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ASTRONOMICAL EVIDENCE OF THE DATE OF MAHABHARATA WAR

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In the history of Bharat, the most important event is Mahabharata war. Mahabharata war and its date are important in two ways. First of all, in Mahabharata war, almost all Kings who were ruling various parts of Bharat, had participated and thus every region of this Nation had involved in it. Thus, it was a PAN Bharatian event. The second thing is, if the date of Mahabharata war is fixed correctly, then the dates of later events that occurred after Mahabharata war can be fixed easily. This is because, Purana especially Vishnu, Brahmanda, Matsya, Vayupurana and Sreemad Bhagavatham describe the chronology of three kingdoms of Bharat, since Mahabharata war. Thus, Purana had taken the time of Mahabharata war as the sheet anchor. The three kingdoms are, 1. Kuru Kingdom from Pandava till its end, 2. Ikshavaku Dynasty, in which born Gautama Buddha as 24th Prince and hence Gauthama Buddha's date can be derived correctly and 3. Magadha Kingdom, where the period of reign of various dynasties and kings from the time of Mahabharata war up to Andhra Satavahana dynasty i.e. just before Gupta period, were enumerated clearly. Here Gautama Buddha was contemporary to the Kings Bimbisara and Ajatasatru of Sisunaga Dynasty. Hence, by means of it also, the date of Gauthama Buddha can be derived easily and correctly. Kaliyuga Raja Vriddhanta, a Sanskrit text, describes the chronology of Magadha kingdom even up to Gupta period. Thus, the date of Mahabharata war is the proper sheet anchor, from which the chronology of events that occurred in Bharat, after the period of Mahabharata war, can be derived perfectly and easily. Hence the fixation of date of the Mahabharata war becomes an important and essential one.

In this book, the Sanskrit terminology is used as such. For example, the word Graha includes Sun, Moon, Jupiter, Saturn, Mars, Venus, Mercury and Rahu and Ketu, which are nothing but the Ascending and Descending nodes of Moon scientifically. This is because, Graha denotes any celestial body that attracts other celestial objects and thus can include stars, planets and satellites and even nodes. Planet is the non-self-illuminating celestial body that revolves around a Star and thus, Graha and planet are not at all synonyms. In the same way, Nakshatra denotes stars, Amavasya denotes New Moon and Paurnami denotes Full Moon. Further, in the 12 zodiac signs Mesha denotes Aries, Vrishabha Taurus, Mithuna Gemini, Karkataka Cancer, Simha Leo, Kanya Virgo, Tula Libra, Vriscika Scorpio, Dhanus Sagittarius, Makara Capricorn, Kumba Aquarius and Meena denotes Pisces.

Earlier Studies

Because of the importance of derivation of the date of Mahabharata war, a lot of scholars and experts worked on it and came to their own conclusions. However, their opinion varies from 6228 B.C.E., to 6th century B.C.E. The following table, taken with thanks from the book, "Astronomical Dating of the Mahabharata war" by Dr.Vedavyas, shows the wide range of opinion of various scholars on the date of Mahabharata war.

	6000 to 3300 B.C.E	3000 to 3300 B.C.E.	3000 to 1500 B.C.E.	1500 to 1000 B.C.E.	Later than 1000 B.C.E.	Total
Number of scholars	6	61	7	40	6	120

Based on Astronomy, Sri. Balakrishnan in 2003, using Simulations Planetarium software gave the date as 3129 B.C.E. or 2559 B.C.E. as a very viable date. However, he used data for eclipses only and in the proposed year there was no eclipse at Jyeshtha Nakshatra. Sri. Iyyangar in 2003 used the Simulations Planetarium software and derived the date as 1478 B.C.E. However, on that date Solar eclipse not occurred at Jyeshtha but near Purvasadha and Lunar eclipse at Mrigasira Paurnami and not at Krittika Paurnami. Sri Sharma derived the date at 3022 B.C.E. but Solar eclipse at Moola and Saturn also at Moola. Sri Narahari Achar using NASA's Planetarium software, fixed the date at 3067 B.C.E. However, he thought that the Saturn was at Rohini and not at Jyeshtha and Mars was retrograde (an apparent backward movement in reverse direction) at Jyeshtha. Since there was Amavasya (New Moon) at Jyeshtha, the Sun was also at Jyeshtha and Mars could not go retrograde when in conjunction with Sun in the same zodiac sign, but 4 signs apart only. The same problems are with the date fixed by Ramesh Panchwag.V., who fixed the date at 3126 B.C.E. using the program Cyber Sky 47.

One more study using the planetarium software (Astronomy simulations provided by Voyager 4.5^{TM} based on NASA database) is mainly based on the astronomical event of Arundhati Nakshatra arising in the east before the rise of Vasishtha Nakshatra in the dawn, i.e. Arundhati walking in front of Vasishtha, as per Veda Vyasa's statement at Bhishma Parva 2nd Adhyaya 31st verse. The derivation of the date is entirely based on this single event and also solely based on Precession of Equinox at the rate of 50**.**3 seconds of arc per year. Through this, the study derived the date at 5561 B.C.E. However, Surya Siddhanta mentioned in the 9th to 12th verses of 3rd Adhyaya (Triprasna Adhikara), that it is only oscillation of equinox i.e. the Equinox moves forward from 0º Mesha to 27º Mesha, then moves backwards to 0º Mesha and further backwards by 27º up to 3º Meena and then forwards to 0º Mesha. That it is 27º forward and 54º backward and then 27º forward to reach again 0º Mesha, thus oscillating to and fro and one full oscillation of 108º is completed in 7200 years. Thus the rate of oscillation is 54 seconds of arc per year, close to modern value. As on date, the backward reverse motion of Equinox should go for another 3º which requires approximately 210 years for the oscillation to turn forward and it is retrograde for the past 5000 years approximately. Thus, we can know the actual reality only after 210 years from present. Further, we cannot say that the rate of precession was the same 50**.**3 seconds of arc in the ancient period also that too more than 5000 years back. Thus, the study is based on the assumption that the rate of precession is very same throughout the 7500 years period. Further, as per above mentioned Purana and Kaliyuga Raja Vriddhanta, the time interval between Mahabharata war to end of Andhra Satavahana Dynasty of Magadha Kingdom will be around 2800 years. Matsya Purana mentions in 273**:**38 that Sapta rishi mandalam, which resides

in one Nakshatra for 100 years, will be in 27th Nakshatra at the time of Andhra Satavana ruling, from the time of Parikshit (the grandson of Arjuna, who born at the time of Mahabharata war). Hence from Parikshit's time, if we calculate, the period of Andhra dynasty was 2700 to 2800 years posterior. After this Gupta ruled for 245 years as per Kaliyuga Raja Vriddhanta and then came the period of reign of King Vikramaditya of Ujjain who started his era at 57 B.C.E. This Vikrama Samvat of 57 B.C.E. is still used by almanacs, Government and by common people. Besides, there are more than 500 inscriptions showing that Vikrama Samvat began at 57 B.C.E. However, as per this date at 5561 B.C.E., King Vikramaditya era would be around 2500 B.C.E. Thus, the derivation of chronology will be very difficult and unacceptable. Further it goes against the internal evidence of Mahabharata text of Veda Vyasa which states that the war was fought at the junction of Dvapara and Kaliyuga and not in Dvapara Yuga. (Refer Adiparva 2**:**13 and Vanaparva 149**:**39, which will be described in detail later). Kaliyuga began at 3101 B.C.E. (current) as per the inscriptional and literary evidences which are shown in this book in the next chapter.

The main problem in all these derivations of the date of Mahabharata war, using Planetarium and other software are 1. They are all based on the Precession of Equinox that too at the present rate of 50**.**3 seconds of arc in the ancient period also. 2. Theses derivations derive the positions of Graha at Sayana longitude i.e. the degrees of precession is included in the calculation where Mesha 0º is drifting backwards and then converting into Nirayana longitude i.e. not including Precession of Equinox, where Mesha 0º is fixed, and 3. These derivations depend on the Julian or Gregorian calendar and extending it to ancient period and converting it into Bharatian calendar either Chandramana or Suryamana. The Julian calendar had begun at 46 B.C.E. and Gregorian calendar was started at 1582 C.E. by Pope Gregory by which 4th October 1582 was counted as 15th October 1582. Whether they hold good before these periods is doubtful. We cannot expect 100% accuracy on these counting of days. The correct way to fix a Bharatian date, that too at an ancient period, is to follow Bharatian calendar only. Bharatian calendar in the ancient time used thithi, nakshatra, month and year to denote dates. It had not calculated dates using numerical like 1, 2, 3, etc. It stated as Prathama, Dvitiya, Tritiya thithi etc. or Nakshatra to denote the date. Thithi is the angular difference between the longitudes of the Sun and the Moon, on seen from the Earth. Lunar month of 29**.**530589 days is divided into 30 thithi. One thithi is the time taken by the Moon to move 12º relative to the Sun, on seen from the Earth and is almost equal to one day. There are 15 thithi in Sukla paksha (bright half from the next day of Amavasya [New Moon] to Paurnami i.e. Full Moon) and 15 thithi in Krishna paksha (dark half from the next day of Paurnami to Amavasya). Nakshatra denotes at which constellation the Moon is in conjunction. So these are completely astronomical and not imaginary counting of dates using numerals. Thus, we cannot give a date of beginning of Mahabharata war as 15/10/3158 B.C.E. i.e. 15th October 3158 B.C.E. etc. but will state the date as, for example, Amavasya Thithi, Karthika month, 42nd year before Kaliyuga beginning.

Further, these derivations calculated the date using the positions of the planets like

Uranus, Neptune and Pluto. However, in Bharatian system of astronomy these planets are not at all mentioned. This does not mean that our ancestors do not know these planets, instead they simply omitted these three planets, because their effect on the Earth, Nature, human beings and other livings are negligible. This is because the mean distance of Uranus from Earth is two times more than that of Saturn and the mass of Uranus is almost seven times less than the mass of Saturn. The mean distance of Neptune and Pluto are 3 and 4 times more than that of Saturn from Earth respectively and the mass of Uranus is more than five times less than that of Saturn and the mass of Pluto is very minimal when compared to that of Saturn. Here these three planets are compared with Saturn because Saturn is the furthest of the Navagraha from the Earth. Thus, the gravitational force and the tidal force of Uranus, Neptune and Pluto on Earth are negligible as shown in the table and hence they are not mentioned in the Bharatian Astronomy. The following table shows it clearly.

Graha	Mass in Kilograms	Mean distance from Earth in Kilometers	Gravitational Force (Mass ÷ distance^2)	Tidal Force (Mass ÷ distance^3)
Sun	1,98,85,000 x10^{23}	14,96,00,000	88,85,101,80,44,553.75	5,93,923.917410112
Moon	0.7342 x10^{23}	3,84,400	49,687,65,44,789.99	12,92,600.272606643
Mercury	3.3010 x10^{23}	14,96,00,000 22,19,00,000 max 7,73,00,000 min	1,47,49,671.14	0.098594058
Venus	48.6760 x10^{23}	14,96,00,000 26,10,00,000 max 3,82,00,000 min	21,74,96,210.93	1.453851677
Mars	6.4171 x10^{23}	22,85,00,000	1,22,90,985.35	0.053789870
Jupiter	18,983.0000 x10^{23}	77,83,00,000	313,37,96,468.71	4.026463406
Saturn	5,683.6000 x10^{23}	142,70,00,000	27,91,10,104.51	0.195592225
Uranus	868.1600 x10^{23}	286,96,00,000	1,05,42,826.14	0.003677814
Neptune	1024.2000 x10^{23}	449,66,00,000	50,65,429.31	0.001126502
Pluto	0.1310 x10^{23}	590,63,50,000	375.52	0.000000064

From the table, it can be shown that the gravitational and especially the tidal force of Uranus, Neptune and Pluto are very minimal and have negligible effect on the Earth, Nature, human beings and other livings. Hence, they are not included in the Navagraha list. Thus, from Surya Siddhanta, Aryabhattiyam, Mahaaryabhatta Siddhanta, Brahmasphuta Siddhanta, Laghu and Mahabhaskariyam, Sishyadhi Vruddhida Tantra, Vatesvara Siddhanta, Laghumanasa of Manjusa and up to later period Karana texts, including Jyotisha texts, there is no mention of Uranus, Neptune and Pluto. Hence, in the derivation of date of Mahabharata war, we cannot include these three planets. If the derivation and positions of these planets are included, it is unwarranted and will misguide us.

Hence, the method used for the derivation of the date of Mahabharata war, should be

totally based on Bharatian calendar and astronomical system, using thithi, nakshatra, month and year method of calculation, rather than in numerical dates and the usage of Julian and Gregorian calendar system. Further, we should use the computing method described in the ancient astronomical texts of our Nation. These texts describe Ahargana calculation and computing mean and true positions of the Graha, for any particular day, by means of Trigonometric mathematical calculations. Hence it is totally based on the Bharatian system and it is the best because we are going to derive a date of a particular event whose astronomical details are described in Bharatian method and system. It is a novel but a well-established approach which fully adheres the time of occurrence and duration of the war and the positions of Graha as described internally within Mahabharata text. So far, no one has used this method. Hence, it is a novel method. At the same time, this method is described in the ancient astronomical texts of our Nation. Hence, it is an authentic, well proved and a well-established method.

Time and Duration of war as found in Mahabharata text.

In Adiparva, Mahabharata text describes at 2nd Adhyaya 13th sloka as,

अंतरे चैव संप्राप्ते कलि द्वापरयोरभूत् । समंतपंचके युद्धं कुरु पांडव सेनयोः ॥

This sloka clearly shows that Mahabharata war between Kuru and Pandava army took place at Samantapancaka at Kali Dvapara yuga junction, i.e. at the end part of Dvaparayuga and before the beginning of Kaliyuga. This is further emphasized by Mahabharata text at Vana Parva, 149th Adhyaya 39th sloka as,

एतत् कलियुगं नाम अचिराद् यत् प्रवर्तते ।

The meaning is Kaliyuga is going to come forth soon speedily. Mahabharata text at Adiparva 2nd Adhyaya 30th and 31st sloka describes the duration of Mahabharata war as 18 days with Bhishma as army chief of Kaurava for 10 days, Drona for 5 days, Karna for 2 days and Salya for one day.

Other Evidences

The other evidences showing that Mahabharata war was fought before the dawn of Kaliyuga can be shown as follows.

1.Aryabhatta, the famous Astronomer and Mathematician, wrote in his Aryabhattiyam at Gitikapada (1st Adhyaya) 5th sloka as,

काहो मनवो ढ मनुयुगाः श्ख गतास्ते च मनु युगाः छना च ।

कल्पादेर्युगपादा ग च गुरुदिवसाच्च भारतात् पूर्वम्॥

Here Aryabhatta calculated the number of years elapsed since Sri Svetavaraha Kalpa (the present Kalpa) up to the Mahabharata war, where 6 Manvantara, 27 Mahayuga, Satya, Treta and Dvapara yuga were elapsed. If Mahabharata war was fought after the beginning of Kaliyuga, then Aryabhatta would have included the number of years elapsed in Kaliyuga also, but he never mentioned the 4th yuga i.e. Kaliyuga at all. This clearly shows that the time of Mahabharata war is before the beginning of Kaliyuga.

2. Bhattotpala in his commentary to Varahamihira's Brihat Samhita at 13th Adhyaya 3rd sloka, mentioned that Vruddha Garga (Garga Rishi Senior) wrote,

तथा च वृद्धगर्गः कलिद्वापर सन्धौ तु सिथतासते पितृदैवतम् । मुनयो धर्मनिरताः प्रजानां पालने रताः ॥

which means that the Saptarishi mandalam (Great Bear constellation) was stationed at Magha Nakshatra at Kali and Dvapara yuga junction. In the very same sloka, for which Bhattotpala wrote commentary, Varahamihira, the famous astronomer, wrote as,

आसन् मगासु मुनयः शासति पृथ्वीं युधिष्ठिरे नृपतौ ।

The meaning is that when Yudhishtira of Panca Pandava was Universal Monarch, Saptarishi Mandalam (Great Bear constellation) was stationed at Magha Nakshatra. Thus, at both Kali Dvapara Junction and at Yudhishtira's rule, Saptarishi was at Magha Nakshatra and Saptarishi completes one revolution of 360° in 2700 years. This clearly shows that King Yudhishtira was ruling the Earth at Kali and Dvaparayuga junction. He became King only after winning Mahabharata war. Hence the time of Mahabharata war is before the beginning of Kaliyuga.

3.Abul-Fazl ibn Mubarak, a vizier in the court of King Akbar wrote in his Ayeen Akbari (Ain i Akbari), in 1st volume, 3rd part, page 263 under the heading 'The Era of Hindus' as, "In the beginning of the fourth or present jowg [yuga], Rajah Joodishter [Yudhishthira] was universal monarch, and the commencement of his reign became an epoch of an era which to this time being the 40th year of the reign [of Akbar], there elapsed 4696 years." Akbar came to power in 1556 C.E. and his 40th year of reign was 1595 C.E. which was 4696 years of Yudhishthira. 4696 years before 1595 is 3101 which is the beginning of Jayabhyudaya Yudhishthira Saka. The very same was quoted by Sir.Alexander Cunningham in page 7 of his book, ' Book of Indian Eras with tables calculating Indian Dates'.

4.Henry Thomas Colebrooke, in page xliii of the book, 'Algebra with Arithmetic and Mensuration from the Sanscrit of Brahmegupta and Bhaskara' wrote under the heading 'Age of Aryabhatta' as, "It is to be observed that he does not use the Saca or Samvat of Vicramaditya nor the Saca era of Salivahana, but exclusively employs the epoch of the war of the Bharata, which is the era of Yudhist'hira and the same with the commencement of Cali yuga."

5. Inscriptional Evidences: There are more than 273 inscriptional evidences show the beginning of Kaliyuga was at 3101 B.C.E. (current). Only a few are shown here for want of space.

A. Aihole Inscription of Pulikesin II, mentions that from Mahabharata war there elapsed 3735 years in Kaliyuga and 556 years in Salivahana Saka. Salivahana Saka started at 78 C.E. Hence 556 Salivahana Saka is 634 C.E. which is 3735 years in Kaliyuga. This shows that Kaliyuga began at 3101 B.C.E. (current) and Mahabharata war was fought prior to the beginning of Kaliyuga.

B. Ivory plated swinging cot at Vedanayaki shrine of Sangameswara temple at Bhavani, Tamilnadu gave the date in Kali Era at 4904, Salivahana Saka at 1725, Common Era (C.E. or A.D.) at January 1803, signed by the then English Collector W.Garrow XI. Thus, Kali 4904 is Salivahana 1725 and Common Era 1803. That means the difference between Kaliyuga and Common Era 3101 years and Common Era and Salivahana Saka is 78 years. Thus, we can

conclude that Kaliyuga began at 3101 B.C.E. and Salivahana Saka began at 78 C.E. This also shows us that Salivahana Saka began in Kaliyuga 3179 years (4904 –1725 = 3179)

C. Stone Inscription in the museum, Gujarat Sabarkanta District, Kali 4300 and Vikrama 1256. This shows us that Vikrama Samvat began at 3044 years in Kaliyuga and is thus at 57 B.C.E (3101 – 3044 = 57)

D. Stone Inscription at Khummoh Bhuvaneswari, Jammu & Kashmir, Kali 4530 Laukika year 4

All these evidences clearly shows that Mahabharata war was fought before the beginning of Kaliyuga and the Kaliyuga began at 3101 B.C.E. (current). This study helps us to go nearer to our result and help us to derive the date more accurately.

Astronomical Events described in Mahabharata text

1. Sree Krishna went to Hastinapura on peace mission in the month of Karthika and started his journey at Revati Nakshatra, as per Udyoga Parva 83rd Adhyaya 6 & 7th sloka.

कौमुते मासि रेवत्यां शरदन्ते हिमागमे । 7 ।

Kaumuti masi means Karthika month, Revatyam denotes Revati Nakshatra. The season was the end part of Sarad ritu and Hemanta ritu was going to come.

