம்—*Mathikentiram;* Moon's anomaly.

கோ.

கோடி—*Kodi;* The second or fourth quadrant of a circle; complement.

கோடிச்சா—*Kodi Jya;* Cosine.

கோபோனஇலக்கினம்—*Kopona Lakkinam;* Right ascension of midheavens, as reckoned from the vernal equinox.

ச.

சகாத்தம்—*Sakattam;* The current year of the era *Salivakana.*

சங்கிரமம்—*Sankiramam;* Sun's transit to a sign; end of the month.

சங்கிரமத்துருவம்—*Sankirama Druvam;* The fractional part of a week, at which the new year commences.

சங்கிராந்தி—*Sankiranti;* The instant of the sun's passing from one sign to another; end of the month.

சசித்துருவம்—*Sasi Druvam;* See மதித்துருவம்.

சசிதேகம்—*Sasitekam;* 1. Moon's disk. 2. Apparent semi-diameter of Moon.

சசிகேந்திரம்—*Sasikenthiram;* Moon's anomaly.

சசிப்புடம்—*Sasippudam;* } Longitude of moon.
சந்திரப்புடம்—*Santirappudam;* }

சந்திரமண்டலம்—*Santira mandalam*; } Moon's apparent
சந்திரவிம்பம்—*Santira vimpam*; } diameter.

சமசந்திரன்—*Sama Santiran*; } Moon's true longitude at
சமதிங்கள்—*Sama Tinkal*; } the middle of an eclipse.

சமரவி—*Sama Ravi*; Sun's true longitude at the middle of an eclipse.

சம்பற்கம்—*Sampalkam*; 1. In solar eclipses, the sum of the apparent diameters of the sun and moon. 2. In lunar eclipses, the sum of the apparent diameters of the moon, and of the earth's shadow.

சம்பற்கார்த்தம்—*Sampalkarttam*; 1. In solar eclipses, the sum of the apparent semi-diameters of the sun and moon. 2. In lunar eclipses, the sum of the apparent semi-diameters of moon and of the earth's shadow.

சயந்தமாலை—*Sayantamalei*; The name of the first system of eclipses given in this work.

சரகண்டம்—*Sarakandam*; Ascensional difference.

சரசா—*Sara Jya*; Sine of Ascensional difference.

சரம்=சரதலம்—*Saram*=*Sarathalam*; Ascensional difference.

சரார்த்தாதி—*Sararttathi*; The sum of three corrections, viz; ascensional difference, allowance for difference of longitude, and equation of time.

சரவினாடி—*Saravinadi*; Ascensional difference in time.

சர்ப்பாகாரம் — *Sarppakaram*; Different denominations of numbers, written one under another in a column, (correlative of தண்டாகாரம், *Tandakaram*)

சவுரம்—*Savuram*; Solar.

சன்னலித்தி=புடநதி—*Sinnalitti*=*Pudanathi*; True distance of the centres of the sun and moon.

சா.

சா—*Jya*; 1. Natural sine 2. A quantity from certain equation tables, as from *Manta Jya*, &c.

சாசங்காரம்பண்ணுதல் } To take out the equation from
சாசங்கரித்தல் } *Jya Vakya*.

சாத்திய—*Sattia*; Rectangular.

சாத்தியத்திரிபுசம்—*Sattiatiripusam*; Right angled triangle.

சாபலம்—*Jyapalam*; Equation to the centre, for any given time.

சாமண்டலம்—*Samandalam*; A revolution reckoned from apogee.

சாயனஅயனஇலக்கினம்—*Syana Ayana Lakkinam*; The oblique ascension of the point of the ecliptic rising.

சாயனம்—*Sayanam*; Celestial longitude. Any longitudinal quantity reckoned from the equinox.

சாயாவிம்பம்—*Sayavimpam*; Apparent diameter of the earth's shadow.

சி.

சித்திலுத்தை—*Sittiluttei*; Parallax of the moon in latitude.

சீ.

சீக்கிரகேந்திரம்—*Sikkirakentiram*; Angle of commutation.
சீக்கிரம்—*Sikkiram*; 1. Annual parallax. 2. Elongation.
சீக்கிரார்த்தம் } *Sikkirarttam*; The first equated geocentric
சீக்கிரவரை } longitude.

சு.