2. Sree Krishna told Karna on returning from peace mission that the war had to start at Amavasya (New Moon) which would fall on 7th day which is presided by Indra. This is revealed in Udyoga Parva 142nd Adhyaya at 18th sloka as,

सप्तमाच्चापि दिवसाद् अमावास्या भविष्यति । संग्रामो युज्यतां तस्यां तामाहु ः शक्रदेवताम् ॥18 ॥

Sakra means Indra as per the Lexicon Amarakosa, at Prathama Khanda, Svarga Varga 42nd sloka and Indra is the deity of Jyeshtha Nakshatra. It also means Jyeshtha Nakshatra as per the Practical Sanskrit English Dictionary of V.S.Apte. Hence, Amavasya was on Jyeshtha Nakshatra.

3. Karna replied Sree Krishna that 1. Rohini Nakshatra was afflicted by Saturn ((Prajapathyam means Rohini as Prajapathi is the deity of Rohini), 2. Mars was acting cruelly at Jyeshtha Nakshatra and desiring to come together with Anuradha Nakshatra, in a friendly manner, 3. Moon was affected badly and 4. Rahu was approaching Sun, as found in Udyoga Parva, 143rd Adhyaya 8th, 9th and 11th sloka as,

प्राजापत्यं हि नक्षत्रं ग्रहस्तीक्ष्णो महाद्युतिः । शनैश्चरः पीडयति पीडयन् प्राणिनोऽधिकम् ॥ 8 ॥

कृत्वा च अंगारको वक्रं ज्येष्ठायां मदुसूदन । अनुराधां प्रार्थयते मैत्रं संगमयन्निव ॥ 9 ॥

सोमस्य लक्ष्म व्यावृत्तं राहुरर्कमुपैति च ।11 ।

Here the meaning is Saturn was afflicting Rohini Nakshatra (by its 3rd, 7th or 10th Drishti [aspect], depends on the position of Saturn). We cannot take as Saturn was in conjunction with Rohini and stationed in Vrishabha zodiac sign. This is because, if we take that Saturn was in conjunction with Rohini and it was afflicting it, then it means as per next sentence that Saturn was also stationed with Animals (Praninam) and is afflicting them more. As Saturn cannot be stationed with animals, it is not a correct understanding of the meaning

4. Veda Vyasa told Dhritarashtra the bad signs, in Bhishma Parva, 2nd Adhyaya 23rd sloka as,

अलक्ष्यः प्रभमाहीनः पौर्णमासीं च कार्तिकीम् । चन्द्रोभूद्अग्निवर्णश्च पद्मवर्ण नभस्तले ॥ 23 ॥

The meaning is at the bottom of the sky, on Paurnami (Full Moon) day in Karthika month, Moon was nonexistent, without light rays and was invisible.

5.In Bhishma Parva, 2nd Adhyaya at 32nd sloka, Veda Vyasa told Dhritarashtra as,

रोहिणीं पीडन्नेष स्थितो राजशनैश्चरः । व्यावृत्तं लक्ष्म सोमस्य भविष्यति महत् भयम् ॥ 32 ॥

This sloka reveals that Saturn was afflicting Rohini Nakshatra. Moon was affected badly. Here the word sthita does not mean situated, abiding, staying but means firm, steadily, steady, steadfast. Hence the meaning is "Hey Raja, Saturn is afflicting Rohini steadily and in a steadfast manner." This was further affirmed by the next sentences which mentioned that Saturn was stationed nearer to Visakha Nakshatra. Rohini is far away from Visakha (15 Nakshatra apart).

6.Veda Vyasa told Dhritarashtra, as shown in Bhishma Parva 3rd Adhyaya 11 &14th sloka, as,

विष्वग्वाताश्च वान्तयग्रा रजो न व्युपशम्यति । अभीक्ष्णं कम्पते भूमिरकँराहुरुपैति च ॥ 11 ॥

मघास्वंगारको वक्रः श्रवणे च बृहस्पतिः । भगं नक्षत्रमाक्रम्य सूर्यपुत्रेण पीड्यते ॥ 14 ॥

The meaning is that 1.Rahu was approaching Sun 2. Mars was cruel to Magha Nakshatra and in the same way Jupiter was to Sravana Nakshatra 3. Saturn (Surya Putra – son of Sun) was overcoming and afflicting Purva Phalguni Nakshatra at Simha zodiac sign (by its 3rd, 7th or 10th Drishti, depends on the position of Saturn). Here also the word Akramya does not mean staying or abiding but has the meaning of seizing, holding, overcoming and conquering.

7. Vyasa mentioned in Bhishma Parva 3rd Adhyaya 15th sloka as,

शुक्रः प्रोष्ठपदे पूर्वे समारुह्य विरोचते । उत्तरे तु परिक्रम्य सहितः समुदीक्षते ॥ 15 ॥

The meaning is Venus rose upon or imposed Purva Bhadrapada Nakshatra with shining and looked up attentively or observed all round Uttara Bhadrapada Nakshatra.

8.Vyasa continued again as shown in Bhishma Parva, 3rd Adhyaya, 17th and 18th sloka as,

रोहिणीं पीडयत्येवमुभौ च शशिभास्करौ । 17 ।

वक्रानुवक्रं कृत्वा च श्रवणं पावकप्रभः । ब्रह्मराशिं समावृत्य लोहितांगो व्यवस्थितः ॥ 18 ॥

Here it means that both Moon and Sun were afflicting Rohini Nakshatra (by their 7th Drishti). Here also we cannot take that both Moon and Sun were stationed in conjunction with Rohini in Vrishabha zodiac sign, as at Karthika Amavasya (New Moon), Sun was at or nearer to Jyeshtha as per Sree Krishna's words and Moon also at or nearer to Jyeshtha Nakshatra. Hence both were at Vriscika zodiac sign and with their 7th Drishti they could afflict Rohini. This also favours the opinion that Saturn was not stationed in conjunction with Rohini and was only afflicting it with its Drishti. Mars (Lohita) was concealing and fully covering (samavrutya) Sravana Nakshatra (Brahma Rasi) by staying apart (vyavasthita).

9.Veda Vyasa further continued as seen in Bhishma Parva 3rd Adhyaya 27, 28 & 32 sloka as,

संवत्सरस्थायिनौ च ग्रहौ प्रज्वलितावुभौ । विशाखायाः समीपस्थौ वृहस्पतिशनैश्चरौ ॥ 27 ॥

चन्द्रादित्यावुभौ ग्रस्तावेकाह्ना हि त्रयोदशीम् । अपर्वणि ग्रहं यातौ प्रजासंक्षयमिच्छतः ॥ 28 ॥

चतुर्दशीं पञ्चदशीं भूतपूर्वां षोडशीं । इमां तु नाभिजानेऽहममावास्यां त्रयोदशीम् ।

चन्द्रसूर्यावुभौ ग्रस्तावेकमासीं त्रयोदशीम् ॥ 32 ॥

These sloka reveals that 1. Jupiter (Brihaspati) and Saturn (Sani) were nearer to Visakha Nakshatra, 2. Both Moon and Sun were seized in the same day and in the same month at thirteen days interval and 3. Amavasya (New Moon) occurred ill timely on 13th day itself.

10. At Karna Parva of 37th Adhyaya, 4th sloka mentioned as,

चचाल प्रथिवी राजन् ववाश च सुविस्तरम् । निःसरन्तो व्यदृश्यन्त सूर्यात सप्त महाग्रहाः ॥

The meaning is the seven Mahagraha starting from Sun started separating and issuing out (nihsara, nihsarana) from their previous position (in conjunction with others), during the days at which Karna was the chief of army of Kaurava. He became chief of army only after 15 days of war. Hence the seven Graha, which were in conjunction, were going out of their conjunction around 15 days of time.

11. At Karna Parva of 94th Adhyaya, 51st sloka mentioned as,

सकाननाश्चाद्रिचयाश्चकम्पिरे प्रविव्यथुर्भूतगणाश्च सर्वे ।

बृहस्पतिः सम्परिवार्य रोहिणीं बभूव चन्द्रार्कसमो विशाम्पते ॥ 51 ॥

The meaning of the second line is Jupiter encompassed or took hold of the Nakshatra Rohini and is shining like Moon and Sun. Thus, Jupiter afflicted Rohini Nakshatra.

Inference from astronomical references

From these narrations of astronomical events described in Mahabharata text, we can infer the following.

1. Sree Krishna started his peace mission at Revati Nakshatra in Karthika month. Revati is the 27th (last) Nakshatra and Krittika is 3rd Nakshatra. Moon will be in conjunction first with Revati and only after 3 to 4 days, it will be in conjunction with Krittika Nakshatra. Moon will be in conjunction with Krittika Nakshatra in Karthika month on Paurnami (Full Moon). Thus, during Mahabharata period, Karthika month commenced before this Paurnami i.e. the conjunction of Moon and Krittika Nakshatra. Hence we can conclude that during Mahabharata period, the year followed was Chandramana with Amanta type i.e. months commenced on the next day of Amavasya (New Moon) in Prathama thithi of Sukla Paksha (bright half of the month) and ended at Amavasya (Amanta). The Paurnamanta type will commence on the next day of Paurnami (Prathama thithi of dark fortnight) and end at Paurnami.
2. Sree Krishna told Karna, on returning from his peace mission, that seventh day would be Amavasya which was presided by Indra (Sakra also means Jyeshtha) and war had to be

started on that day. As the Mahabharata war was started on Amavasya day and as it was an Amanta method of month calculation, it was the last day of Karthika month. Besides, as per the statement of Sree Krishna to Karna that the presiding deity of that 7^{th} day occurring Amavasya was Indra and the fact that Indra is the deity of Jyeshtha Nakshatra, it is very clear that Karthika Amavasya occurred in Jyeshtha Nakshatra, at Mahabharata war period. Since Amavasya occurred in Jyeshtha Nakshatra, the Sun and the Moon were in conjunction with Jyeshtha Nakshatra and were in Vriscika zodiac sign. From Jyeshtha Nakshatra, Sun and Moon were afflicting Rohini by their 7^{th} Drishti. Since Karna and Vyasa told that Rahu (Ascending node of Moon) was approaching Sun, it shows that on the very same day, a Solar eclipse also occurred and Rahu was also at or nearer to Jyeshtha Nakshatra and Ketu (Descending node of Moon) was 180º apart.

3. Karna told Sree Krishna that Saturn was afflicting Rohini and in the same way Vyasa told Dhritarashtra that Saturn was afflicting Rohini and Purva Phalguni Nakshatra. Besides Vyasa mentioned that Saturn was placed nearer to Visakha Nakshatra. Visakha is in Vriscika and Tula zodiac sign, hence Saturn must be in Vriscika or in Tula zodiac sign. However, Saturn had to afflict both Rohini and Purva Phalguni by its 3^{rd} or 7^{th} or 10^{th} Drishti. Hence Saturn should be in Vriscika, so that it could afflict Rohini with its 7^{th} Drishti and Purva Phalguni with its 10^{th} Drishti. It was nearer to Visakha, hence it was either in conjunction with Anuradha or Jyeshtha Nakshatra.
4. Karna told Sree Krishna that Mars was harassing Jyeshtha and was praying to come towards Anuradha Nakshatra, in a friendly manner. Vyasa told that Mars (Lohita) was concealing and fully covering (samavrutya) Sravana Nakshatra (Brahma Rasi) by staying apart (vyavasthita).
5. Vyasa told Dhritarashtra that Jupiter was nearer to Visakha Nakshatra and it also afflicts Rohini Nakshatra. Since Visakha and Rohini are far apart, separated by 15 Nakshatra and are almost situated opposite in the zodiac cycle of 360 degrees, Jupiter could not be at Rohini. Jupiter has 5^{th}, 7^{th} and 9^{th} Drishti and Jupiter was nearer to Visakha Nakshatra. Hence Jupiter should be either in Vriscika zodiac sign in conjunction with Anuradha or Jyeshtha (7^{th} Drishti to Rohini of Vrishabha zodiac sign) or in Kanya Zodiac sign in conjunction with Uttara Phalguni or Hasta or Citra Nakshatra (9^{th} Drishti to Rohini of Vrishabha zodiac sign).
6. Veda Vyasa mentioned that Venus was imposing upon Purva Bhadrapada Nakshatra with shining and was looking attentively all round at Uttara Bhadrapada Nakshatra. Purva and Uttara Bhadrapada Nakshatra are situated at 320º to 346º 40′. Since Sun was at Jyeshtha Nakshatra (226º 40′ to 240º) as Amavasya fell on Jyeshtha Nakshatra, Venus could not be at Purva and Uttara Bhadrapada Nakshatra, as the difference in longitude at the minimum will be 80º. This is because the maximum elongation of Venus i.e. the difference between the longitudes of Sun and Venus is 45º to 47º. Since Veda Vyasa told that Venus was looking attentively at Uttara Bhadrapada Nakshatra, we can take that Venus was situated in Kanya zodiac sign and thus looked at Purva and Uttara Bhadrapada Nakshatra which

are situated at Meena zodiac sign (7th from Kanya) by its 7th Drishti. Here also Venus cannot be more than 47º in longitude from Sun. The Sun was at Jyeshtha Nakshatra (226º 40′ to 240º). Thus, here the minimum difference is 46º 40′. This is further acceptable because of the following two facts. 1. Venus and Sun travelled at least 12º from the position of Karthika Paurnami to Amavasya and then the difference will be less by 12 º i.e. 34º 40′, which is more and easily acceptable. 2. Though the sentence is in present tense, as per Panini's Ashtadhyayi 3:3:131, a verb of present tense can also denote an incidence of recent past. Hence, it is acceptable and there is no contradiction. Thus, we can conclude that Venus was situated around 180º either in Kanya or Tula zodiac sign.

7. Karna told Sree Krishna that Moon was in a bad situation and Vyasa also told in the same way. Further, Vyasa told that on the Karthika Paurnami (Full Moon) day, the Moon was non-existent without light rays and was invisible. Besides, Vyasa told that the Moon and the Sun were seized in the same month. Hence there was a possibility of a Lunar Eclipse occurred in the Karthika month at Paurnami (as he used the words 'in the same month').
8. Veda Vyasa told that the Amavasya occurred on the 13th day after Paurnami and it was a very rare event. Hence the difference of time between Karthika month Paurnami and Amavasya and hence between the Lunar and Solar eclipse was only 13 days.
9. Sree Krishna started his peace mission at Revati Nakshatra of Karthika month and Veda Vyasa told that it was Karthika Paurnami and thus, all these events were happened in Karthika and Margasirsha months.
10. Mahabharata text, at Udyoga Parva 83rd Adhyaya 7th sloka, showed that the season was at the end of Sarad ritu and Hemanta ritu was going to come. Hence, all these events were happened at the end part of Sarad ritu and in the early part of Hemanta ritu.

36 years of gap

Before going to the derivation of the positions of Graha, one important aspect has to be studied. The internal evidences found in Mahabharata text shows that there was a gap of at least 36 years or a few years more between the time of Mahabharata war and the beginning of Kaliyuga. In Mahabharata text at Stree Parva at 25th Adhyaya 44th sloka, it is found that Gandhari, wife of Dhritarashtra told that 36 years after Mahabharata war, there would be destruction of Yadava vamsa to which Sree Krishna belonged.

त्वमप्युर्णस्थते वर्षषट् त्रिंशे मधुसूदन । 44 ।

In Mausala Parva at 1st Adhyaya 1st sloka, it was mentioned that Yudhishtira had seen bad signs at 36 years. In the same Mausala Parva at 1st Adhyaya 3rd sloka it was mentioned when 36 years was reached, a great calamity overtook Vrishni (Yadava). Impelled by time, they all met with destruction in consequence of the iron bolt or pestle.

Sree Krishna remembered the curse of Gandhari at 36th year and told Yadava that as happened during the time of Mahabharata war, Amavasya (New Moon) coincided with the 13th Lunation and the 14th Lunation was made as 15th by Rahu. Hence, there was a difference of a minimum of 36 years between the Mahabharata war and the beginning of Kaliyuga. (Refer

Mauasala Parva 2nd Adhyaya 18 to 21 Sloka).

In Mausala Parva, at 1st Adhyaya 7th sloka, it was mentioned that Yadava fought among themselves with discs and clubs after a period of time, further after this 36 years duration.

कस्यचित् त्वथ कालस्य कुरुराजो युधिष्ठिरः । शश्रवृष्णि चक्रस्य मौसल कदनं कृतम् ॥ 7 ॥

The meaning of कस्यचित् काल is after some time. Further, in Mausala Parva at 2nd Adhyaya 24th sloka and 3rd Adhyaya 7th sloka, it was mentioned that as per the instructions of Sree Krishna, Vrishni people (Yadava) went on to pilgrimage to sea sore holy places and started residing at Prabhasa Pattanam. Thus, these three sloka show that the time gap between the Mahabharata war and the beginning of Kaliyuga was not 36 years but a few more years beyond 36 years.

Thus, the evidences narrated clearly shows the positions of 8 Graha in the zodiac signs and the occurrence of Lunar and Solar eclipses in the same month, at 13 days interval and also points out that the Kaliyuga started at 3101 B.C.E. (current) and Mahabharata war was fought before the dawn of the Kaliyuga and the time duration between Mahabharata war and beginning of Kaliyuga was either 36 years or a few years more than 36 years.

Actual Derivation

To derive the actual position of the 9 Graha (Navagraha), a novel yet a well-established approach is followed. In the ancient Astronomical and Mathematical texts of our Nation, there described methods to derive the positions of Graha for any particular time, from the Epoch mentioned in that particular text. They are 1. Ahargana calculation i.e. the number of days elapsed since the Epoch, 2. Derivation of the Madhya (Mean) position of the Graha, 3. Application of Manda (Apsis) and Sighra corrections to derive the Sphuta (Exact) positions of the Graha and 4. Application of Desantara and Bhujantara corrections to the mean and exact positions respectively.

1. Ahargana: This is the number of days elapsed since the particular Epoch. Calculate the number of years elapsed since the Epoch mentioned in the particular astronomical text we have chosen. Then multiply it by 12. This is the number of months elapsed up to the beginning of the year. Add the number of months elapsed in the current year. The result, say x is multiplied by 15,93,336 and divided by 5,18,40,000 to get the adhikamasa i.e. excess months (in integral number omitting the fraction) elapsed. (In 5,18,40,000 months, there will be 15,93,336 excess months). Add the excess months to x, to get the total months elapsed which is multiplied by 30, to get the total thithi elapsed. Add to it, the number of thithi elapsed in the current month. The result is say y, which is multiplied by 2,50,82,580 and divided by 160,30,00,080. (2,50,82,850 omitted thithi present in 160,30,00,080 thithi). Subtract the result (in integral number omitting the fraction) from y. The resultant value is the Ahargana.
2. In all the astronomical texts of our Nation, especially Aryabhattiyam, Surya Siddhanta, Laghu and Mahabhaskariyam, Vatesvara Siddhanta, Sishyadhi Vruddhida Tantra etc., the

value of the total revolutions of all Graha during a particular period i.e. either a Mahayuga of 43,20,000 years or a Kalpa of 432 crore years are given. By multiplying the Ahargana with the total number of revolutions of that particular Graha divided by the total number of days of either Mahayuga (157,79,17,500) or Kalpa (1,57,791,75,00,000) respectively, one can get the angular distance travelled by the Graha during the Ahargana period. The integral number shows the completed revolutions and the fraction shows the incomplete revolutions. Since one revolution is of 360º, the fraction showing incomplete revolutions is multiplied by 360 to get the angular distance travelled by the Graha. Add it to the original mean position of the Graha at Epoch. (In case of Rahu and Ketu subtract it, as they are revolving in the reverse direction). This gives the Madhya (mean) position of the Graha on the particular day of the selected month and year.

3. To the mean position, add or subtract desantara correction to get the position of the Graha at the required place. In ancient texts of Bharat, the referral longitude was Ujjaini and Lanka. (This is different from the present day Sri Lanka). From that we have to calculate the longitude difference in degrees between Ujjaini and the required place. Multiply it by mean daily motion of that Graha in degrees and divide it by 360. The result is either added or subtracted to the mean position of the Graha arrived in the previous step. If the place is west to Ujjaini we have to subtract and if it is east then we have to add.
4. To get the Sphuta (exact) position of the Graha, we have to apply the Manda (Apsis) correction to Sun, Moon, Jupiter, Saturn, Mars, Venus and Mercury, as all these 7 Graha has Manda Epicycles. Sighra correction is to be applied to Jupiter, Saturn, Mars, Venus and Mercury, as these Graha have both Manda and Sighra Epicycles. In the case of Sun and Moon, the following procedure is applied. Vatesvara Siddhanta, the ancient astronomical text, gave the positions of Mandoccha (Apsis) of all these 7 Graha at the beginning of Kaliyuga. Surya Siddhanta, the very ancient astronomical text, gave the velocity of revolutions of the Mandoccha (Apsis) of these 7 Graha. From this we can calculate the Mandoccha of a particular Graha at a particular period. Then subtract the mean position of the Graha from its Mandoccha. This is Manda Anomaly or Manda Kendra (m). Find out the sine value of this Manda Anomaly. If the Manda anomaly is less than 180º, then the Manda correction is to be added to the mean position of the Graha or otherwise subtracted. As given in Surya Siddhanta, the periphery of Manda epicycle for Sun is 13.6667º in odd quadrants (p_o) and in even quadrants it is 14º (p_e). and that of Moon, the values are 31.6667º (p_o) and 32º (p_e). Then calculate the corrected periphery of the Manda epicycle (PEM) using the formula, $PEM = p_e - [(p_e - p_o) \times \text{sine } m]$. The Manda correction will be 3438 x (PEM/360º) x sine m. 360 is the total degrees of a circle and 3438 is R sine value in Bharatian Trigonometry and is the radius of a circle expressed in minutes of arc. From this formula, we can calculate the Manda (Apsis) correction value and if applied to mean position of Sun or Moon, we can get the exact position of the Sun or Moon respectively. The periphery of Manda epicycle for the 7 Graha are given in Surya Siddhanta and other astronomical texts of our Nation.

5. In the case of Jupiter, Saturn, Mars, Venus and Mercury, the following procedure is applied. Here to get the Manda anomaly or Manda Kendra (m), mean position of the Graha is subtracted from its Mandoccha. If the Manda anomaly is less than 180º, the Manda correction is to be added to the mean position of the Graha or otherwise subtracted. Get the sine value of this Manda Anomaly. Then calculate the corrected periphery of the Manda epicycle (PEM) using the formula PEM= $p_e - [(p_e - p_o)$ x sine m]. Then Manda correction is 3438 x (PEM/360º) x sine m. 360 is the total degrees of a circle and 3438 is R sine value in Bharatian Trigonometry and radius of a circle expressed in minutes of arc.

   Next step is to get the Sighra correction for these 5 Graha. For Jupiter, Saturn and Mars their Sighroccha is the mean Sun. For Venus and Mercury their Sighroccha can be calculated, as the revolutions of their Sighroccha in a particular period are given in all astronomical texts. The Sighra anomaly or Sighra Kendra (s) of Jupiter, Saturn and Mars can be obtained by subtracting their mean position from mean Sun. For Venus and Mercury, it is by subtracting mean Sun from their Sighroccha position. In both cases we can get the Sighra correction by the formula R sine Sighraphala = (r/k) x R sine s, where r is the corrected radius of the sighra epicycle of the Graha, k is the sighra hypotenuse (Sighrakarna) and R sine s is the Bharatian sine of Sighra anomaly s of the Graha. The peripheries of the Sighra Epicycles of these Graha are given for odd and even quadrants in the astronomical texts of our Nation. From this, the corrected periphery of Sighra epicycle can be calculated using the formula, as in the case of Manda epicycle, PES= $p_e -$ $[(p_e - p_o)$ x sine s]. Then the following steps are used, where R is 3438, the Bharatian R sine value and radius expressed in minutes of arc.

   Dohphala = (PES / 360º) x R sine s, Kotiphala = (PES/ 360º) x R cos s, Sphutakoti = R± Kotiphala, Sighrakarna (Sighra Hypotenuse) =$\sqrt{(\text{Dohphala})^2 + (\text{Sphutakoti})^2}$, Then sighra correction = sine^{-1}(dohphala / sighrakarna). Sighra correction is additive if Sighra anomaly is less than 180º and subtractive if more than 180º.

   After getting the value of Manda correction and Sighra correction, the following procedures will be applied.

   Procedure 1, P1 = Mean position ± sighra correction

   Procedure 2, P2 = P1 ± manda correction

   Procedure 3, Calculate the manda correction for this P2 value and apply it fully to the original Mean position to get P3.

   Procedure 4, Calculate sighra correction for P3 and apply it fully to P3. This is P4.

   This P4 becomes the true (Sphuta or exact) position of the Graha. These steps are found in the ancient astronomical texts of our Nation, especially Surya Siddhanta

6. Bhuajantara Correction: The true midnight differs from the mean midnight by an amount of time known as ‘equation of time’ due to eccentricity of the Earth’s orbit and obliquity of the ecliptic with the celestial equator. To correct it, Bhujantara correction is applied to

the Sphuta position of Graha. The formula is [manda correction of Sun in degrees x daily mean motion of the Graha in degrees ÷ 360º]. If the manda correction of Sun is positive, it is additive and if negative, it is then subtractive.

Method applied

From the calculations described so far, one can calculate the exact positions of the Graha for any date. To calculate the positions of Graha at the first day of Mahabharata war, we can do the same calculations in the reverse order. This is because, we are calculating the Mean position of a Graha for an ancient date from the mean position of Graha of recent date. Thus, to get their mean position of Graha at an ancient date, instead of adding the value in degrees of the incomplete revolutions of Sun, Moon, Jupiter, Saturn, Mars, Venus and Mercury to their mean position of recent date, as shown in the 2nd step shown above, it is subtracted, as we are going in the reverse order. For Rahu and Ketu, instead of subtracting, we are adding, as Rahu and Ketu are revolving in the reverse direction.

Ahargana calculation is followed from Laghubhaskariyam of Bhaskara. The statistical values showing the number of revolutions of each Graha in a Mahayuga of 43,20,000 years and the value of total number of days in a Mahayuga are followed from Vatesvara Siddhanta and Sishyadhi Vruddhida Tantra. The mandoccha values of the Graha at Kaliyuga beginning are followed from Vatesvara Siddhanta and the value of number of revolutions of mandoccha of the Graha in a Kalpa of 432 crore years are followed from Surya Siddhanta. The values of Manda and Sighra epicycles at odd and even quadrants are followed from Surya Siddhanta. The calculations are made as shown in Surya Siddhanta, Vatesvara Siddhanta and Laghubhaskariyam.

The reference point is Chaitra month, Sukla Prathama thithi, at Sun rise (first day) of the year 1442 Salivahana Saka. The reference longitude is that of Ujjaini. This is because, in the ancient days it is the 0º longitude like today's Greenwich. The mean positions of the Graha or their Sighrakendra on this day at Sunrise at Ujjaini are given in the astronomical text Grahalaaghavam (ग्रहलाघवम्) authored by the famous astronomer and mathematician Ganesa Daivajna (गणेश दैवज्ञ) of 1520 B.C.E., i.e. almost 500 years before present (as on 2019 C.E.). Refer Grahalaaghavam by Sri Ganasa Daivajna with Sanskrit commentary of Mallari and 'Candrika' Hindi commentary pages 6 to15 (Chowkhamba Sanskrit Series Office, Varanasi 1994) and Ganesa Daivajna Kruta Grahalaaghavam with Mallari and Visvanatha Sanskrit commentary and Kedaradatta Joshi Hindi commentary (Motilal Banarsidass1994, 9 to 22 pages). Salivahana Saka 1442 is 1520 C.E. (1442+78). In this text at the 1st Adhyaya (Madhyama Adhikara:) 4th sloka shows the year of composition of the text is shown as 1442 Salivahana Saka (1520 C.E.) and 8th sloka shows the mean position of Sun, Moon, Rahu, Mars, Jupiter and Saturn and Sighrakendra of Mercury and Venus at the year 1442 Salivahana Saka, Chaitra month, Sukla Prathama thithi, at Sun rise, at the longitude of Ujjaini. This is given in the following table.

Graha	Zodiac Signs (Rasi)	Amsa	Kala	Degrees (Rasi x 30) + Amsa	Minutes (Kala)
Sun	11	19	41	349	41
Moon	11	19	06	349	06
Rahu	00	27	38	027	38
Mars	10	07	08	307	08
Mercury Sighra Kendra	08	29	33	269	33
Jupiter	07	02	16	212	16
Venus Sighra Kendra	07	20	09	230	09
Saturn	09	15	21	285	21
Moon Apsis (Uccha)	05	17	33	167	33

Thus, these are the mean positions of Sun, Moon, Rahu (Ascending Node of Moon), Mars, Jupiter and Saturn and the Sighra Kendra of Mercury and Venus at the year 1442 Salivahana Saka, Chaitra month, Sukla Prathama thithi, at Sun rise, at the longitude of Ujjaini. Sighrakendra will be explained in the next Chapter and Ketu (Descending Node of Moon) will be 180 degrees apart from Rahu.

Then it is back calculated following the methods already elaborated and by doing so, we can get the mean positions of Graha for any year in the past, on the Amavasya day (New Moon day) of Karthika month. From the mean (Madhya) positions of the Graha, we can get the true or exact (Sphuta) positions of the Graha by following the steps explained already. First of all, the position of Rahu is assessed on the day of Karthika Amavasya, since a Solar Eclipse occurred at Jyeshtha Nakshatra on Karthika month Amavasya day. Thus, the position of Rahu should be at or very nearer to Jyeshtha Nakshatra. If it is satisfied, then the positions of Sun and Moon are assessed on Karthika Amavasya day. They should be at Jyeshtha Nakshatra, as Sree Krishna told that Amavasya was going to happen at Jyeshtha Nakshatra. If satisfied, then the positions of other Graha are calculated for Karthika Amavasya day. If they also satisfied the details given internally in Mahabharata text, then that year is taken as the date of Mahabharata war. By trial and error method and by repeated calculations, the result is obtained and is given below.

Calculations

Here the final result alone is shown i.e. the calculation for the year which satisfied the astronomical events described in Mahabharata Text of Veda Vyasa alone is shown here. The calculations for other years are omitted for want of space.

Ahargana Calculation

This is as per Laghubhaskariyam 1 **:** 4 to 8.

Year of Grahalaaghavam 1442 Salivahana Saka (current) and it is the first day of the year (Chaitra Sukla Prathama Thithi).

Hence Elapsed years since Salivahana Saka are = 1441

Starting year of Salivahana Saka since Kaliyuga = 3179

Before the beginning of Kaliyuga = 41

Therefore total years = 4661

Thus the years elapsed are 4661.
4661 has to be multiplied by 12 to get the months elapsed.
4661 x12 = 55,932.
Since Mahabharata war began on the last day of Karthika month, then 4 months were elapsed if we back calculate. (Phalguna, Magha, Pushya and Margasirsha).
Hence total months elapsed 55,932 +4 = 55,936.
For these 55,936 months, the excess months are 1,719 ([55,936 x 15,93,336] ÷ 5,18,40,000).
Omit the fraction which is an incomplete month.
This is because in 5,18,40,000 months there will be 15,93,336 excess months as per Laghubhaskariyam 1 **:** 4 to 8.
Add excess months to the months elapsed. 55,936 + 1719 = 57,655.
Multiply it with 30 to calculate the days elapsed 57,655 x 30 = 17,29,650.
For these 17,29,650 days, omitted thithi are 27,064 ([17,29,650 x 2,50,82,580] ÷ 160,30,00,080).
Omit the fraction which is an incomplete thithi.
This is because in 160,30,00,080 days 2,50,82,580 are the omitted thithi as per Laghubhaskariyam 1 **:** 4 to 8.
Now subtract the omitted thithi from the days elapsed.
17,29,650 – 27,064 = 17,02,586.
Now, 17,02,586 is the number of days elapsed from Karthika month, Amavasya thithi, in 42nd year before Kaliyuga to 1442 Salivahana Saka, Chaitra month, Sukla Prathama thithi.
Thus Ahargana is 17,02,586.

Derivation of position of Rahu

Rahu is the Ascending Node of Moon. It has a revolution velocity of 2,32,226 revolutions (360º) in a reverse backward direction, in 157,79,17,500 days of a Yuga of 43,20,000 years, as per Sishyadhi Vruddhida Tantra of Lallacarya (1**:**4 to 8).

Hence, in the Ahargana days of 17,02,586, Rahu revolved by 250**.**5737698175 revolutions. (17,02,586 x 2,32,226) ÷ 157,79,17,500 = 250**.**5737698175 revolutions. In this 250 are complete revolutions and the remaining 0**.**5737698175 is the incomplete revolutions. The incomplete revolutions should be converted into degrees of arc. It will be 206º 33′ 25″ 41**.**01‴. (0**.**5737698175 x 360 to get degrees of arc, then remaining fraction multiplied by 60 to get minutes of arc, like that up to seconds and thirds of arc). Since Rahu and Ketu are revolving in backward direction and we are calculating it for the year of past, we have to add this value to the mean position of Rahu at 1442 Salivahana Saka, which was at **27º 38′.**
027º 38′ 00″00.00‴ + 206º 33′ 25″ 41**.**01‴ = 234º 11′ 25″ 41**.**01‴.
Thus, **234º 11′ 25″ 41.01‴** was the position of Rahu on Amavasya thithi of Karthika Month at 42nd year before Kaliyuga at Ujjaini.
Since, Mahabharata text describes the positions of Graha at Hastinapura (the dialogues between Sree Krishna and Karna and also the explanations of bad signs by Veda Vyasa to Dhritarashtra

were happened at Hastinapura), we have to calculate the positions of Graha at Hastinapura only. Since the text Grahalaaghavam mentioned the mean positions of Graha at Ujjaini, we have to do Desantara correction to know the positions of Graha ta Hastinapura.

Desantara Correction for Rahu

Longitude of Ujjaini 75**.**7849º East, Longitude of Hastinapura 78**.**02º East.

Longitude Difference is **02.2351º** towards East.

The angle of arc difference for Rahu is calculated by multiplying daily mean motion of Rahu (0**.**0529820856º) with Longitude difference between Ujjaini and Hastinapura in degrees and divide the value by 360º. Thus, the angle of difference is 01″11**.**05‴,

[(2**.**2351º x 0**.**0529820856º) ÷ 360º].

Since, Rahu is revolving backwards and Hastinapura is more East than Ujjaini we have to subtract this angle of arc difference from the value got in previous calculation.

234º 11′ 25″ 41**.**01‴ – 01″11**.**05‴ = 234º 11′ 24″ 29**.**96‴.

Thus, position of Rahu on Amavasya thithi Karthika Month at 42nd year before Kaliyuga at Hastinapura was **234º 11′ 24″ 29.96‴.**

Since Jyeshtha Nakshatra is situated in the zodiac at 226º 40′ to 240º 00′, Rahu was in conjunction with Jyeshtha Nakshatra. This satisfies the statement of Mahabharata text that Karthika Amavasya would fall on Jyeshtha Nakshatra as per Sree Krishna's statement to Karna in Udyoga Parva 142nd Adhyaya at 18th sloka and Karna and Vyasa's statement Udyoga Parva, 143rd Adhyaya 11th sloka and in Bhishma Parva 3rd Adhyaya 11th sloka respectively that Solar eclipse was going to occur on Karthika Amavasya day. Scientifically Solar Eclipse will occur only on the day of Amavasya. Thus, Solar eclipse also happened in Jyeshtha Nakshatra only. Then it means that Rahu should be at or nearer to Jyeshtha Nakshatra. The above derivation showed that Rahu was in conjunction with Jyeshtha Nakshatra. Thus, it fully satisfies the statements in Mahabharata text of Veda Vyasa.

Now we have to derive the position of Rahu at the end of Amavasya thithi. This can be done only after obtaining the positions of Sun and Moon on the day of Amavasya of Karthika month at 42nd year before Kaliyuga. Hence it will be shown after the derivation of the positions of Sun and Moon.

<u>Derivation of position of Sun</u>

Sun revolves at the velocity of 43,20,000 revolutions in 157,79,17,500 days of a Yuga of 43,20,000 years as per Sishyadhi Vruddhida Tantra of Lallacarya (1**:**4 to 8). That means one revolution every year. This is because, the revolutions of the Earth around the Sun in the Ecliptic is seen as the apparent revolutions of the Sun. This is like a person sitting in a boat sees that the trees etc. on the river bank are moving in the reverse direction, though they are stationary. This is Aryabhatta's example in his Aryabhattiyam (4**:**9).

Hence, in the Ahargana days of 17,02,586, the Sun revolved by 4661**.**3156391256 revolutions. ([17,02,586 x 43,20,000] ÷ 157,79,17,500. Here 4661 are completed revolutions. The remaining

0.3156391256 are the incomplete revolutions. The incomplete revolutions should be converted into degrees of arc. It will be 113º 37′ 48″ 18.41‴ (0.3156391256 x 360 to get degrees of arc, then remaining fraction multiplied by 60 to get minutes of arc, like that up to seconds and thirds of arc). We have to subtract this value from the mean position of Sun at 1442 Salivahana Saka at Ujjaini (which was at **349º 41′**), as we are back calculating, for the year of past.

349º 41′ 00″ 00.00‴ – 113º 37′ 48″ 18.41‴ = **236º 03′ 11″ 41.59‴.**

This is the mean position of Sun on Amavasya thithi of Karthika Month at 42nd year before Kaliyuga at Ujjaini.

Then Desantara correction is applied to know the mean position of Sun at Hastinapura.

The angle of arc difference for Sun is calculated by multiplying daily mean motion of Sun (0.9856028595º) with Longitude difference between Ujjaini and Hastinapura in degrees and divide the value by 360º. Thus the angle of difference is **22″ 01.75‴,**

[(2.2351º x 0.9856028595º) ÷ 360º].

Since, Hastinapura is more East than Ujjaini, we have to add this angle of arc difference to the mean position of Sun at Ujjaini, which is calculated above.

236º 03′ 11″ 41.59‴ + 22″ 01.75‴ = 236º 03′ 33″ 43.34‴.

Thus, mean position of Sun on Amavasya thithi of Karthika Month at 42nd year before Kaliyuga at Hastinapura was **236º 03′ 33″ 43.34‴.**

Now we have to get the Equation of Center (Manda correction) for the mean position. This is because, the Earth is revolving the Sun in an elliptical circle and not in a perfect circle and also the Sun is situated eccentrically i.e. not at the perfect center of Earth's revolution circle. Hence, the ancient astronomical texts of our Nation followed two methods to correct this. They are 1. Epicyclic model and 2. Eccentric model. In this book the Epicyclic model is followed.

To do the Equation of Center (Manda) correction, we have to know the position of Mandoccha at the required year, i.e. 42nd year before Kaliyuga.

Vatesvara Siddhanta at 1:4:56 to 62 sloka gives the position of Sun's Mandoccha at the beginning of Kaliyuga as 78º 51′ 37″ and the velocity of Sun's Mandoccha as per Surya Siddhanta at 1:40 & 41 is 387 revolutions in 432 crore years of one Kalpa. Based on this we can calculate the positions of Mandoccha at 42nd year Karthika month Amavasya day (last day of Karthika month as it is an Amanta type of month calculation).

[(41.3333 x 387 x 360 x 60 x 60) ÷ 432,00,00,000] in seconds of arc.

It is 04″ 47.90‴. As we are back calculating for a year of past, it has to be subtracted,

78º 51′ 37″– 04″ 47.93‴ =78º 51′ 32″ 12.07‴.

Hence, Sun's Mandoccha on Karthika month Amavasya day at 42nd year before Kaliyuga was **78º 51′ 32″ 12.07‴.**

Now we have to calculate Manda anomaly or Manda Kendra (m) by subtracting Mean Sun from Mandoccha.

(78º 51′ 32″ 12.07‴ + 360º) –236º 03′ 33″ 43.34‴= **202º 47′ 58″ 28.73‴** (202.7996º).