சுத்த—*Sutta*; True; corrected.
சுத்தசந்திரன்—*Sutta Santiran*; True longitude of the moon.
சுத்ததினம்—*Sutta Tinam*; The days passed in *Cali Yuga*, at any given time.
சுத்தபுடம்—*Sutta Pudam*; True longitude.
சுத்தம்பண்ணுதல்; To equate, to correct a quantity in Astronomy.
சுபாவசாரம்—*Supavasaram*; Direct motion of a planet.
சுன்—*Sun*; A cypher.

சூ.

சூரிய கதி=வெய்யோன் கதி-*Suryakathi*=*Veyyonkathi*; Daily motion of the sun.
சூரியமண்டலம் } *Suryamandalam*; } Sun's apparent diame-
சூரியவிம்பம் } *suryavimpam*; } ter.

சை.

சையோகதேலம்—*Seiyoga telam*; Sum of the semi-diameters of the sun and moon.
சையோகதேலவர்க்கம்—*Seiyogatelavatkam*; Square of the preceding number,

சோ.

சோதிசாத்திரம்—*Sothi Sastra*; Astronomy.
சோத்தியம்—*Sotliam*; A period of days, &c. which contain complete synodic revolutions of the several planets.
சோமகதி—*Somakathi*; The moon's daily motion.

சௌ.

சௌர } ஆண்டு—*Savura Aadu*; Solar year.
சவுர }

ஞா.

ஞான்—*Nyan*; 1. The chord of an arc. 2. Increment of the moon's latitude for every 15° of her longitude from the node.
ஞான்வாக்கியம்—*Nyan Vakya*; Table of lunar latitudinal arcs.

த.

தக்கணம்—*Takkanam*; South.

நித்தியதக்கணம்—*Nitya takkanam*; The third of the *Vikkepam*; the same as *Nitya Vikkepam*.

தக்கணயனம்—*Takkanayanam*; South solstitial point.

தண்டாகாரம்—*Tandakaram*; Numbers placed one after another, according to their local value.

தற்பரை—*Talparei*; A third;—the one sixtieth part of a *Vinadi*.

தனம்—*Tanam*; Plus; additive.

தா.

தாக்கல்; To multiply.

தி.

திதி—*Tithi*; A lunar day, which consists of the time occupied by the moon in passing through 12° of longitude from the sun.

திதிஅர்த்தம்—*Tithiarttam*; Half of the duration of an eclipse.

திதிநாடி—*Tithinadi*; Duration of an eclipse in *Nadis*, &c.

திதிப்பிரமாணம்—*Tithi Pramanam*; Length of a *Tithi*.

திரிசா—*Trijya*; Tabular radius.

திரிபுசம்—*Tripusam*; Triangle.

திரைராசிகம்—*Tireirasikam*; Rule of three.

திவாமானம்—*Tivamanam*; Length of the day, from sunrise to sunset.

திவார்த்தம்—*Tivarttam*; Half of the length of the day, from sunrise to sunset.

தினம்—*Tinam*; 1. Day of 24 hours. 2. Daytime from sunrise to sun-set.

தினசேஷம்—*Tinasesham*; The difference between the *Varuda Sesham* and the next less number of days in *Paririrutti*.

தினப்பிரமாணம்—*Tina Pramanam*; Duration of the day.

தினதி—*Tinathi*; A correction for the time of conjunction or opposition, reckoned from sun-rise.

தினார்த்தம்—*Tinarttam*; Half of day, from sun-rise to sunset.

து.

துங்கமத்திமபுத்தி—*Tunkamattima Putti*, Mean daily motion of moon's apogee.

துங்கன்—*Tunkan*; Moon's apogee.

துருவம்—*Druvam*; 1. Celestial poles. 2. Poles of the earth. 3. Longitude of a planet, especially in combination with *Mulam*. 4. The longitudinal distance of a planet from the first of Aries, as determined by the *Sodya Vakya*. 5. The fraction of a week remaining at the commencement of the year, which is to be added to the numbers in *Sankirama Vakya* for the beginning of the months.

சசித்துருவம்—*Sasi Druvam*; Longitude of moon's apogee for the commencement of *Panchanka Vakya*.

மூலத்துருவம்—*Mula Druvam*; Longitude at a given epoch, generally at the epoch of the system.

துருவாக்கரம்—*Druvakkaram*; Longitudinal distance of the sun, or a planet, from the first of Aries, at the end of synodic periods, as arranged in the *Sodya Vakya*.

துலாம்—*Tulam*; Libra.