Here 360º are added to Mandoccha, as Mandoccha is less than Mean Sun.
Since Manda Anomaly (m) is more than 180º, Manda correction is subtractive.
Sine value of this Manda anomaly 202**.**7996º is (sine m) – 0**.**38750915.
Sun's Manda epicycle is 13**.**6667º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 14º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2**:**34 to 37.
Hence, Sun's corrected periphery of Epicycle (PEM) for this Manda anomaly value is,
$PEM = p_e - [(p_e - p_o)$ x sine m. Thus the value is 14**.**1291567997.
Now the Manda correction (Equation of Center) is [(PEM/360º) x 3438 x Sine m].
Here the value is 52**.**2879455229′ i.e. **00º 52′ 17″ 16.60‴.**
It has to be subtracted from the Mean Sun, as the Manda anomaly (m) is more than 180º.
Thus, mean true Sun is 236º 03′ 33″ 43**.**34‴ – 00º 52′ 17″ 16.60‴ = **235º11′ 16″ 26.74‴.**
Now we have to apply the Bhujantara correction, which is explained already.
The formula is [manda correction of Sun in degrees x daily mean motion of the Graha in degrees ÷360º]. If the manda correction of Sun is positive, it is additive and if negative, it is then subtractive. The calculated value is 00º 00′ 08″ 35**.**35‴. It is subtracted from the above value of mean true Sun to get the exact or true or sphuta Sun.
235º11′ 16″ 26**.**74‴– 00º 00′ 08″ 35**.**35‴ =235º 11′ 07″ 51**.**39‴.
Thus, the exact (Sphuta, True) position of the Sun on Karthika Amavasya day of Karthika month at 42nd year before Kaliyuga, at Hastinapura was **235º 11′ 07″ 51.39‴.**
Since Jyeshtha Nakshatra is situated in the zodiac at 226º 40′ to 240º 00′, Sun was in conjunction with Jyeshtha Nakshatra. This satisfies the statement of Mahabharata text of Veda Vyasa that Karthika Amavasya would fall on Jyeshtha Nakshatra as per Sree Krishna's statement to Karna in Udyoga Parva 142nd Adhyaya at 18th sloka. Thus, it fully satisfies the statements in Mahabharata text of Veda Vyasa. Further, Vyasa mentioned as shown in Bhishma Parva, 3rd Adhyaya, 17th sloka that both Moon and Sun were afflicting Rohini Nakshatra. Sun has 7th Drishti and Rohini is situated in Vrishabha zodiac sign which is 7th from Vriscika zodiac sign in which Jyeshtha Nakshatra is situated. Thus, this statement of Vyasa also fully satisfied.
Now we have to derive the position of Sun at the end of Amavasya thithi. This can be done only after obtaining the positions of Moon on the day of Amavasya of Karthika month at 42nd year before Kaliyuga. Hence it will be shown after the derivation of the positions of Moon.

<u>Derivation of position of Moon</u>

Moon revolves at the velocity of 5,77,53,336 revolutions in 157,79,17,500 days of a Yuga of 43,20,000 years as per Sishyadhi Vruddhita Tantra of Lallacarya (1**:**4 to 8).
Hence, in the Ahargana days of 17,02,586, the Moon revolved by 62,316**.**325997332 revolutions. ([17,02,586 x 5,77,53,336] ÷ 157,79,17,500. Here 62,316 are completed revolutions. The remaining 0**.**325997332 are the incomplete revolutions. The incomplete revolutions should

be converted into degrees of arc. It will be 117º 21′ 32″ 32**.**58‴ (0**.**325997332 x 360 to get degrees of arc, then remaining fraction multiplied by 60 to get minutes of arc, like that up to seconds and thirds of arc). Subtract this value from the mean position of Moon at 1442 Salivahana Saka at Ujjaini, (which was at **349º 06′**) as we are back calculating, for the year of past.

349º 06′ 00″ 00.00‴ – 117º 21′ 32″ 32**.**58‴ = **231º 44′ 27″ 27.42‴.**

This is the mean position of Moon on Amavasya thithi of Karthika Month at 42nd year before Kaliyuga at Ujjaini.

Then Desantara correction is applied to know the mean position of Moon at Hastinapura.

The angle of arc difference for Moon is calculated by multiplying daily mean motion of Moon (13**.**1763548855º) with Longitude difference between Ujjaini and Hastinapura in degrees and divide the value by 360º. Thus, the angle of difference is **04′ 54″ 30.28‴,**

[(2.2351º x 13**.**1763548855º) ÷ 360º].

Since, Hastinapura is more East than Ujjaini, we have to add this angle of arc difference to the mean position of Moon at Ujjaini, which is calculated above.

231º 44′ 27″ 27**.**42‴+ 04′ 54″ 30**.**28‴ = 231º 49′ 21″ 57**.**70‴.

Thus, mean position of Moon on Amavasya thithi of Karthika Month at 42nd year before Kaliyuga at Hastinapura was **231º 49′ 21″ 57.70‴.**

Now we have to get the Equation of Center (Manda correction) for the mean position. This is because, the Moon is revolving the Earth in an elliptical circle and not in a perfect circle and also the Earth is situated eccentrically i.e. not at the perfect center of Moon's revolution circle. Hence, the ancient astronomical texts of our Nation followed two methods to correct this. They are 1. Epicyclic model and 2. Eccentric model. In this book the Epicyclic model is followed.

To do the Equation of Center (Manda) correction, we first know the position of Mandoccha at the required year, i.e. 42nd year before Kaliyuga.

Vatesvara Siddhanta at 1**:**4**:**56 to 62 sloka gives the position of Moon's Mandoccha at the beginning of Kaliyuga as 90º and the velocity of Moon's Mandoccha as per Vatesvara Siddhanta at 1**:**1**:**12 to 14 is 4,88,211 revolutions in 43,20,000 years of one Yuga. Based on this we can calculate the positions of Mandoccha at 42nd year on Karthika month Amavasya day (last day of Karthika month as it is an Amanta type of month calculation).

[(41**.**3333 x 4,88,211) ÷ 43,20,000] in revolutions.

It is 4**.**6711508626 i.e. 4 complete revolutions and 0**.**6711508626 incomplete revolutions. 0**.**6711508626 x 360 to get degrees of arc, then remaining fraction multiplied by 60 to get minutes of arc, like that up to seconds and thirds of arc. The value is 241º 36′ 51″ 31**.**07‴ As we are back calculating for a year of past, it has to be subtracted.

(90º + 360 º) – 241º 36′ 51″ 31**.**07‴= 208º 23′ 08″ 28**.**93‴.

Here 360º are added to Mandoccha at Kali beginning (90º), as it is less than 241º 36′ 51″ 31**.**07‴.

Hence, Moon's Mandoccha on Karthika month Amavasya day at 42nd year before Kaliyuga was

208º 23′ 08″ 28.93‴.

Now we have to calculate Manda anomaly or Manda Kendra (m) by subtracting Mean Moon from Mandoccha.

(208º 23′ 08″ 28.93‴+ 360º) –231º 49′ 21″ 57.70‴= **336º 33′ 46″ 31.23‴** (336.5629º).

Here 360º are added to Mandoccha, as Mandoccha is less than Mean Moon.

Since Manda Anomaly (m) is more than 180º, Manda correction is subtractive.

Sine value of this Manda anomaly 336.5629º is (sine m) – 0.39774207.

Moon's Manda epicycle is 31.6667º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 32º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2:34 to 37.

Hence, Moon's corrected periphery of Epicycle (PEM) for this Manda anomaly value is,

PEM = $p_e - [(p_e - p_o)$ x sine m. Thus the value is 32.1325674319

Now the Manda correction (Equation of Center) is [(PEM/360º) x 3438 x Sine m].

Here the value is 122.0535255996′ i.e. **02º 02′ 03″ 12.69‴.**

It has to be subtracted from the Mean Moon, as the Manda anomaly (m) is more than 180º.

Thus, mean true Moon is 231º 49′ 21″ 57.70‴– 02º 02′ 03″ 12.69‴= **229º 47′ 18″ 45.01‴.**

Now we have to apply the Bhujantara correction, which is explained already.

The formula is [manda correction of Sun in degrees x daily mean motion of the Graha in degrees ÷360º]. If the manda correction of Sun is positive, it is additive and if negative, it is then subtractive. The calculated value is 00º 01′ 54″ 49.65‴. It is subtracted from the above value of mean true Moon to get the exact or true or sphuta Moon.

229º 47′ 18″ 45.01‴– 00º 01′ 54″ 49.65‴ = 229º 45′ 23″ 55.36‴.

Thus, the exact (Sphuta, True) position of the Moon on Karthika Amavasya Day of Karthika month at Hastinapura, at 42nd year before Kaliyuga was **229º 45′ 23″ 55.36‴.**

Since Jyeshtha Nakshatra is situated in the zodiac at 226º 40′ to 240º 00′, Moon was in conjunction with Jyeshtha Nakshatra. This satisfies the statement of Mahabharata text of Veda Vyasa that Karthika Amavasya would fall on Jyeshtha Nakshatra as per Sree Krishna's statement to Karna in Udyoga Parva 142nd Adhyaya at 18th sloka. Thus, it fully satisfies the statements in Mahabharata text of Veda Vyasa. Further, Vyasa mentioned as shown in Bhishma Parva, 3rd Adhyaya, 17th sloka that both Moon and Sun were afflicting Rohini Nakshatra. Moon has 7th Drishti and Rohini is situated in Vrishabha zodiac sign which is 7th from Vriscika zodiac sign in which Jyeshtha Nakshatra is situated. Thus, this statement of Vyasa also fully satisfied.

<u>Fixation of time of end of Amavasya Thithi and the occurrence of Solar eclipse</u>

The difference between the true Sun and true Moon will help us to fix the time of end of Amavasya thithi. Usually the Solar eclipse occurs around the end of Amavasya thithi because at the end of Amavasya thithi only, the longitudes of Sun and Moon will be same and both will be in exact conjunction.

True Sun on Karthika Amavasya day 42nd year before Kaliyuga was at 235º 11′ 07″ 51.39‴.

True Moon on Karthika Amavasya day 42nd year before Kaliyuga was at 229º 45′ 23″ 55.36‴.

The difference in longitude **005º 25′ 43″ 56.03‴.**

To cover this difference of longitude where the Sun's longitude is more than that of Moon, the Moon has to revolve more and during that period Sun will also revolve to certain amount. Thus, by calculating the Moon's revolution and the time required for this revolution and the Sun's revolution during the time of Moon's revolution, in multiple times, we can derive the exact time of Amavasya and the longitudes of Sun and Moon at that time.

The calculation shows the true Sun and Moon were at 235º 34′ 19″ 02.47‴ after a period of 9 hours 24 minutes 36 seconds and 09.12 thirds (9.4100422123 hours).

Thus, the true Sun and Moon at the end of Amavasya thithi of Karthika month at 42nd year before Kaliyuga at Hastinapura were **235º 34′ 19″ 02.47‴.**

During this period of 9 hours 24 minutes 36 seconds and 09.12 thirds, Rahu would have travelled 00º 01′ 14″ 47.07‴ in backward direction. Rahu's mean daily velocity is 0.0529820856º or 3.1789251339′ i.e. in 24 hours Rahu revolves 3.1789251339′. Then in 9 hours 24 minutes 36 seconds and 09.12 thirds (9.4100422123 hours) it will revolve 01′ 14″ 47.07‴. Since Rahu revolves in backward direction it has to be subtracted.

Rahu position on Amavasya day of Karthika month at 42nd year before Kaliyuga at Hastinapura was 234º 11′ 24″ 29.96‴.

Rahu travelling in 9.4100422123 hours was – 000º 01′ 14″ 47.07‴.

The value was 234º 10′ 09″ 42.89‴.

Thus, Rahu position at the time of end of Amavasya in Karthika month of 42nd year before Kali yuga at Hastinapura was **234º 10′ 09″ 42.89‴.**

Now the difference between the longitude of Sun and Rahu was **001º 24′ 09″ 19.58‴**at the time of end of Amavasya thithi in Karthika month at 42nd year before Kaliyuga beginning.

(235º 34′ 19″ 02.47‴– 234º 10′ 09″ 42.89‴= 001º 24′ 09″ 19.58‴).

Hence, a Solar eclipse is definite to occur, as the limit of Solar eclipse is 15.4º to 18.4º i.e. the difference in longitude between Sun and Rahu should be less than 15.4º to 18.4º.

Position of Ketu

Ketu (Descending Node of Moon) is always at 180º apart from Rahu, the Ascending Node of Moon. Hence, Ketu was situated at **54º 11′ 24″ 29.96‴** on Amavasya day of Karthika month at 42nd year before Kaliyuga at Hastinapura. (234º 11′ 24″ 29.96‴ – 180º). Thus, Ketu was situated at **54º 10′ 09″ 42.89‴** in conjunction with Mrigasira Nakshatra, at the time of end of Amavasya in Karthika month of 42nd year before Kali yuga at Hastinapura.

Derivation of position of Jupiter

Jupiter revolves at the velocity of 3,64,220 revolutions in 157,79,17,500 days of a Yuga of 43,20,000 years as per Vatesvara Siddhanta (1**:**1**:**12 to 14).

Hence, in the Ahargana days of 17,02,586, Jupiter revolved by 392**.**9963847413 revolutions. ([17,02,586 x 3,64,220] ÷ 157,79,17,500). Here 392 are completed revolutions. The remaining 0**.**9963847413 are the incomplete revolutions. The incomplete revolutions should be converted into degrees of arc. It will be 358º 41′ 54″ 37**.**48‴ (0**.**9963847413 x 360 to get degrees of arc, then remaining fraction multiplied by 60 to get minutes of arc, like that up to seconds and thirds of arc). We have to subtract this value from the mean position of Jupiter at 1442 Salivahana Saka at Ujjaini which was at **212º 16′,** as we are back calculating for the year of past.

212º 16′ 00″ 00.00‴+ 360º – 358º 41′ 54″ 37**.**48‴ = **213º 34′ 05″ 22.52‴,** which is the mean position of Jupiter on Amavasya thithi of Karthika Month at 42nd year before Kaliyuga at Ujjaini. 360º is added, as the mean position of Jupiter at 1442 Salivahana Saka at Ujjaini is less than 358º 41′ 54″ 37**.**48‴.

Then, Desantara correction is applied to know the mean position of Jupiter at Hastinapura.

The angle of arc difference for Jupiter is calculated by multiplying daily mean motion of Jupiter (0**.**0830963596º) with Longitude difference between Ujjaini and Hastinapura in degrees and divide the value by 360º. Thus, the angle of difference is **01″ 51.44‴,**

[(2.2351º x 0**.**0830963596º) ÷ 360º].

Since, Hastinapura is more East than Ujjaini, we have to add this angle of arc difference to the mean position of Jupiter at Ujjaini, which is calculated above.

213º 34′ 05″ 22**.**52‴+ 01″ 51**.**44‴ = 213º 34′ 07″ 13**.**96‴.

Thus, mean position of Jupiter on Amavasya thithi of Karthika Month at 42nd year before Kaliyuga at Hastinapura was **213º 34′ 07″ 13.96‴.**

Now we have to get the Equation of Center (Manda correction) for the mean position. This is because the Jupiter is revolving the Sun in an elliptical circle and not in a perfect circle and also the Sun is situated eccentrically i.e. not at the perfect center of Jupiter's revolution circle. Hence, the ancient astronomical texts of our Nation used two methods to correct this. They are 1. Epicyclic Model and 2. Eccentric model. In this book the Epicyclic model is followed.

To do the Equation of Center (Manda) correction, we first know the position of Mandoccha at the required year, say here, 42nd year before Kaliyuga.

Vatesvara Siddhanta at 1**:**4**:**56 to 62 sloka gives the position of Jupiter's Mandoccha at the beginning of Kaliyuga as 172º 48′ 31″ and the velocity of Jupiter's Mandoccha as per Surya Siddhanta at 1**:** 40 & 41 is 900 revolutions in 432 crore years of one Kalpa. Based on this we can calculate the positions of Mandoccha at 42nd year Karthika month Amavasya day (last day of Karthika month as it is an Amanta type of month calculation).

[(41**.**3333 x 900 x360 x 60 x 60) ÷ 432,00,00,000] in seconds of arc.

It is 00º 00′ 11″ 09**.**60‴. As we are back calculating for a year of past, it has to be subtracted.

172º 48′ 31″ 00**.**00‴. – 00º 00′ 11″ 09**.**60‴. = 172º 48′ 19″ 50**.**40‴.

Hence Jupiter's Mandoccha on Karthika month Amavasya day at 42nd year before Kaliyuga was **172º 48′ 19″ 50.40‴.**

1. **Manda Correction (Mandaphala or Equation of Center)**

Now we have to calculate Manda anomaly or Manda Kendra (m) by subtracting Mean Jupiter from Mandoccha.

(172º 48′ 19″ 510**.**40‴+ 360º) –213º 34′ 07″ 13**.**96‴= **319º 14′ 12″ 36.44‴ (319.2368º).**

Here 360º are added to Mandoccha, as Mandoccha is less than Mean Jupiter.

Since Manda Anomaly (m) is more than 180º, Manda correction is subtractive.

Sine value of this Manda anomaly 319**.**2368º is (sine m) – 0**.**65293427.

Jupiter's Manda epicycle is 32º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 33º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2**:**34 to 37.

Hence Jupiter's corrected periphery of Epicycle (PEM) for this Manda Anomaly value is,

$PEM = p_e - [(p_e - p_o)$ x sine m. Thus, the value is 33**.**65293427.

Now the Manda correction (Equation of Center) is [(PEM / 360º) x 3438 x Sine m]

Thus, the Manda phala i.e. Equation of Center is 209**.**08436213775′ i.e.

03º 29′ 50″ 37.04‴.

It has to be subtracted from the Mean Jupiter, as the Manda anomaly (m) is more than 180º.

2. **Sighra Correction (Annual Parallax Correction)**

To find out Sighra anomaly i.e. Sighra Kendra of Jupiter, we have to subtract Mean Jupiter from Mean Sun, because Mean Sun is the Sighroccha of planets like Mars, Jupiter and Saturn which revolve the Sun outside the Earth.

Mean Sun is 236º 03′ 33″ 43**.**34‴.

Mean Jupiter is 213º 34′ 07″ 13**.**96‴.

Sighra anomaly (s) 022º 29′ 26″ 29**.**38‴ (22**.**4907º).

Since Sighra Anomaly is less than 180º, it is additive.

Sine of Sighra anomaly (Sine s) of 22.4907º is + 0**.**38253347.

Jupiter's Sighra epicycle is 72º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 70º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2**:**34 to 37.

Hence Jupiter's corrected periphery of Epicycle (PES) for this Sighra anomaly value is,

$PES = p_e - [(p_e - p_o)$ x sine m. Thus the value is **70.76506694**.

Now we have to calculate Doh phala, Koti Phala, Sphuta Koti and Sighra karna to find out the Sighra Correction or Sighraphala.

Doh phala is the result from the base sine of the right angled triangle.

Koti phala is the result from perpendicular sine of the right angled triangle.

Sphuta koti is Koti phala added to or subtracted from the radius of the circle expressed in minutes of arc i.e. 3438.

Sighra Karna is the Sighra Hypotenuse.

Doh phala is [(PES x 3438 x sine s) ÷ 360º] = 258.5185631383.

Koti phala is [(PES x 3438 x cos s) ÷ 360º] = 624.4056636311.

(Cos s of 22.4907º is 0.92394164).

Sphuta Koti is Koti phala + 3438 = 4062.4056636311.

Sighra karna is $\sqrt{(\text{Doh phala})^2 + (\text{Sphuta koti})^2}$ and the value got is 4070.623002.

Now Sighra Correction (Sighra phala) = Sine^{-1} [Doh phala ÷ Sighra Karna].

The value is 3.641211089º i.e. 03º 38′ 28″ 22‴.′

Thus, the Sighra Correction or Correction of Annual Parallax is **03º 38′ 28″ 22‴.**

It has to be added to the Mean Jupiter, as the Sighra Anomaly (s) is less than 180º.

3. Four Procedures

Procedure 1

Here the half of the Sighra correction is either added to or subtracted from the Mean Jupiter depending on whether Sighra anomaly (Sighra Kendra) is less than or more than 180º respectively.

Since here the Sighra anomaly is less than 180º, it is additive.

Mean Jupiter is at 213º 34′ 07″ 13.96‴.

Sighra Correction is 03º 38′ 28″ 22‴ and half of it is 01º 49′ 14″ 11‴.

Hence, P1 is Mean Jupiter + half Sighra Correction.

P1 = 213º 34′ 07″ 13.96‴ + 01º 49′ 14″ 11‴ = **215º 23′ 21″ 24.96‴.**

Procedure 2

To find out P2, the half of the Manda correction is either added to or subtracted from P1, depending on whether Manda anomaly (Manda Kendra) is less than or more than 180º respectively.

Since here the Manda anomaly is more than 180º, it is subtractive.

P1 is 215º 23′ 21″ 24.96‴.

Manda Correction is 03º 29′ 50″ 37.04‴ and half of it is 01º 44′ 55″ 18.52‴.

Hence, P2 is P1 – half Manda Correction.

P2 = 215º 23′ 21″ 24.96‴– 01º 44′ 55″ 18.52‴= **213º 38′ 26″ 06.44‴.**

Procedure 3

Here we have to calculate Manda correction for P2.

Manda anomaly or Manda Kendra (m) is calculated by subtracting P2 from Mandoccha.

(172º 48′ 19″ 50.40‴+ 360º) –213º 38′ 26″ 06.44‴= **319º 09′ 53″ 43.96‴ (319.1649º).**

Here 360º are added to Mandoccha, as Mandoccha is less than Mean Jupiter.

Since Manda Anomaly (m) is more than 180º, Manda correction is subtractive.

Sine value of this Manda anomaly 319.1649º is (sine m) – 0.65388422.

Jupiter's Manda epicycle is 32º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 33º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2**:**34 to 37.

Hence Jupiter's corrected periphery of Epicycle (PEM) for this Manda Anomaly value is,

$PEM = p_e - [(p_e - p_o)$ x sine m. Thus the value is 33**.**65388422.

Now the Manda correction (Equation of Center) is [(PEM/360º) x 3438 x Sine m]

Thus, the Mandaphala i.e. Equation of Center is 210**.**1548536067′ i.e.

03º 30′ 09″ 17.47‴.

It is subtracted fully from the Mean Jupiter, as the Manda anomaly (m) is more than 180º.

Mean Jupiter 213º 34′ 07″ 13**.**96‴.

Manda Anomaly – 03º 30′ 09″ 17.47‴.

P3 = **210º 03′ 57″ 56.49‴.**

Procedure 4

Now we have to find out Sighra anomaly i.e. Sighra Kendra of this P3. This is done by subtracting P3 from Mean Sun, because Mean Sun is the Sighroccha of the planets like Mars, Jupiter and Saturn which revolve the Sun outside the Earth.

Mean Sun is 236º 03′ 33″ 43**.**34‴.

P3 is 210º 03′ 57″ 56.49‴.

Sighra anomaly (s) 025º 59′ 35″ 46**.**85‴(25**.**9933º).

Since Sighra Anomaly is less than 180º, it is additive.

Sine of Sighra anomaly of 25**.**9933º (Sine s) is + 0**.**43826604.

Jupiter's Sighra epicycle is 72º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 70º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2**:**34 to 37.

Hence Jupiter's corrected periphery of Epicycle (PES) for this Sighra anomaly value is,

$PES = p_e - [(p_e - p_o)$ x sine m. Thus, the value is **70.87653208**.

Now we have to find out Doh phala, Koti Phala, Sphuta Koti and Sighra karna to find out the Sighra Correction.

Doh phala is the result from the base sine of the right angled triangle.

Koti phala is the result from the perpendicular sine of the right angled triangle.

Sphuta koti is Koti phala added to or subtracted from the radius of the circle expressed in minutes of arc i.e. 3438.

Sighra Karna is the Sighra Hypotenuse.

Doh phala is [(PES x 3438 x sine s) ÷ 360º] = 296**.**6495207667.

Koti phala is [(PES x 3438 x cos s) ÷ 360º] = 608**.**4022104209.

(Cos s of 25**.**9933º is 0**.**8988453).

Sphuta Koti is Koti phala + 3438 = 4046**.** 4022104209.

Sighra karna is $\sqrt{(\text{Doh phala})^2 + (\text{Sphuta koti})^2}$ and the value got is 4057.261612.

Now Sighra Correction (Sighra phala) = Sine^{-1} [Doh phala ÷ Sighra Karna].

The value is 4.192962535º i.e. 04º 11′ 34″ 39.91‴.

It has to be added fully to P3, as the Sighra Anomaly (s) is less than 180º.

P3 = 210º 03′ 57″ 56.49‴.

Sighra correction = 04º 11′ 34″ 39.91‴.

True Mean position of Jupiter = **214º 15′ 32″ 36.40‴.**

Now we have to apply the Bhujantara correction, which is explained already.

The formula is [manda correction of Sun in degrees x daily mean motion of the Graha in degrees ÷360º]. If the manda correction of Sun is positive, it is additive and if negative, it is then subtractive. The calculated value is 43.45‴. It is subtracted from the above value of mean true Jupiter to get the exact or true or Sphuta Jupiter.

214º 15′ 32″ 36.40‴– 00º 00′ 00″ 43.45‴ = 214º 15′ 31″ 52.95‴.

Thus, the exact position of the Jupiter on Amavasya Day of Karthika month at 42nd year before Kaliyuga at Hastinapura was **214º 15′ 31″ 52.95‴.**

Now we can calculate the true or exact or Sphuta position of Jupiter at the end of Amavasya in Karthika month of 42nd year before Kaliyuga, by multiplying the mean daily motion of Jupiter with the time duration required for Sun and Moon to be exactly in the same longitude and dividing the result by 24 hours of a day. The daily mean motion of Jupiter is 0.0830963596º. The period of time is 9 hours 24 minutes 36 seconds and 09.12 thirds (9.4100422123 hours). The value is 00º 01′ 57″ 17.46‴. This is to be added.

Thus, the true or exact or Sphuta position of Jupiter at the end of Amavasya thithi of Karthika month at 42nd year before Kaliyuga at Hastinapura was **214º 17′ 29″ 10.41‴.**

Since Anuradha Nakshatra is situated in the zodiac at 213º 20′ to 226º 40′, Jupiter was in conjunction with Anuradha Nakshatra. This satisfies the statement of Mahabharata text of Veda Vyasa that Jupiter was nearer to Visakha Nakshatra as per Veda Vyasa statement to Dhritarashtra in Bhishma Parva 3rd Adhyaya 27th sloka. Anuradha is the immediate next Nakshatra to Visakha Nakshatra. Thus, it fully satisfies the statement in Mahabharata text of Veda Vyasa. Further, at Karna Parva, 94th Adhyaya, 51st sloka, it was mentioned that Jupiter was afflicting Rohini Nakshatra. Jupiter has 7th Drishti and Rohini is situated in Vrishabha zodiac sign which is 7th from Vriscika zodiac sign in which Anuradha Nakshatra is situated and Jupiter was in conjunction with Anuradha Nakshatra. Thus, these statements of Mahabharata text of Veda Vyasa are fully satisfied.

Derivation of the position of Saturn

Saturn revolves at the velocity of 1,46,568 revolutions in 157,79,17,500 days of a Yuga of 43,20,000 years as per Vatesvara Siddhanta (1:1:12 to 14).

Hence, in the Ahargana days of 17,02,586, Saturn revolved by 158.1480811563 revolutions.

([17,02,586 x 1,46,568] ÷ 157,79,17,500). Here 158 are completed revolutions. The remaining 0.1480811563 are the incomplete revolutions. The incomplete revolutions should be converted into degrees of arc. It will be 53º 18′ 33″ 10.72‴ (0.1480811563 x 360 to get degrees of arc, then remaining fraction multiplied by 60 to get minutes of arc, like that up to seconds and thirds of arc). We have to subtract this value from the mean position of Saturn at 1442 Salivahana Saka at Ujjaini which was at **285º 21′,** as we are back calculating for the year of past

285º 21′ 00″ 00.00‴– 053º 18′ 33″ 10.72‴ = **232º 02′ 26″ 49.28‴.**

This is the mean position of Saturn on Amavasya thithi of Karthika Month at 42nd year before Kaliyuga at Ujjaini.

Then, Desantara correction is applied to know the mean position of Saturn at Hastinapura.

The angle of arc difference for Saturn is calculated by multiplying daily mean motion of Saturn (0.0334393148º) with Longitude difference between Ujjaini and Hastinapura in degrees and divide the value by 360º. Thus, the angle of difference is **44.84‴,**

[(2.2351º x 0.0830963596º) ÷ 360º].

Since, Hastinapura is more East than Ujjaini, we have to add this angle of arc difference to the mean position of Saturn, which is calculated above.

232º 02′ 26″ 49.28‴ + 44.84‴ = 232º 02′ 27″ 34.12‴.

Thus, mean position of Saturn on Amavasya thithi of Karthika Month at 42nd year before Kaliyuga at Hastinapura was **232º 02′ 27″ 34.12‴.**

Now we have to get the Equation of Center (Manda correction) for the mean position. This is because the Saturn is revolving the Sun in an elliptical circle and not in a perfect circle and also the Sun is situated eccentrically i.e. not at the perfect center of Saturn's revolution circle. Hence, the ancient astronomical texts of our Nation developed two methods to correct this. They are 1. Epicyclic Model and 2. Eccentric model. In this book the Epicyclic model is followed.

To do the Equation of Center (Manda) correction, we first know the position of Mandoccha at the required year, i.e. 42nd year before Kaliyuga.

Vatesvara Siddhanta at 1:4:56 to 62 sloka gives the position of Saturn's Mandoccha at the beginning of Kaliyuga as 235º 56′ 53″ and the velocity of Saturn's Mandoccha as per Surya Siddhanta at 1: 40 & 41 is 39 revolutions in 432 crore years of one Kalpa. Based on this we can calculate the positions of Mandoccha at 42nd year Karthika month Amavasya day (last day of Karthika month as it is an Amanta type of month calculation).

[(41.3333 x 39 x360 x 60 x 60 x 60) ÷ 432,00,00,000] in thirds of arc.

It is 00º 00′ 00″ 29.02‴. As we are back calculating for a year of past, it has to be subtracted.

235º 56′ 53″ 00.00‴– 00º 00′ 00″ 29.02‴= 235º 56′ 52″ 30.98‴.

Hence Saturn's Mandoccha on Karthika month Amavasya day at 42nd year before Kaliyuga was **235º 56′ 52″ 30.98‴.**

1. Manda Correction (Equation of Center)

Now we have to calculate Manda anomaly or Manda Kendra (m) by subtracting Mean Saturn

from Mandoccha.

235º 56′ 52″ 30**.**98‴ –232º 02′ 27″ 34**.**12‴= **03º 54′ 24″ 56.86‴ (3.90693º)**

Since Manda Anomaly (m) is less than 180º, Manda correction is additive.

Sine value of this Manda anomaly 3**.**90693º is (sine m) + 0**.**06813596.

Saturn's Manda epicycle is 48º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 49º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2**:**34 to 37.

Hence, Saturn's corrected periphery of Epicycle (PEM) for this Manda Anomaly value is,

$PEM = p_e - [(p_e - p_o)$ x sine m. Thus, the value is 48**.** 93186404.

Now the Manda correction (Equation of Center) is [(PEM /360º) x 3438 x Sine m].

Thus, the Manda phala i.e. Equation of Center is 31**.**8398865206′ i.e.

00º 31′ 50″ 23.59‴.

It has to be added to the Mean Saturn, as the Manda anomaly (m) is less than 180º.

2. Sighra Correction (Annual Parallax Correction)

To find out Sighra anomaly i.e. Sighra Kendra of Saturn, we have to subtract Mean Saturn from Mean Sun, because Mean Sun is the Sighroccha of planets like Mars, Jupiter and Saturn which revolve the Sun outside the Earth.

Mean Sun is 236º 03′ 33″ 43**.**34‴.

Mean Saturn is 232º 02′ 27″ 34**.**12‴.

Sighra anomaly (s) **04º 01′ 06″ 09.22‴ (04.0184º).**

Since Sighra Anomaly is less than 180º, it is additive.

Sine of Sighra anomaly (Sine s) of 04**.**0184º is + 0**.**07007683.

Saturn's Sighra epicycle is 40º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 39º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2**:**34 to 37.

Hence Saturn's corrected periphery of Epicycle (PES) for this Sighra anomaly value is,

$PES = p_e - [(p_e - p_o)$ x sine m. Thus, the value is **39.07007683**.

Now we have to find out Doh phala, Koti Phala, Sphuta Koti and Sighra karna to find out the Sighra Correction.

Doh phala is the result from the base sine of the right angled triangle.

Koti phala is the result from the perpendicular sine of the right angled triangle.

Sphuta koti is Koti phala added to or subtracted from the radius of the circle expressed in minutes of arc i.e. 3438.

Sighra Karna is the Sighra Hypotenuse.

Doh phala is [(PES x 3438 x sine s) ÷ 360º] = 26**.**1470131116.

Koti phala is [(PES x 3438 x cos s) ÷ 360º] = 372**.**2019574023.

(Cos s of 4**.**0184º is 0**.**9975416).

Sphuta Koti is Koti phala + 3438 = 3810**.**2019574023.

Sighra karna is $\sqrt{(\text{Doh phala})^2 + (\text{Sphuta koti})^2}$ and the value got is 3810.291672.

Now Sighra Correction (Sighra phala) = Sine^{-1} [Doh phala ÷ Sighra Karna].

The value is 0.393182241º i.e. 00º 23′ 35″ 27.36‴.

Thus, the Sighra Correction or Correction of Annual Parallax is **00º 23′ 35″ 27.36‴.**

It has to be added to the Mean Saturn, as the Sighra Anomaly (s) is less than 180º.

3. Four Procedures

Procedure 1

Here the half of the Sighra correction is either added to or subtracted from the Mean Saturn depending on whether Sighra anomaly (Sighra Kendra) is less than or more than 180º respectively.

Since here the Sighra anomaly is less than 180º, it is additive.

Mean Saturn is at 232º 02′ 27″ 34.12‴.

Sighra Correction is 00º 23′ 35″ 27.36‴and half of it is 00º 11′ 47″ 43.68‴.

Hence P1 is Mean Saturn + half Sighra Correction.

P1 = 232º 02′ 27″ 34.12‴+ 00º 11′ 47″ 43.68‴= **232º 14′ 15″ 17.80‴.**

Procedure 2

To find out P2, the half of the Manda correction is either added to or subtracted from P1, depending on whether Manda anomaly (Manda Kendra) is less than or more than 180º respectively.

Since here the Manda anomaly is less than 180º, it is additive.

P1 is 232º 14′ 15″ 17.80‴.

Manda Correction is 00º 31′ 50″ 23.59‴and half of it is 00º 15′ 55″ 11.80‴.

Hence P2 is P1+ half Manda Correction.

P2 = 232º 14′ 15″ 17.80‴+ 00º 15′ 55″ 11.80‴= **232º 30′ 10″ 29.60‴.**

Procedure 3

Here we have to calculate Manda correction for P2.

Manda anomaly or Manda Kendra (m) is calculated by subtracting P2 from Mandoccha.

235º 56′ 52″ 30.98‴ –232º 30′ 10″ 29.60‴= **03º 26′ 42″ 01.38‴ (3.445º).**

Since Manda Anomaly (m) is less than 180º, Manda correction is additive.

Sine value of this Manda anomaly 3.445º is (sine m) + 0.06009037.

Saturn's Manda epicycle is 48º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 49º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2:34 to 37.

Hence Saturn's corrected periphery of Epicycle (PEM) for this Manda Anomaly value is,

$PEM = p_e - [(p_e - p_o) \times \text{sine m}$. Thus the value is 48.93990963.

Now the Manda correction (Equation of Center) is [(PEM/360º) x 3438 x Sine m].

Thus, the Mandaphala i.e. Equation of Center is 28.0848049995′ i.e.

00º 28′ 05″ 05.30‴.

It is added fully to the Mean Saturn, as the Manda anomaly (m) is less than 180º.

Mean Saturn 232º 02′ 27″ 34**.**12‴.

Manda Anomaly + 00º 28′ 05″ 05.30‴.

P3 = **232º 30′ 32″ 39.42‴.**

Procedure 4

Now we have to find out Sighra anomaly i.e. Sighra Kendra of this P3. This is done by subtracting P3 from Mean Sun, because Mean Sun is the Sighroccha of planets like Mars, Jupiter and Saturn which revolve the Sun outside the Earth.

Mean Sun is 236º 03′ 33″ 43**.**34‴.

P3 is 232º 30′ 32″ 39.42‴.

Sighra anomaly (s) 03º 33′ 01″ 03**.**92‴(3**.**5503º).

Since Sighra Anomaly is less than 180º, it is additive.

Sine of Sighra anomaly of 3**.**5503º (Sine s) is + 0**.**06192478.

Saturn's Sighra epicycle is 40º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 39º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2**:**34 to 37.

Hence Saturn's corrected periphery of Epicycle (PES) for this Sighra anomaly value is,

$PES = p_e - [(p_e - p_o)$ x sine m. Thus, the value is **39.06192478**.

Now we have to find out Doh phala, Koti Phala, Sphuta Koti and Sighra karna to find out the Sighra Correction.

Doh phala is the result from the base sine of the right angled triangle.

Koti phala is the result from the perpendicular sine of the right angled triangle.

Sphuta koti is Koti phala added to or subtracted from the radius of the circle expressed in minutes of arc i.e. 3438.

Sighra Karna is the Sighra Hypotenuse.

Doh phala is [(PES x 3438 x sine s) ÷ 360º] = 23**.**1005054895.

Koti phala is [(PES x 3438 x cos s) ÷ 360º] = 372**.**3254480902.

(Cos s of 3**.**5503º is 0**.**99808082).

Sphuta Koti is Koti phala + 3438 = 3810**.**3254480902.

Sighra karna is $\sqrt{(\text{Doh phala})^2 + (\text{Sphuta koti})^2}$ and the value got is 3810**.**395472.

Now Sighra Correction (Sighra phala) = Sine^{-1} [Doh phala ÷ Sighra Karna].

The value is 0**.**347357533º i.e. 0º 20′ 50″ 29**.**23‴.

It has to be added fully to P3, as the Sighra Anomaly (s) is less than 180º.

P3 = 232º 30′ 32″ 39.42‴.

Sighra correction = + 0º 20′ 50″ 29**.**23‴.

True Mean position of Saturn = **232º 51′ 23″ 08.65‴.**

Now we have to apply the Bhujantara correction, which is explained already.

The formula is [manda correction of Sun in degrees x daily mean motion of the Graha in degrees ÷360º]. If the manda correction of Sun is positive, it is additive and if negative, it is then subtractive. The calculated value is 17**.**48‴. It is subtracted from the above value of mean true Saturn to get the exact or true or sphuta Saturn.

232º 51′ 23″ 08.65‴– 00º 00′ 00″ 17**.**48‴ = 232º 51′ 22″ 51**.**17‴.

Thus, the exact position of the Saturn on Amavasya Day of Karthika month at Hastinapura at 42nd year before Kaliyuga was **232º 51′ 22″ 51.17‴.**

Now we can calculate the true or exact or Sphuta position of Saturn at the end of Amavasya in Karthika month of 42nd year before Kaliyuga, by multiplying the mean daily motion of Saturn with the time duration required for Sun and Moon to be exactly in the same longitude and dividing the result by 24 hours of a day. The daily mean motion of Saturn is 0**.**0334393148º. The period of time is 9 hours 24 minutes 36 seconds and 09**.**12 thirds (9**.**4100422123 hours). The value is 00º 00′ 47″ 11**.**99‴. This is to be added.