துலாயனம்—*Tulayanam*; Autumnal equinoctial point.

தூ.

தூமகேது—*Tumakethu*; Comet.

தே.

தேசாந்தரம்—*Tesantaram*; 1. Difference of longitude. 2. Allowance made for a planet's proper motion while passing from the first meridian to that of a given place (virtually, allowance for longitude.)

தேசாந்தரசந்திரன்—*Tesantara Santiran*; The moon's longitude corrected for difference of longitude of place.

தொ.

தொறு—*Toru*; 1. A difference, as between mean and apparent time. 2. Equation.

தொறுவாக்கியம்—*Toru Vakya*; A table of these equations.

தொறுவிவரம்—*Toru Vivaram*; Any given equation of time.

ந

நட்சத்திரம்—*Nacshastra*; 1. A star, a constellation. 2. A lunar mansion, one of the 27 divisions of the zodiac=13° 20′, of longitude.

நட்சத்திரப்பிரமாணம்—*Nacshastra Pramanam*; The length of a Nacshastra.

நதபாகை—*Nathapakei*; Zenith distance in degrees.

நதம்—*Natham*; 1. Zenith distance. 2. Equinoctial distance from the meridian in time.

நதி—*Nathi*; The sum of *Nitya Vikshepam* and *Sittilu*l*ei*.

நதோனபத்திரம்—*Nathonapattiram*; *Natham*, in time, subtracted from 24 *Nadis*.

நாடி or நாழிகை—*Nadi* or *Nalikei*; An Indian hour of 24 minutes.

நி.

நிசாமானம்—*Nisamanam*; Length of the night.

நிசார்த்தம்—*Nisarttam*; Half the length of the night.

நித்தியவிக்ஷேபம் } *Nitya Vikshepam;* } Parallax of the ze-
நித்தியவிக்கேபம் } *Nitya Vikkepam;* } nith distance of the equator, at the place of observation.

நிமிர்ச்சி—*Nimitchi*; A planet's being stationary.

நு.

நுதிவிழுதல்—*Nuthiviluthal;* A correction sometimes required in the use of the *Panchanka Vakya.* See விசேடவுரை, 5. on page 28 of Astronomy.

ப.

பஞ்சாங்கவாக்கியம்—*Punchanka Vakya;* Table of moon's longitudes from apogee, and daily motions, for 248 days.

பதனம்—*Pathanam;* Latitude of a planet.

பரிசகாலம் } *Parisakalam;* } Beginning of an eclipse.
பரிசம் } *Parisam;* }

பரிசநாடி—*Parisa Nadi*; Beginning of an eclipse in *Nadi.*

மத்திமபரிசம்—*Mattima Parisam*; Mean time of the beginning of an eclipse.

சுத்தபரிசம்—*Sutta Parisam*; True time of the beginning of an eclipse.

பரிதி—*Parithi;* Epicycle.

பரிதிபாகை—*Parithi Pakei*; Mean degrees counted on an epicycle, always in a given ratio to those of the deferent.

சீக்கிரபரிதி—*Seekkira Parithi*; 1. The annual parallax of a superior planet. 2. The elongation of inferior planets.

பரிவிருத்தி—*Parivirutti*; 1. Revolution. 2. Synodic revolution.

பரிவிருத்திவாக்கியம்—*Parivirutti Vakya*; Table for determining the geocentric longitude of the five planets.

பவனசக்கரம்—*Pavana Chakkaram;* Zodiac.

பவுரணை—*Pavuranei;* Full moon; Opposition.

பறுவநாடி—*Parura Nadi*; Time of conjunction or opposition of sun and moon; i. e. time of the day for this, in *Nalikeis,* &c.

பா.

பாகை—*Pakei;* A degree.

பாதுனசந்திரன்—*Pathuna Santiran;* Nodal distance of the moon.

பி.

பிரதிபன்னடி—*Pirathi pannadi*; Portion of the day remaining after conjunction or opposition of sun and moon, expressed in *Nalikei* and *Vinalikei.* The same as *Tinathi.*

பிரதிமண்டலம்—*Pirathi Mandalam*; An eccentric orbit.

பிரமாணம்—*Piramanam;* 1. Digits eclipsed. 2. Longitudinal distance to the end of any given sign.

பிராக்சக்கரம்—*Piraksakkaram*; The epicycle employed in calculating the precession of the equinoxes.

பு.