Thus, the true or exact or Sphuta position of Saturn at the end of Amavasya thithi of Karthika month at 42nd year before Kaliyuga at Hastinapura was **232º 52′ 10″ 03.16‴.**

Since, Jyeshtha Nakshatra is situated in the zodiac at 226º 40′ to 240º 00′, Saturn was in conjunction with Jyeshtha Nakshatra. This satisfies the statement of Mahabharata text of Veda Vyasa that Saturn was situated nearer to Visakha as per Veda Vyasa statement to Dhritarashtra in Bhishma Parva 3rd Adhyaya 27th sloka. Jyeshtha is the second Nakshatra to Visakha Nakshatra. Thus, it fully satisfies the statement in Mahabharata text of Veda Vyasa. Karna replied Sree Krishna that Rohini Nakshatra was afflicted by Saturn as found in Udyoga Parva, 143rd Adhyaya 8th sloka. Further, in Bhishma Parva, 2nd Adhyaya at 32nd sloka, Veda Vyasa told Dhritarashtra that Saturn was afflicting Rohini Nakshatra. Saturn has 7th Drishti and Rohini is situated in Vrishabha zodiac sign which is 7th from Vriscika zodiac sign in which Jyeshtha Nakshatra is situated and Saturn was in conjunction with Jyeshtha Nakshatra. Besides, Veda Vyasa told Dhritarashtra, as shown in Bhishma Parva 3rd Adhyaya 14th sloka that Saturn was overcoming and afflicting Purva Phalguni Nakshatra which is at Simha zodiac sign. Simha zodiac sign is 10th zodiac sign from Vriscika zodiac sign in which Jyeshtha Nakshatra is situated. Saturn was in conjunction with Jyeshtha Nakshatra and has 10th Drishti. Hence, Saturn definitely afflicted Purva Phalguni by its 10th Drishti from Jyeshtha Nakshatra. Thus, the statements of Vyasa and Karna are also fully satisfied.

<u>Derivation of the position of Mars</u>

Mars revolves at the velocity of 22,96,828 revolutions in 157,79,17,500 days of a Yuga of 43,20,000 years as per Vatesvara Siddhanta (1**:**1**:**12 to 14).

Hence, in the Ahargana days of 17,02,586, Mars revolved by 2478**.**2963603661 revolutions. ([17,02,586 x 22,96,828] ÷ 157,79,17,500). Here 2478 are completed revolutions. The remaining 0**.**2963603661 are the incomplete revolutions. The incomplete revolutions should be converted into degrees of arc. It will be 106º 41′ 23″ 02**.**07‴ (0**.**2963603661 x 360 to get degrees of arc,

then remaining fraction multiplied by 60 to get minutes of arc, like that up to seconds and thirds of arc). We have to subtract this value from the mean position of Mars at 1442 Salivahana Saka at Ujjaini which was at **307º 08′,** as we are back calculating for the year of past.

307º 08′ 00″ 00.00 – 106º 41′ 23″ 02**.**07‴ = **200º 26′ 36″ 57.93‴.**

This is the mean position of Mars on Amavasya thithi of Karthika Month at 42nd year before Kaliyuga at Ujjaini.

Then, Desantara correction is applied to know the mean position of Mars at Hastinapura.

The angle of arc difference for Mars is calculated by multiplying the daily mean motion of Mars (0**.**5240185751º) with Longitude difference between Ujjaini and Hastinapura in degrees and divide the value by 360º. Thus, the angle of difference is **11″ 42.74‴.**

[(2.2351º x 0**.**5240185751º) ÷ 360º]

Since, Hastinapura is more East than Ujjaini, we have to add this angle of arc difference to the mean position of Mars at Ujjaini, which is calculated above.

200º 26′ 36″ 57.93‴ + 11″ 42**.**74‴ = 200º 26′ 48″ 40**.**67‴.

Thus, mean position of Mars on Amavasya thithi of Karthika Month at 42nd year before Kaliyuga at Hastinapura was **200º 26′ 48″ 40.67‴.**

Now we have to get the Equation of Center (Manda correction) for the mean position. This is because the Mars is revolving the Sun in an elliptical circle and not in a perfect circle and also the Sun is situated eccentrically i.e. not at the perfect center of Mars' revolution circle. Hence, the ancient astronomical texts of our Nation used two methods to correct this. They are 1. Epicyclic Model and 2. Eccentric model. In this book the Epicyclic model is followed.

To do the Equation of Center (Manda) correction, we first know the position of Mandoccha at the required year, say here, 42nd year before Kaliyuga.

Vatesvara Siddhanta at 1**:**4**:**56 to 62 sloka gives the position of Mars' Mandoccha at the beginning of Kaliyuga as 128º 50′ 50″ and the velocity of Mars' Mandoccha as per Surya Siddhanta at 1**:**40 & 41 is 204 revolutions in 432 crore years of one Kalpa. Based on this we can calculate the positions of Mandoccha at 42nd year Karthika month Amavasya day (last day of Karthika month as it is an Amanta type of month calculation).

[(41**.**3333 x 204 x360 x 60 x 60) ÷ 432,00,00,000] in seconds of arc.

It is 00º 00′ 02″ 31**.**78‴. As we are back calculating for a year of past, it has to be subtracted.

128º 50′ 50″ 00**.**00‴ – 00º 00′ 02″ 31**.**78‴. = 128º 50′ 47″ 28**.**22‴.

Hence Mars' Mandoccha on Karthika month Amavasya day at 42nd year before Kaliyuga was **128º 50′ 47″ 28.22‴.**

1. **Manda Correction (Equation of Center)**

Now we have to calculate Manda anomaly or Manda Kendra (m) by subtracting Mean Mars from Mandoccha.

(128º 50′ 47″ 28**.**22‴+ 360º) – 200º 26′ 48″ 40**.**67‴= **288º 23′ 58″ 47.55‴ (288.3997º).**

Here 360º are added to Mandoccha, as Mandoccha is less than Mean Mars.

Since Manda Anomaly (m) is more than 180º, Manda correction is subtractive.

Sine value of this Manda anomaly 288.3977º is (sine m) – 0.94887766.

Mars' Manda epicycle is 72º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 75º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2:34 to 37.

Hence Mars' corrected periphery of Epicycle (PEM) for this Manda Anomaly value is,

$PEM = p_e - [(p_e - p_o)$ x sine m. Thus, the value is 77. 84663298.

Now the Manda correction (Equation of Center) is [(PEM / 360º) x 3438 x Sine m]

Thus, the Manda phala i.e. Equation of Center is 705.429190486′ i.e.

11º 45′ 25″ 45.09‴.

It has to be subtracted from the Mean Mars, as the Manda anomaly (m) is more than 180º.

2. **Sighra Correction (Annual Parallax Correction)**

To find out Sighra anomaly i.e. Sighra Kendra of Mars, we have to subtract Mean Mars from Mean Sun, because Mean Sun is the Sighroccha of planets like Mars, Jupiter and Saturn which revolve the Sun outside the Earth.

Mean Sun is 236º 03′ 33″ 43.34‴.

Mean Mars is 200º 26′ 48″ 40.67‴.

Sighra anomaly (s) 035º 36′ 45″ 02.67‴ (35.6125º).

Since Sighra Anomaly is less than 180º, it is additive.

Sine of Sighra anomaly (Sine s) of 35.6125º is + 0.58230035.

Mars' Sighra epicycle is 232º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 235º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2:34 to 37.

Hence Mars' corrected periphery of Epicycle (PES) for this Sighra anomaly value is,

$PES = p_e - [(p_e - p_o)$ x sine m. Thus the value is **233.25309895**.

Now we have to find out Doh phala, Koti Phala, Sphuta Koti and Sighra karna to find out the Sighra Correction.

Doh phala is the result from the base sine of the right angled triangle.

Koti phala is the result from the perpendicular sine of the right angled triangle.

Sphuta koti is Koti phala added to or subtracted from the radius of the circle expressed in minutes of arc i.e. 3438.

Sighra Karna is the Sighra Hypotenuse.

Doh phala is [(PES x 3438 x sine s) ÷ 360º] = 1297.113099051.

Koti phala is [(PES x 3438 x cos s) ÷ 360º] = 1810.9535523007.

(Cos s of 35.6125º is 0.81297374)

Sphuta Koti is Koti phala + 3438 = 5248.9535523007.

Sighra karna is $\sqrt{(\text{Doh phala})^2 + (\text{Sphuta koti})^2}$ and the value got is 5406.848970.

Now Sighra Correction (Sighra phala) = Sine^{-1} [Doh phala ÷ Sighra Karna].

The value is 13**.**88074786º i.e. 13º 52′ 50″ 41**.**54‴

Thus, the Sighra Correction or Correction of Annual Parallax is **13º 52′ 50″ 41.54‴.**

It has to be added to the Mean Mars, as the Sighra Anomaly (s) is less than 180º.

3. **Four Procedures**

Procedure 1

Here the half of the Sighra correction is either added to or subtracted from the Mean Mars depending on whether Sighra anomaly (Sighra Kendra) is less than or more than 180º respectively.

Since here the Sighra anomaly is less than 180º, it is additive.

Mean Mars is at 200º 26′ 48″ 40**.**67‴.

Sighra Correction is 13º 52′ 50″ 41.54‴and half of it is 06º 56′ 25″ 20**.**77‴.

Hence P1 is Mean Mars + half Sighra Correction.

P1 = 200º 26′ 48″ 40**.**67‴+ 06º 56′ 25″ 20**.**77‴= **207º 23′ 14″ 01.44‴.**

Procedure 2

To find out P2, the half of the Manda correction is either added to or subtracted from P1, depending on whether Manda anomaly (Manda Kendra) is less than or more than 180º respectively.

Since here the Manda anomaly is more than 180º, it is subtractive.

P1 is 207º 23′ 14″ 01.44‴

Manda Correction is 11º 45′ 25″ 45**.**09‴ and half of it is 05º 52′ 42″ 52**.**55‴.

Hence P2 is P1– half Manda Correction

P2 = 207º 23′14″ 01.44‴– 05º 52′ 42″ 52**.**55‴..= **201º 30′ 31″ 08.89‴**

Procedure 3

Here we have to calculate Manda correction for P2.

Manda anomaly or Manda Kendra (m) is calculated by subtracting P2 from Mandoccha.

(128º 50′ 47″ 28**.**22‴ + 360º) – 201º 30′ 31″ 08.89‴**= 287º 20′ 16″ 19.33‴ (287.3379º)**

Here 360º are added to Mandoccha, as Mandoccha is less than Mean Jupiter.

Since Manda Anomaly (m) is more than 180º, Manda correction is subtractive.

Sine value of this Manda anomaly 287.3379º is (sine m) – 0**.**95456388.

Mars' Manda epicycle is 72º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 75º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2**:**34 to 37.

Hence Mars' corrected periphery of Epicycle (PEM) for this Manda Anomaly value is,

$PEM = p_e - [(p_e - p_o)$ x sine m. Thus the value is 77**.**86369164.

Now the Manda correction (Equation of Center) is [(PEM/360º) x 3438 x Sine m].

Thus, the Mandaphala i.e. Equation of Center is 709**.**8120356087′ i.e.

11º 49′ 48″ 43.33‴.

It is subtracted fully from the Mean Mars, as the Manda anomaly (m) is more than 180º.

Mean Mars 200º 26′ 48″ 40.67‴

Manda Anomaly – 11º 49′ 48″ 43.33‴

P3 = **188º 36′ 59″ 57.34‴**

Procedure 4

Now we have to find out Sighra anomaly i.e. Sighra Kendra of this P3. This is done by subtracting P3 from Mean Sun, because Mean Sun is the Sighroccha of Superior planets like Mars, Jupiter and Saturn which revolve the Sun outside the Earth.

Mean Sun is 236º 03′ 33″ 43.34‴

P3 is 188º 36′ 59″ 57.34‴

Sighra anomaly (s) 47º 26′ 33″ 46.00‴(47.4427º)

Since Sighra Anomaly is less than 180º, it is additive.

Sine of Sighra anomaly of 47.4427º (Sine s) is + 0.73660133.

Mars' Sighra epicycle is 232º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 235º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2:34 to 37.

Hence Mars' corrected periphery of Epicycle (PES) for this Sighra anomaly value is,

$PES = p_e - [(p_e - p_o)$ x sine m. Thus, the value is **232.79019601**.

Now we have to find out Doh phala, Koti Phala, Sphuta Koti and Sighra karna to find out the Sighra Correction.

Doh phala is the result from the base sine of the right angled triangle.

Koti phala is the result from the perpendicular sine of the right angled triangle.

Sphuta koti is Koti phala added to or subtracted from the radius of the circle expressed in minutes of arc i.e. 3438.

Sighra Karna is the Sighra Hypotenuse.

Doh phala is [(PES x 3438 x sine s) ÷ 360º] = 1637.5725743229.

Koti phala is [(PES x 3438 x cos s) ÷ 360º] = 1503.5743608942.

(Cos s of 47.4427º is 0.6763272)

Sphuta Koti is Koti phala + 3438 = 4941.5743608942.

Sighra karna is $\sqrt{(\text{Doh phala})^2 + (\text{Sphuta koti})^2}$ and the value got is 5205.842977.

Now Sighra Correction (Sighra phala) = Sine^{-1} [Doh phala ÷ Sighra Karna].

The value is 18.33451557º i.e. 18º 20′ 04″ 15.36‴.

It has to be added fully to P3, as the Sighra Anomaly (s) is less than 180º.

P3 = 188º 36′ 59″ 57.34‴.

Sighra correction = 18º 20′ 04″ 15.36‴.

True Mean position of Mars = **206º 57′ 04″ 12.70‴.**

Now we have to apply the Bhujantara correction, which is explained already.

The formula is [manda correction of the Sun in degrees x daily mean motion of the Graha in

degrees ÷360º]. If the manda correction of Sun is positive, it is additive and if negative, it is then subtractive. The calculated value is 04′ 34**.**00″′. It is subtracted from the above value of mean true Mars to get the exact or true or sphuta Mars.

206º 57′ 04″ 12.70″′– 00º 00′ 04′ 34**.**00″′ = 206º 56′ 59″ 38**.**70″′

Thus, the exact (Sphuta, True) position of the Mars on Amavasya Day of Karthika month at Hastinapura at 42nd year before Kaliyuga was **206º 56′ 59″ 38.70″′.**

Now we can calculate the true or exact or Sphuta position of Mars at the end of Amavasya in Karthika month of 42nd year before Kaliyuga, by multiplying the mean daily motion of Mars with the time duration required for Sun and Moon to be exactly in the same longitude and dividing the result by 24 hours of a day. The daily mean motion of Mars is 0**.**5240185751º .The period of time is 9 hours 24 minutes 36 seconds and 09**.**12 thirds (9**.**4100422123 hours). The value is 00º 12′ 19″ 39**.**33″′. This is to be added.

Thus, the true or exact or Sphuta position of Mars at the end of Amavasya thithi of Karthika month 42nd year before Kaliyuga at Hastinapura was **207º 09′ 19″ 18.03″′**

Since Visakha Nakshatra is situated in the zodiac at 200º 00′ to 213º 20′, Mars was in conjunction with Visakha Nakshatra. Besides, the Tula zodiac sign is between 180º to 210º. Thus, Mars was situated in Tula zodiac sign. Now Mars was moving towards the next Nakshatra i.e. Anuradha which is at 213º 20′ to 226º 40′. Karna replied Sree Krishna that Mars was acting cruelly at Jyeshtha Nakshatra and praying to come together with Anuradha Nakshatra, in a friendly manner as found in Udyoga Parva, 143rd Adhyaya 9th sloka. This statement is satisfied as Mars was situated at Visakha Nakshatra and was just 6º to 7º away from Anuradha Nakshatra and which can be covered in about 15 days i.e. before the end of Mahabharata war. Besides, Veda Vyasa told Dhritarashtra that Mars (Lohita) was concealing and fully covering (samavrutya) Sravana Nakshatra (Brahma Rasi) by staying apart (vyavasthita) as shown in Bhishma Parva, 3rd Adhyaya 18th sloka. Mars was situated in Tula zodiac sign and Makara is the 4th zodiac sign from Tula. Sravana Nakshatra is situated in Makara zodiac sign. Mars has 4th Drishti and hence can affect Sravana Nakshatra by its 4th Drishti. The sloka also mentioned that Mars was not at Sravana Nakshatra but stayed apart (vyavasthita). It was situated at Visakha Nakshatra which is 6 Nakshatra apart from Sravana Nakshatra. This satisfies the statements of Mahabharata text of Veda Vyasa.

<u>Derivation of the position of Venus</u>

Venus and Mercury are the planets that are revolving the Sun inner to the Earth's orbit around the Sun. Hence to derive the exact positions of these two Graha, a slightly modified procedure is followed. This is described in Laghu Bhaskariyam (2**:**37 to 39) of Bhaskara, who is a follower of Aryabhatta's tradition in Astronomy and Mathematics. His date is either 629 C.E. or 522 C.E.

Mean position of the Sun is taken as the mean position of Venus. Hence, Mean Venus revolves at the velocity of 43,20,000 revolutions in 157,79,17,500 days of a Yuga of 43,20,000 years, as per Vatesvara Siddhanta (1**:**1**:**12 to 14). This is because the Earth not only revolves round the

Sun, but revolves round the Venus and Mercury also, because Venus and Mercury are within the orbit of Earth around the Sun and are in between Earth and the Sun. Thus, the revolution of Earth around the Sun at a velocity of 43,20,000 revolutions in 157,79,17,500 days is not only imposed on Sun but on Venus and Mercury also. (This proves our ancestors followed the Heliocentric model only). That is why we are calculating 43,20,000 revolutions in 157,79,17,500 days for Venus and Mercury like that of Sun.

Mean Sun i.e. Mean Venus at Ujjaini = 236º 03′ 11″ 41**.**59‴.

(Already derived at the calculation for Sun).

Velocity of Sighra Kendra is calculated by subtracting Velocity of mean Sun from the velocity of Sighroccha of Venus. (Velocity of Sighroccha is equal to the addition of velocities of Mean Sun and Sighrakendra in case of planets that revolve round the Sun inner to Earth's orbit). Velocity of Sighroccha of Venus is 70,22,376 and the velocity of mean Sun is 43,20,000 revolutions in 157,79,17,500 days as per Vatesvara Siddhanta (1**:**1**:**12 to14). Hence, the velocity of Sighra Kendra of Venus is 70,22,376 – 43,20,000 = **27,02,376** revolutions in 157,79,17,500 days.

Sighra Kendra or Sighra anomaly of Venus at 1442 Salivahana Saka, Chaitra month, Prathama thithi, at Sun rise as per Grahalaaghavam was **230º 09′.**

In the Ahargana days of 17,02,586, the Sighra Kendra of Venus revolved by 2915**.**885998055 revolutions. ([17,02,586 x 27,02,376] ÷ 157,79,17,500). Here 2915 are completed revolutions. The remaining 0**.**885998055 are the incomplete revolutions. The incomplete revolutions should be converted into degrees of arc. It will be 318º 57′ 33″ 28**.**76‴ (0**.**885998055 x 360 to get degrees of arc, then remaining fraction multiplied by 60 to get minutes of arc, like that up to seconds and thirds of arc). We have to subtract this value from the position of Sighra Kendra of Venus at 1442 Salivahana Saka at Ujjaini which was at **230º 09′,** as we are back calculating for the year of past.

.(230º 09′ 00″ 00.00‴+ 360º) – 318º 57′ 33″ 28**.**76‴ = 271º 11′ 26″ 31**.**24‴.

360º is added, as the position of Sighra Kendra of Venus at 1442 Salivahana Saka at Ujjaini is less than 318º 57′ 33″ 28**.**76‴.

Thus, the position of Sighra Kendra or Sighra Anomaly of Venus at Amavasya day of Karthika month of 42nd year before Kaliyuga was **271º 11′ 26″ 31.24‴.**

Now we have to get the Equation of Center (Manda correction) for Venus. This is because, the Venus is revolving the Sun in an elliptical circle and not in a perfect circle and also the Sun is situated eccentrically i.e. not at the perfect center of Venus' revolution circle. Hence, the ancient astronomical texts of our Nation used two methods to correct this. They are 1. Epicyclic Model and 2. Eccentric model. In this book the Epicyclic model is followed.

To do the Equation of Center (Manda) correction, we first know the position of Mandoccha at the required year, i.e. 42nd year before Kaliyuga.