புசாகோடி—*Pusakodi;* (Pusei and Kodi) An argument to reduce the mean anomaly, and other quantities, to the equation tables, which extends only to 3s. The reduction is as follows:—1. If the mean anomaly exceeds 3s., subtract it from 6s; 2. If it exceeds 6s., subtract from it 6 signs. 3. If it exceeds 9s., subtract it from 12 signs.

புசாந்தரசந்திரன்—*Pusantara Santiran*; The moon's longitude corrected for errors arising from the use of the numbers 3031 and 248, in determining the longitude.

புசாபலம்—*Pusapalam;* The result obtained from the process *Pusakodi*.

புசை—*Pusei*; A circle being divided into four equal sections, the 1st and 3d are, each, called *Pusei*, and the 2d and 4th, each, *Kodi*. *Pusei* only is to be used; hence the argument is frequently expressed by *Pusei* only. When the two are combined, they are written *Pusakodi*.

புடம்—*Pudam;* Equated longitude.

புடநதி—*Pudanathi*; } Apparent distance of the
புடவிக்கேபம்—*Pudavikkepam*: } centres of the sun and moon at conjunction. The same as the apparent latitude of the moon.

புத்தி—*Putti*; Daily motion of a planet.

மத்திமபுத்தி—*Mattima putti*; Mean motion of a planet.

புடபுத்தி—*Pudaputti*; True motion of a planet.

பூ.

பூருவவாக்கியம்—*Purva Vakya*; The first of two successive *Vak as* taken from a table.

பூர்வான்னம்—*Purvannam;* Forenoon.

ம.

மகரச்சா—*Makara Jya*; For the superior planets, the parallactic equation of the orbit for the first and last quadrants, as reckoned from the sun. For the inferior planets, it is the equation of elongation, for the same.

மகரம்—*Makaram*; Capricornus.

மண்டலம்—*Mandalam*; 1. Circle. More generally in Astronomy, celestial circle. 2. Apparent diameter. i. e. in the sense of the whole disk.

மண்டலாத்தம்—*Mandalattam*; Complete revolution of the sun.

மண்டலார்த்தம்—*Mandalarttam;* 1. Semi-circle. 2. Semi-diameter.

மதித்துருவம்=சசித்துருவம்—*Mathi Druvam=Sasi Druvam*;

Longitude of the moon at sun-rise for the beginning of *Panchanka Vakya*; also the longitude of the moon's apogee, for the same time, the moon then being supposed to be in apogee.

மத்தியகாலம்—*Mattiakalam*; Middle of an eclipse, or time of an eclipse expressed in *Nalikei*, &c.

மந்தம்-*Mantam*; 1. Anomaly. 2. The first equated heliocentric longitude.

மந்தச்சா—*Manta Jya*; Equation of the centre.

மந்தபரிதி—*Manta Parithi*; Element used for computing the first inequality of a planet; which inequality, as entered in the table, is called *Manta Jya*.

மா.

மாதவாக்கியம்--*Matha Vakya*; A table giving the length of the months, in *days*, *Nalikeis*, *&c.*

மானம்—*Manam*; 1. Measure. 2. The computation of the duration of a year, solar, lunar, synodical, &c.

மானயோகார்த்தம்—*Manayokarttam*; Sum of the apparent semi-diameters of either the sun and moon; or, of the moon and the earth's shadow.

மூ.

மூலச்சா—*Mula Jya*; Sine, natural sine.

மூலத்துருவம்—*Mula Druvam*; The longitude of a planet at the epoch of the system, to be applied to that obtained from the *Kandam*.

மே.

மேடாயனம்—*Medayanam*; Vernal equinoctial point.

மோ.

மோட்சநாடி—*Modchanadi*; } End of an eclipse.
மோட்சம்—*Modcham*; }

மத்தியமோட்சம்—*Mattia Modcham*; Mean time of the end of an eclipse.

சுத்தமோட்சம்-Sutta *Modcham*; True time of the end of an eclipse.

யு.

யுகம்—*Yugam*; A mythological Age, or Period, of the world.

யுத்தநாதி—*Yutta Nathi*; The precession of the equinoxes at a given time.

யுத்தநாதிவாக்கியம்—*Yutta Nathi Vakya*; Table of *Yuttanathis*, or of the amount of precession for given times.

யோ.

யோகம்—*Yokam*; Conjunction.

யோக்கியாதி—*Yokyathi*; 1. A table giving the equation of the sun's motion, considered at the rate of one degree (1°) for a day, to his true motion, for every day in the year. The correction includes the equation of the centre. 2. An equation from the *Yokyathi table.*

யோசனை—*Yosanei;* The 5059th part of a great circle. It, of course, varies in length with the latitude of the place. On the equator it is about 4¼ geographical miles, (4.2696.)

வ

வக்கிரசாரம்—*Vakkirasaram;* Motion of a planet in retrogradation.

வக்கிரம்—*Vakkiram;* Retrogradation of a planet.

வக்கிராத்தமனம்—*Vakkirattamanam;* Immersion of a planet, when retrograding.

வக்கிரோதயம்—*Vakkirothayam;* Emersion of a planet, when retrograding.

வருடசேஷம்—*Varudasesham;* The number of days remaining in an unfinished synodic period, and used as the argument for the *Parivirutti Vakya.*

வர்க்கம்—*Vatkam;* In extracting the square root, the quantity is divided into periods of two figures each, as usual; the right hand figure in each period, is called *Vatkam,*—and the other figure *Avatkam.*

வலயம்—*Valayam;* 1. A circle. 2. An arc.

வி.

விகலை—*Vikalei;* 1. A second of a degree. 2. One sixtieth of a *Kalei.*

விக்ஷேபம்—*Vikshepam;* } Latitudinal distance.
விக்கேபம்—*Vikkepam;* }

இரவிவிக்ஷேபம்—*Ravi Vikshepam;* } Moon's parallax
இரவிவிக்கேபம்—*Ravi Vikkepam;* } in latitude.

மதிவிக்ஷேபம்—*Mathi Vikshepam;* Moon's latitude.

நித்தியவிக்ஷேபம்—*Nitya Vikshepam;* Parallax of the zenith distance of the equator, at the place of observation.

சுத்தவிக்ஷேபம்—*Sutta Vikshepam;* } Distances of the
புடவிக்ஷேபம்—*Puda Vikshepam;* } centres of the sun and moon, at the time of an eclipse—the same as the apparent latitude.

விஷுவம்—*Vishuvam;* Equinoctial points.

விஷுவரேகை—*Vishva Rekei;* Equinoctial colures.

விஷுவச்சாயை—*Vishva Sayei;* Equinoctial shadow, at a given place.

விஷுவச் சாயாங்குலம்—*Vishva Sayangkulam;* The same as the preceding in *Angkulas,* at a given place.

விநாடி or விநாழிகை—*Vinadi* or *Vinalikei;* The one sixtieth of a *Nadi* (one sixtieth of 24m. of time.)

விமார்த்தம்—*Vimarttam;* Half the duration of a lunar eclipse —the same as *Tithiarttam.*

விம்சதி—*Vimsathi*; Twenty years, in reference *to* the cycle of 60.

வியங்குலம்—*Viangkulam*; The one sixtieth of an angkulam.

விவரம்—*Vivaram*; Difference between the time passed from sun-rise on a given day, and half the length of that day.

விவரபுத்தி—*Vivaraputti*; } Difference of the daily motion
விவரகதி—*Vivarakathi*; } of the sun and moon. The *relative daily motion* of the moon.

CORRIGENDA.

Introduction.

Page 17; 2d paragraph, for "1234", read, "1243."
Page 18; 1st paragraph, for "1788," read "1756."

Translation.

Page 4; The 2d Table is the "*Matha Vakya*" referred to in the work.

Page 8; Under Nacshastra No. 1., for "Table No. "XIII." read "Table No. XV."

Page 8; Under Tithi No. 3, for "Table No. XII." read "Table No. XIV."

Page 10; 3d line, for "Jan. 1234," read "Feb. 1243."

Page 13; No. 4, 2d line, before the word "Table," insert, "and parallactic."

In the same note, 6th line, for "In English," read "In the Translation."

Page 21; Rule 2. 3d line, for "aphelion," read "planet."

Rule 3. 2d line, for "second column" read "first, column"; and for "Table 3. Parivirutti", read "Table' Parivirutti."

Rule 4. 1st line, for "last column" read "first column."

In the next paragraph, for "No. 1." read "No. 2."

Page 25, In No. 24; last line; strike out all after "Druvam" in the parenthesis.

Page 34, No. 24; Note, last line, strike out the phrase, "and nearly that of "Ramisseram;""