Vatesvara Siddhanta at 1**:**4**:**56 to 62 sloka gives the position of Venus' Mandoccha at the beginning of Kaliyuga as 080º 03′ 26″ and the velocity of Venus' Mandoccha as per Surya Siddhanta at 1**:** 40 & 41 is 535 revolutions in 432 crore years of one Kalpa. Based on this, we

can calculate the position of Mandoccha at 42nd year Karthika month Amavasya day (last day of Karthika month as it is an Amanta type of month calculation).

[(41.3333 x 535 x 360 x 60 x 60) ÷ 432,00,00,000] in seconds of arc.

It is 00º 00′ 06″ 38.04‴. As we are back calculating for a year of past, it has to be subtracted.

080º 03′ 26″ – 00º 00′ 06″ 38.04‴= 080º 03′ 19″ 21.96‴.

Hence, Venus' Mandoccha at Karthika month Amavasya day at 42nd year before Kaliyuga was **080º 03′ 19″ 21.96‴.**

Now we have to find out Sighra correction of Venus. For Venus and Mercury, this is the correction of their elongation i.e. the longitude difference between Venus or Mercury from the Sun.

Sighra Correction (Elongation Correction)

Sighra Kendra or Sighra anomaly (s) is 271º 11′ 26″ 31.24‴ (271.1907º) as derived before.

Since Sighra Anomaly is more than 180º, it is additive. (This is because, in case of Venus and Mercury it is reversed and has to be subtracted if it is less than 180º).

Sine of Sighra anomaly (Sine s) of 271.1907º is – 0.99978407.

Venus' Sighra epicycle is 260º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 262º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2:34 to 37.

Hence, Venus' corrected periphery of Epicycle (PES) for this Sighra anomaly value is,

$PES = p_e - [(p_e - p_o)$ x sine m. Thus the value is **263.99956814**.

Now we have to find out Doh phala, Koti Phala, Sphuta Koti and Sighra karna to find out the Sighra Correction.

Doh phala is the result from the base sine of the right angled triangle.

Koti phala is the result from the perpendicular sine of the right angled triangle.

Sphuta koti is Koti phala added to or subtracted from the radius of the circle expressed in minutes of arc i.e. 3438.

Sighra Karna is the Sighra Hypotenuse.

Doh phala is [(PES x 3438 x sine s) ÷ 360º] = 2520.6514739116.

Koti phala is [(PES x 3438 x cos s) ÷ 360º] = 52.3908032652.

(Cos s of 271.1907º is 0.02078014).

Sphuta Koti is 3438 + Koti phala = 3490.3908032652.

(If Sighra Kendra (Sighra Anomaly) is 2nd and 3rd quadrants (90º to 180º and 180º to 270º), we have to subtract Koti phala from 3438, the radius of circle in minutes of arc. In 1st and 4th quadrants (0º to 90º and 270º to 360º), we have to add Koti phala to 3438).

Sighra karna is $\sqrt{(\text{Doh phala})^2 + (\text{Sphuta koti})^2}$ and the value got is 4305.404953.

Now Sighra Correction (Sighra phala) = Sine^{-1} [Doh phala ÷ Sighra Karna].

The value is 35.83564277º i.e. 35º 50′ 08″ 18.84‴.

Thus, the Sighra Correction or Correction of Elongation is **35º 50′ 08″ 18.84‴.**

Half of the Sighra Correction (17º 55′ 04″ 09**.**42‴) has to be added to the Mandoccha of Venus, as the Sighra Anomaly (s) is more than 180º. (This is because, in case of Venus and Mercury it is reversed and has to be subtracted if it is less than 180º).

Manda Correction

Here we have to calculate Manda correction with the Mandoccha added with half of Sighra Correction.

Venus' Mandoccha at Karthika month Amavasya day at 42nd year before Kaliyuga was 080º 03′ 19″ 21.96‴.

New Mandoccha is 080º 03′ 19″ 21**.**96‴+17º 55′ 04″ 09**.**42‴= **97º 58′ 23″ 31.38‴.**

Now this new Mandoccha has to be subtracted from Mean Sun.

Mean Sun or Mean Venus = 236º 03′ 11″ 41**.**59‴.

New Mandoccha = 97º 58′ 23″ 31**.**38‴.

Manda Kendra (Manda Anomaly) = 138º 04′ 48″ 10**.**21‴ (138**.**08005º).

As Manda Anomaly is less than 180º, it is subtractive (This is because, in case of Venus and Mercury it is reversed).

Sine value of this Manda anomaly 138**.**08378º is (sine m) +0**.**66809168.

Venus' Manda epicycle is 11º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 12º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2**:**34 to 37.

Hence, Venus' corrected periphery of Epicycle (PEM) for this Manda Anomaly value is,

$PEM = p_e - [(p_e - p_o) \times \text{sine m}$. Thus the value is 11**.**33190832.

Now the Manda correction (Equation of Center) is [(PEM/360º) x 3438 x Sine m].

Thus, the Mandaphala i.e. Equation of Center is 72**.**3006975209 i.e.

01º 12′ 18″ 02.51‴.

It is subtracted fully from the Mean Sun (Mean Venus), as the Manda anomaly (m) is less than 180º. (This is because, in case of Venus and Mercury it is reversed).

Mean Sun (Venus) 236º 03′ 11″ 41**.**59‴.

Manda Anomaly – 01º 12′ 18″ 02**.**51‴.

Now the true mean Venus = **234º 50′ 53″ 39.08‴.**

Now we have to find out Sighra correction for this true mean Venus.

First we have to find out Venus' Sighroccha.

For Venus and Mercury, Sighroccha is equal to the addition of its Sighra Kendra (Sighra Anomaly) with Mean Sun.

Venus' Sighra Kendra is 271º 11′ 26″ 31**.**24‴.

Mean Sun is + 236º 03′ 11″ 41**.**59‴.

Thus, Sighroccha is 507º 14′ 38″ 12**.**83‴.

Since, this is more than 360º and the maximum degrees of a circle is 360º, we have to subtract

360º from it. Thus, Sighroccha is **147º 14′ 38″ 12.83‴.**

Now we have to subtract the true mean Venus from this Sighroccha of Venus, to get new Sighrakendra (Sighra Anomaly - s)

(147º 14′ 38″ 12**.**83‴ + 360º) – 234º 50′ 53″ 39**.**08‴ **=272º 23′ 44″ 33.75‴** (272**.**3957º).

We have to add 360º to Sighroccha of Venus, as the true mean Venus is more than the Sighroccha of Venus.

Sine of Sighra Anomaly s (272**.**3957º) is – 0**.**99912597. As the Sighra Kendra is more than 180º, it is subtracted.

Venus' Sighra epicycle is 260º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 262º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2**:**34 to 37.

Hence, Venus' corrected periphery of Sighra Epicycle (PES) for this Sighra Anomaly is

$PES = p_e - [(p_e - p_o)$ x sine m. Thus the value is **263.99825194**.

Now we have to find out Doh phala, Koti Phala, Sphuta Koti and Sighra karna to find out the Sighra Correction.

Doh phala is the result from the base sine of the right angled triangle.

Koti phala is the result from the perpendicular sine of the right angled triangle.

Sphuta koti is Koti phala added to or subtracted from the radius of the circle expressed in minutes of arc i.e. 3438.

Sighra Karna is the Sighra Hypotenuse.

Doh phala is [(PES x 3438 x sine s) ÷ 360º] = 2518**.**979716182.

Koti phala is [(PES x 3438 x cos s) ÷ 360º] = 105**.**3871514087.

(Cos s of 272**.**3954º is 0**.**04179893).

Sphuta Koti is 3438 + Koti phala = 3543**.**3871514087.

(If Sighra Kendra (Sighra Anomaly) is 2nd and 3rd quadrants (90º to 180º and 180º to 270º), we have to subtract Koti phala from 3438, the radius of circle in minutes of arc. In 1st and 4th quadrants (0º to 90º and 270º to 360º), we have to add Koti phala to 3438).

Sighra karna is $\sqrt{(\text{Doh phala})^2 + (\text{Sphuta koti})^2}$ and the value got is 4347**.**510933.

Now Sighra Correction (Sighra phala) = Sine^{-1} [Doh phala ÷ Sighra Karna].

The value is 35**.**40886841º i.e. 35º 24′ 31″ 55**.**58‴.

Thus, the Sighra Correction or Correction of Elongation is **35º 24′ 31″ 55.58‴.**

Subtract Sighra correction from the true mean longitude of Venus.

The true mean Venus = 234º 50′ 53″ 39**.**08‴.

Sighra Correction = 35º 24′ 31″ 55**.**58‴.

True position of Venus = 199º 26′ 21″ 43**.**50‴.

Thus, the exact position of the Venus on Amavasya Day of Karthika month at 42nd year before Kaliyuga at Ujjaini was **199º 26′ 21″ 43.50‴.**

Then Desantara correction is applied to know the true or exact or Sphuta position of Venus at Hastinapura.

The angle of arc difference for Venus is calculated by multiplying daily mean motion of Venus (0.9856028595º) with Longitude difference between Ujjaini and Hastinapura in degrees and divide the value by 360º. Thus the angle of difference is **22″ 01.75‴,**

[(2.2351º x 0.9856028595º) ÷ 360º].

Since Hastinapura is more East than Ujjaini, we have to add this angle of arc difference from the value got in previous calculation.

199º 26′ 21″ 35.86‴+ 22″ 01.75‴ = 199º 26′ 43″ 45.25‴.

Thus, True Venus at Hastinapura was **199º 26′ 43″ 45.25‴.**

Bhujantara Correction

The formula is [manda correction of Sun in degrees x daily mean motion of the Graha in degrees ÷360º]. If the manda correction of Sun is positive, it is additive and if negative, it is then subtractive. The calculated value is 08″ 35.35‴. It is subtracted from the above value of true Venus at Hastinapura. 199º 26′ 43″ 37.61‴– 08″ 35.35‴ = 199º 26′ 35″ 09.90‴.

Thus, true (Sphuta or exact) position of Venus on Amavasya thithi of Karthika Month at 42nd year before Kaliyuga at Hastinapura was **199º 26′ 35″ 09.90‴.** Thus, Venus was at Tula zodiac sign (180º to 210º) at Svati Nakshatra (186º 40′ to 200º 00′).

Now we can calculate the true or exact or Sphuta position of Venus at the end of Amavasya in Karthika month of 42nd year before Kaliyuga, by multiplying the mean daily motion of Venus with the time duration required for Sun and Moon to be exactly in the same longitude and dividing the result by 24 hours of a day. The daily mean motion of Venus is 0.9856028595º. The period of time is 9 hours 24 minutes 36 seconds and 09.12 thirds (9.4100422123 hours). The value is 00º 23′ 11″ 11.08‴. This is to be added.

Thus, the true or exact or Sphuta position of Venus at the end of Amavasya thithi of Karthika month at 42nd year before Kaliyuga at Hastinapura was **199º 49′ 46″ 20.98‴**

Venus cannot be more than 45º to 47º away from Sun, in longitude. That is the limit of elongation of Venus. Here at the end of Amavasya thithi of Karthika month at 42nd year at Hastinapura, Venus was situated at 199º 49′ 46″ 20.98‴ and Sun was at 235º 34′ 19″ 02.47‴. The difference in longitude of Sun and Venus is **35º 44′ 32″ 41.49‴.** Hence, it is acceptable.

Veda Vyasa mentioned that Venus was imposing upon Purva Bhadrapada Nakshatra with shining and was looking attentively all round at Uttara Bhadrapada Nakshatra. Since Veda Vyasa told that Venus was looking attentively (Samudeekshate) at Uttara Bhadrapada Nakshatra, we can take that Venus was situated in Kanya zodiac sign and thus looked at Purva and Uttara Bhadrapada Nakshatra which are situated at Meena zodiac sign (7th from Kanya) by its 7th Drishti. However, our derivation shows that Venus was situated in Tula zodiac sign and in conjunction with Svati Nakshatra (186º 40′ to 200º 00′). This can be explained by the following two facts. 1. Just 20 days back, Venus was definitely in Kanya zodiac sign and at that time by its

7th Drishti, it looked at (aspected) Purva and Uttara Phalguni Nakshatra which are situated in Meena zodiac sign which is 7th zodiac sign from Kanya. It is acceptable. Further the effect of Venus on Purva and Uttara Phalguni Nakshatra would have initiated the war provoking situation and also would have continued its post effect even during the Mahabharata war. 2. Though the sentence is in present tense, a verb of present tense can also denote an incidence of recent past, as per Panini's Ashtadhyayi 3**:**3**:**131. Hence, it is acceptable and there is no contradiction. Further, Sree Krishna told Karna that war had to be started on Amavasya which fell on Jyeshtha Nakshatra. (Udyoga Parva 142nd Adhyaya at 18th sloka). Hence, Sun must be in Jyeshtha Nakshatra of 226º 40′ to 240º 00′. Kanya zodiac sign is at 150º to 180º. Here the minimum difference between Jyeshtha Nakshatra and Kanya zodiac sign is 46º 40′, which almost exceeds the limit of elongation of Venus of 45º to 47º. Besides, we cannot take that Venus was in conjunction with Purva and Uttara Bhadrapada Nakshatra. This is because Purva Bhadrapada is situated at 320º 00′ to 333º 20′ and Uttara Bhadrapada Nakshatra is at 333º 20′ to 346º 40′. Thus, the minimum difference between Jyeshtha Nakshatra and Purva Bhadrapada Nakshatra will be 80º and Uttara Bhadrapada is still further away. Hence it exceeds much the limit of elongation of 45º to 47º of Venus. Hence, Venus cannot be at Purva and Uttara Bhadrapada Nakshatra. Further, the Mahabharata text mentioned that Venus looked attentively (Samudeekshate) at Uttara Bhadrapada Nakshatra and Venus has only 7th Drishti and can aspect Purva and Uttara Bhadrapada Nakshatra from Kanya zodiac sign only, that happened just 20 days before the starting of war and it was one of the factors that provoked the war and it continued its post effect during the war also. Thus, it satisfies the statement of Veda Vyasa as shown at Bhishma Parva 3rd Adhyaya 15th sloka.

Derivation of the position of Mercury

Venus and Mercury are the planets that are revolving the Sun inner to the Earth's orbit around the Sun. Hence to derive the exact positions of these two Graha, a slightly modified procedure is followed. This is described in Laghu Bhaskariyam (2**:**37 to 39) of Bhaskara, who is a follower of Aryabhatta's tradition in Astronomy and Mathematics. His date is either 629 C.E. or 522 C.E.

Mean position of the Sun is taken as the mean position of Mercury. Hence, Mean Mercury revolves at the velocity of 43,20,000 revolutions in 157,79,17,500 days of a Yuga of 43,20,000 years as per Vatesvara Siddhanta (1**:**1**:**12 to 14). This is because, the Earth not only revolves round the Sun, but the Venus and Mercury also, because Venus and Mercury are within the orbit of Earth around the Sun and are in between Earth and the Sun. Thus, the revolution of Earth around the Sun at a velocity of 43,20,000 revolutions in 157,79,17,500 days is not only imposed on Sun but on Venus and Mercury also. (This proves our ancestors followed the Heliocentric model only). That is why we are calculating 43,20,000 revolutions in 157,79,17,500 days for Venus and Mercury like that of Sun.

Mean Sun i.e. Mean Mercury at Ujjaini = 236º 03′ 11″ 41**.**59‴.
(Already derived at the calculation for Sun).

Velocity of Sighra Kendra is calculated by subtracting Velocity of mean Sun from the velocity of Sighroccha of Mercury. (Velocity of Sighroccha is equal to the addition velocities of Mean Sun and Sighrakendra in case of planets that revolve round the Sun inner to Earth's orbit). Velocity of Sighroccha of Mercury is 1,79,37,060 and the velocity of mean Sun is 43,20,000 revolutions in 157,79,17,500 days as per Vatesvara Siddhanta (1**:**1**:**12 to 14). Hence the velocity of Sighra Kendra of Venus is 1,79,37,060 – 43,20,000 = **1,36,17,060** revolutions in 157,79,17,500 days.

Sighra Kendra or Sighra anomaly of Mercury at 1442 Salivahana Saka, Chaitra month, Prathama thithi, at Sun rise as per Grahalaaghavam was **269º 33′.**

In the Ahargana days of 17,02,586, the Sighra Kendra of Mercury revolved by 14,692**.**920077988 revolutions. ([17,02,586 x 1,36,17,060] ÷ 157,79,17,500). Here 14,692 are completed revolutions. The remaining 0**.**920077988 are the incomplete revolutions. The incomplete revolutions should be converted into degrees of arc. It will be 331º 13′ 41″ 04**.**41‴ (0**.**920077988 x 360 to get degrees of arc, then remaining fraction multiplied by 60 to get minutes of arc, like that up to seconds and thirds of arc). We have to subtract this value from the position of Sighra Kendra of Mercury at 1442 Salivahana Saka at Ujjaini, which was at **269º 33′,** as we are back calculating for the year of past

(269º 33′ 00″ 00.00‴+ 360º) – 331º 13′ 41″ 04**.**41‴ = 298º 19′ 18″ 55**.**59‴.

360º is added, as the position of Sighra Kendra of Venus at 1442 Salivahana Saka at Ujjaini is less than 318º 57′ 33″ 28**.**76‴.

Thus, the position of Sighra Kendra or Sighra Anomaly of Mercury at Amavasya day of Karthika month of 42nd year before Kaliyuga was **298º 19′ 18″ 55.59‴.**

Now we have to get the Equation of Center (Manda correction) for Mercury. This is because the Mercury is revolving the Sun in an elliptical circle and not in a perfect circle and also the Sun is situated eccentrically i.e. not at the perfect center of Mercury's revolution circle. Hence, the ancient astronomical texts of our Nation used two methods to correct this. They are 1. Epicyclic Model and 2. Eccentric model. In this book the Epicyclic model is followed.

To do the Equation of Center (Manda) correction, we first know the position of Mandoccha at the required year, say here, 42nd year before Kaliyuga.

Vatesvara Siddhanta at 1**:**4**:**56 to 62 sloka gives the position of Mercury's Mandoccha at the beginning of Kaliyuga as 226º 42′ 54″ and the velocity of Mercury's Mandoccha as per Surya Siddhanta at 1**:** 40 & 41 is 368 revolutions in 432 crore years of one Kalpa. Based on this we can calculate the position of Mandoccha at 42nd year Karthika month Amavasya day (last day of Karthika month as it is an Amanta type of month calculation).

[(41**.**3333 x 368 x 360 x 60 x 60) ÷ 432,00,00,000] in seconds of arc.

It is 00º 00′ 04″ 33**.**79‴. As we are back calculating for a year of past, it has to be subtracted.

226º 42′ 54″ 00**.**00‴– 00º 00′ 04″ 33**.**79‴= 226º 42′ 49″ 26**.**21‴.

Hence Mercury's Mandoccha at Karthika month Amavasya day at 42nd year before Kaliyuga was **226º 42′ 49″ 26.21‴.**

Now we have to find out Sighra correction of Mercury. For Venus and Mercury, this is the correction of their elongation i.e. the longitude difference between Venus or Mercury from the Sun.

Sighra Correction (Elongation Correction)

Sighra Kendra or Sighra anomaly (s) is 298º 19′ 18″ 55**.**59‴ (298**.**321924º) as derived before.

Since Sighra Anomaly is more than 180º, it is additive. (This because, in case of Venus and Mercury it is reversed and has to be subtracted if it is less than 180º).

Sine of Sighra anomaly (Sine s) of 298**.**321924º is – 0**.**88029588.

Mercury's Sighra epicycle is 132º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 133º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º).

Refer Surya Siddhanta 2**:**34 to 37.

Hence Mercury's corrected periphery of Epicycle (PES) for this Sighra anomaly value is,

$PES = p_e - [(p_e - p_o)$ x sine m. Thus the value is **133.88029588**.

Now we have to find out Doh phala, Koti Phala, Sphuta Koti and Sighra karna to find out the Sighra Correction.

Doh phala is the result from the base sine of the right angled triangle.

Koti phala is the result from the perpendicular sine of the right angled triangle.

Sphuta koti is Koti phala added to or subtracted from the radius of the circle expressed in minutes of arc i.e. 3438.

Sighra Karna is the Sighra Hypotenuse.

Doh phala is [(PES x 3438 x sine s) ÷ 360º] = 1125**.**5083059691.

Koti phala is [(PES x 3438 x cos s) ÷ 360º] = 606**.**579437081.

(Cos s of 298**.**321924º is 0**.**47442509).

Sphuta Koti is 3438 + Koti phala = 4044**.**579437081.

(If Sighra Kendra (Sighra Anomaly) is 2nd and 3rd quadrants (90º to 180º and 180º to 270º), we have to subtract Koti phala from 3438, the radius of circle in minutes of arc. In 1st and 4th quadrants (0º to 90º and 270º to 360º), we have to add Koti phala to 3438).

Sighra karna is $\sqrt{(\text{Doh phala})^2 + (\text{Sphuta koti})^2}$ and the value got is 4198**.**260565.

Now Sighra Correction (Sighra phala) = Sine^{-1} [(Doh phala ÷ Sighra Karna].

The value is 15**.**55059455º i.e. 15º 33′ 02″ 08**.**42‴.

Thus, the Sighra Correction or Correction of Elongation is **15º 33′ 02″ 08.42‴.**

Half of the Sighra Correction (07º 46′ 31″ 04**.**21‴) has to be added to the Mandoccha of Venus, as the Sighra Anomaly (s) is more than 180º. (This is because, in case of Venus and Mercury it is reversed and has to be subtracted if it is less than 180º).

Manda Correction

Here we have to calculate Manda correction with the Mandoccha added with half of Sighra Correction.

Mercury's Mandoccha at Karthika month Amavasya day at 42nd year before Kaliyuga was

226º 42′ 49″ 26.21‴.

New Mandoccha is 226º 42′ 49″ 26**.**21‴ + 07º 46′ 31″ 04**.**21‴= **234º 29′ 20″ 30.42‴.**

Now this new Mandoccha has to be subtracted from Mean Sun.

Mean Sun or Mean Mercury = 236º 03′ 11″ 41**.**59‴.

New Mandoccha = 234º 29′ 20″ 30**.**42‴**.**

= 001º 33′ 51″ 11**.**17‴.

Manda Kendra (Manda Anomaly) = **001º 33′ 51″ 11.17‴** (01**.**56422º).

As Manda Anomaly is less than 180º, it is subtractive (This is because, in case of Venus and Mercury it is reversed).

Sine value of this Manda anomaly 01**.**56422º is (sine m) + 0**.**0272974.

Mercury's Manda epicycle is 28º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 30º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2**:**34 to 37.

Hence Mercury's corrected periphery of Epicycle (PEM) for this Manda Anomaly value is,

$PEM = p_e - [(p_e - p_o)$ x sine m. Thus the value is 29**.**9454052.

Now the Manda correction (Equation of Center) is [(PEM/360º) x 3438 x Sine m].

Thus, the Mandaphala i.e. Equation of Center is 07**.**8064727723′ i.e.

00º 07′ 48″ 23.30‴.

It is subtracted fully to the Mean Sun (Mean Mercury), as the Manda anomaly (m) is less than 180º. (This is because, in case of Venus and Mercury it is reversed).

Mean Sun (Mercury) 236º 03′ 11″ 41**.**59‴.

Manda Anomaly – 00º 07′ 48″ 23**.**30‴.

Now the true mean Mercury = **235º 55′ 23″ 18.29‴.**

Now we have to find out Sighra correction for this true mean Mercury.

First we have to find out Mercury's Sighroccha.

For Venus and Mercury Sighroccha is equal to the addition of its Sighra Kendra (Sighra Anomaly) with Mean Sun.

Mercury's' Sighra Kendra is 298º 19′ 18″ 55**.**59‴.

Mean Sun is + 236º 03′ 11″ 41**.**59‴.

Thus, Sighroccha is 534º 22′ 30″ 37**.**18‴.

Since, this is more than 360º and the maximum degrees of a circle is 360º, we have to subtract 360º from it. Thus, Sighroccha is **174º 22′ 30″ 37.18‴.**

Now we have to subtract the true mean Mercury from this Sighroccha of Mercury, to get new Sighrakendra (Sighra Anomaly - s)

(174º 22′ 30″ 37**.**18‴ + 360º) – 235º 55′ 23″ 18**.**29‴= **298º 27′ 07″ 18.89‴** (298**.**452º).

We have to add 360º to Sighroccha of Mercury, as the true mean Mercury is more than the Sighroccha of Venus.

Since, Sighra Kendra is more than 180º, we have to subtract it.

Sine of Sighra Anomaly s (298**.**452º) is – 0**.**87921655.

Mercury's Sighra epicycle are 132º at odd quadrants (p_o, 1st and 3rd quadrants, 0º to 90º and 180º to 270º) and is 133º in even quadrants (p_e, 2nd and 4th quadrants, 90º to 180º and 270º to 360º). Refer Surya Siddhanta 2**:**34 to 37.

Hence, Mercury's corrected periphery of Sighra Epicycle (PES) for this Sighra Anomaly is $PES = p_e - [(p_e - p_o)$ x sine m. Thus, the value is **133.87921655**.

Now we have to find out Doh phala, Koti Phala, Sphuta Koti and Sighra karna to find out the Sighra Correction.

Doh phala is the result from the base sine of the right angled triangle.

Koti phala is the result from the perpendicular sine of the right angled triangle.

Sphuta koti is Koti phala added to or subtracted from the radius of the circle expressed in minutes of arc i.e. 3438.

Sighra Karna is the Sighra Hypotenuse.

Doh phala is [(PES x 3438 x sine s) ÷ 360º] = 1124**.**1192586166.

Koti phala is [(PES x 3438 x cos s) ÷ 360º] = 609**.**1281495004.

(Cos s of 298**.**452º is 0**.**47642236).

Sphuta Koti is 3438 + Koti phala = 4047**.**1281495004.

(If Sighra Kendra (Sighra Anomaly) is 2nd and 3rd quadrants (90º to 180º and 180º to 270º), we have to subtract Koti phala from 3438, the radius of circle in minutes of arc. In 1st and 4th quadrants (0º to 90º and 270º to 360º), we have to add Koti phala to 3438).

Sighra karna is $\sqrt{(\text{Doh phala})^2 + (\text{Sphuta koti})^2}$ and the value got is 4200**.**344077.

Now Sighra Correction (Sighra phala) = Sine^{-1} [Doh phala ÷ Sighra Karna].

The value is 15**.**52302005º i.e. 15º 31′ 22″ 52**.**33‴.

Thus, the Sighra Correction or Correction of Elongation is **15º 31′ 22″ 52.33‴.**

Subtract Sighra correction from the true mean longitude of Mercury.

The true mean Mercury = 235º 55′ 23″ 18**.**29‴.

Sighra Correction = 15º 31′ 22″ 52**.**33‴.

True position of Mercury = 220º 24′ 00″ 25**.**96‴.

Thus, the exact position of the Mercury on Amavasya Day of Karthika month at 42nd year before Kaliyuga at Ujjaini was **220º 24′ 00″ 25.96‴.**

Then, Desantara correction is applied to know the mean position of Mercury at Hastinapura.

The angle of arc difference for Mercury is calculated by multiplying daily mean motion of Mercury (0**.**9856028595º) with Longitude difference between Ujjaini and Hastinapura in degrees and divide the value by 360º. Thus the angle of difference is **22″01.75‴**

[(2.2351º x 0**.**9856028595º) ÷ 360º].

Since Hastinapura is more East than Ujjaini, we have to add this angle of arc difference from the

value got in previous calculation.

220º 24′ 00″ 25.96‴+ 22″ 01.75‴ = 220º 24′ 22″ 27.71‴.

Thus, True Mercury at Hastinapura was **220º 24′ 22″ 27.71‴.**

Bhujantara Correction

The formula is [manda correction of Sun in degrees x daily mean motion of the Graha in degrees ÷360º]. If the manda correction of Sun is positive, it is additive and if negative, it is then subtractive. The calculated value is 08″ 35.35‴. It is subtracted from the above value of true Mercury. 220º 24′ 22″ 27.71‴ – 08″ 35.35‴ = 220º 24′ 13″ 52.36‴.

Thus, exact (Sphuta, True) position of Mercury on Amavasya thithi of Karthika Month at 42nd year before Kaliyuga, at Hastinapura was **220º 24′ 13″ 52.36‴.**

Thus, it is in Vriscika zodiac sign (210º to 240º) and in conjunction with Anuradha Nakshatra (213º 20′ to 226º 40′). Now we can calculate the true or exact or Sphuta position of Mercury at the end of Amavasya in Karthika month of 42nd year before Kaliyuga, by multiplying the mean daily motion of Mercury with the time duration required for Sun and Moon to be exactly in the same longitude and dividing the result by 24 hours of a day. The daily mean motion of Mercury is 0.9856028595º. The period of time is 9 hours 24 minutes 36 seconds and 09.12 thirds (9.4100422123 hours). The value is 00º 23′ 11″ 11.08‴. This is to be added.

Thus, the true or exact or Sphuta position of Mercury at the end of Amavasya thithi of Karthika month at 42nd year before Kaliyuga at Hastinapura was **220º 47′ 25″ 03.44‴.**

Here, at the end of Amavasya thithi of Karthika month in 42nd year at Hastinapura, Mercury was situated at 220º 47′ 25″ 03.44‴and Sun was at 235º 34′ 19″ 02.47‴. The difference in longitude of Sun and Venus was **14º 46′ 53″ 59.03‴**. Mercury cannot be more than 18º to 28º away from Sun in longitude. That is the limit of elongation of Mercury. Hence it is acceptable.

<u>Possibility of Lunar Eclipse at Karthika Paurnami</u>

Veda Vyasa mentioned that both Lunar and Solar Eclipse were occurring in the same month and the occurrence of Amavasya happened ill timely at just 13 days interval from Paurnami. These statements are as per in Bhishma Parva 3rd Adhyaya 28 & 32 sloka. Further Veda Vyasa mentioned that as per Bhishma Parva, 2nd Adhyaya 23rd sloka that at the bottom of the sky, on Paurnami (Full Moon) day in Karthika month, Moon was nonexistent, without light rays and was invisible. Besides Karna replied Sree Krishna as per Udyoga Parva, 143rd Adhyaya 11th sloka that Moon was in a bad condition. These statements suggest the possibility of a Lunar Eclipse in the same Karthika month just 13 days prior to Amavasya and the Solar Eclipse, that occurred on the last day of Karthika Month. (It is Amantha type of month calculation where last day of the month will be Amavasya). Now we have to analyse the possibility of Lunar Eclipse in Karthika month in 42nd year prior to Kaliyuga beginning.

Mean Sun on Karthika Amavasya at 42nd year before Kaliyuga beginning 236º 03′ 33″ 43.34‴.
Sun moved in 13 days – 12º 48′ 46″ 12.83‴.
(Mean daily motion of Sun is 59.1361715679′ multiplied by 13 days)
Sun's position on Karthika Paurnami of 42nd year before Kali beginning **223º 14′ 47″ 30.51‴.**
Rahu on Karthika Amavasya in 42nd year before Kaliyuga beginning 234º 11′ 24″ 29.96‴.
Rahu moved in 13 days + 00º 41′ 19″ 33.70‴.
(Mean daily motion of Rahu is 03.1789251339′ multiplied by 13 days)
Rahu's position on Karthika Paurnami of 42nd year before Kali beginning **234º 52′ 44″ 03.66‴.**
The difference in the longitude between Sun and Rahu or Moon and Ketu **11º 37′ 56″ 33.15‴.**
(234º 52′ 44″ 03.66‴ –223º 14′ 47″ 30.51‴). Moon will be 180º apart from Sun at the end of Paurnami thithi and Ketu will always be180º apart from Rahu. The limit of partial Lunar Eclipse is 12º 12′. Thus, there was a possibility of partial Lunar Eclipse on Karthika Paurnami day of 42nd year before Kaliyuga beginning. Hence, this also satisfied.

The Result

At 42nd year before the beginning of Kaliyuga (3143 B.C.E.), i.e. 5161 years before present (at 2019 C.E.) at Karthika month on Amavasya day, at Hastinapura the positions of Graha are,

1.Sun 235º 11′ 07″ 51.39‴ in conjunction with Jyeshtha Nakshatra (226°40′ to 240°) in Vriscika zodiac sign (210° to 240°).

2.Moon 229°45′ 23″ 55.36‴ in conjunction with Jyeshtha Nakshatra (226°40′ to 240°) in Vriscika zodiac sign (210° to 240°).

Thus, here the Moon revolved round a few degrees (which requires just a few hours only) to reach the same longitude of Sun i.e. in conjunction with Sun and that was the end of Amavasya. Thus, it satisfies the words of Sree Krishna who said that Amavasya was going to occur in Jyeshtha Nakshatra. It also satisfies the Vyasa's words that both Moon and Sun were afflicting Rohini Nakshatra. Sun and Moon have 7th Drishti and Rohini is in the 7th zodiac sign (Vrishabha) from Jyeshtha which is in Vriscika.

3.Rahu 234º 11′ 24″ 29.96‴ in conjunction Jyeshtha Nakshatra (226°40′ to 240°) in Vriscika zodiac sign (210° to 240°).

Solar eclipse is a definite possibility as the difference between the longitude of Sun and Rahu, **at the time of end of Amavasya thithi,** was just 01º 24′ 09″ 19.58‴. The limits of Solar eclipse are 18.4° at maximum and 15.4° minimum. It satisfies the statements of Karna and Vyasa that Rahu is approaching Sun. It also satisfies the words of Vyasa who said that Moon and Sun were going to be eclipsed in the same month and same day.

NASA's ten millennium years of catalogue of long Solar eclipse shows that there was a long annular solar eclipse occurred at –3142 astronomical year on November 13th. NASA clarified that –3142 astronomical year means 3143 B.C.E. This is because in astronomical year calculation, there is zero year between minus and plus years where as in B.C.E. and

C.E. method of calculation there is no zero year. This is well clarified in NASA's same web site itself at 'year dating conventions' (BCE/CE Dating Conventions).

4. Ketu 180° apart from Rahu (54° 11′ 24″ 29.96‴), in conjunction with Mrigasira (53º 20′ to
66º 40′) in Vrishabha zodiac sign (30° to 60°)

5.Jupiter 214°15′ 31″ 52.95‴ in conjunction with Anuradha Nakshatra (213°20′ to 226°40′) in Vriscika zodiac sign (210° to 240°).

This satisfies Veda Vyasa's statement that Jupiter was nearer to Visakha Nakshatra. Anuradha is the immediate next Nakshatra to Visakha. Since Jupiter was situated in Vriscika zodiac sign (210° to 240°), it can afflict Rohini Nakshatra which is situated in Vrishabha zodiac sign which is 7th zodiac sign from Vriscika zodiac sign and Jupiter has 7th Drishti. This satisfies the statement at Karna parva that Jupiter was afflicting Rohini Nakshatra.

6. Saturn 232° 51′ 22″ 51.17‴ in conjunction with Jyeshtha Nakshatra (226°40′ to 240°) in Vriscika zodiac sign (210° to 240°).

It satisfies the statement of Vyasa that Saturn was placed nearer to Visakha Nakshatra and Jyeshtha is just the 2nd Nakshatra to Visakha. Further it satisfies Vyasa and Karna's words that Saturn was afflicting Rohini. Saturn which has the 7th Drishti and Rohini is in the 7th zodiac sign (Vrishabha) from Jyeshtha which is in Vriscika. Hence by its 7th Drishti, it afflicted Rohini. Besides, Veda Vyasa told that Saturn was afflicting Purva Phalguni Nakshatra. Saturn also has 10th Drishti besides 3rd and 7th Drishti and Purva Phalguni is situated in Simha zodiac sign and Simha is 10th zodiac sign from Vriscika where Jyeshtha Nakshatra is situated. Hence by its 10th Drishti, Saturn afflicted Purva Phalguni. Thus, it is also satisfied.

7.Mars 206° 56′ 59″ 38.70‴ in conjunction with Visakha Nakshatra (200° 00′ to 213°20′) in Tula zodiac sign (180° to 210°).

It satisfies Karna's reply to Sree Krishna that Mars was acting cruelly at Jyeshtha Nakshatra and was praying to be associated and come together with Anuradha Nakshatra, in a friendly manner. Mars was just 6º to 7º away from Anuradha Nakshatra and which can be covered in about 15 days i.e. before the end of Mahabharata war. Mars was situated in Tula Zodiac sign (180° to 210°) and Makara is the 4th zodiac sign from Tula. Sravana Nakshatra is situated in Makara Zodiac sign. Mars has 4th Drishti and hence can affect Sravana Nakshatra by its 4th Drishti. The sloka also mentioned that Mars was not at Sravana Nakshatra but stayed apart (vyavasthita). It was situated at Visakha Nakshatra which is six nakshatra apart from Sravana Nakshatra. This satisfies the statements of Mahabharata text of Veda Vyasa.

8.Venus 199° 26′ 35″ 09.90‴ in conjunction with Svati Nakshatra (186° 40′ to 200°00′) in Tula zodiac sign (180° to 210°). .

The difference in longitude of Sun and Venus was 35º 44′ 32″ 41.49‴. Hence it is acceptable, as the limit of elongation of Venus is 45º to 47º. Just 20 days back, Venus was definitely in Kanya Zodiac sign and at that time, by its 7th Drishti, it aspected Purva and Uttara Phalguni Nakshatra which are situated in Meena zodiac sign which is 7th Zodiac sign from Kanya. The effect of Venus on Purva and Uttara Phalguni Nakshatra would have one of the cause that initiated the war provoking situation and also continued its post effect even during the Mahabharata war. Though the sentence is in present tense, a verb of present tense can also denote an incidence of recent past, as per Panini's Ashtadhyayi 3:3:131. Hence it is acceptable. Since, the Mahabharata text mentioned that Venus looked attentively (Samudeekshate) at Uttara Bhadrapada Nakshatra and Venus has only 7th Drishti and can aspect Purva and Uttara Bhadrapada Nakshatra from Kanya Zodiac sign only. Thus, it had happened some 20 days before the starting of war. Thus, it satisfies the statement of Veda Vyasa.

9.Mercury 220° 24′ 13″ 52.36‴in conjunction with Anuradha Nakshatra (213° 20′ to 226° 40′) in Vriscika zodiac sign (210° to 240°).

The difference in longitude of Sun and Venus was 14º 46′ 53″ 59.03‴. The limit of elongation of Mercury is 18º to 28º away from Sun in longitude. Hence it is acceptable.

10.As referred in Karna Parva, the Graha that are in conjunction in the same Vriscika zodiac sign, started separating in 15 days. Moon, due to its greatest angular velocity it moved away first. Sun also moved away as it was only less than 06° to reach Moola Nakshatra in Dhanus zodiac sign (It has the angular velocity of almost 1° per day).

11.Lunar Eclipse at Paurnami (Full Moon) of Karthika month, just 13 days before Amavasya (New Moon) and the Solar Eclipse. Just 13 days difference between Paurnami and Amavasya is a very rare event as stated by Veda Vyasa. Normally it takes 15 days or a minimum of 14 days and sometimes even 16 days. Hence, it is a very rare phenomenon and Sree Krishna told Yadava that Amavasya (New Moon) coincided with the 13th Lunation and the 14th Lunation was made as 15th by Rahu, as happened during the time of Mahabharata war. (Refer Mausala Parva and is detailed already). Hence, it may be due to resultant vector force of Sun, Earth and Moon acting at Rahu (the ascending node of Moon, a point in the Moon's orbit at a mean distance of 3,84,400 Kilometers away from the Earth). This Rahu might have acted on Moon to increase its angular velocity. Hence, Moon had covered 15 thithi and 14 Nakshatra in 13 days duration. Scientifically, when the Moon is at Perigee (nearer to Earth in its eccentric orbit), its angular velocity increase by 6% due to the gravitational forces of Earth and Moon, which accelerates the Moon. Further, as it is at Perigee, the angular velocity increases by another 6%, due to its orbit much closer to Earth. Hence there is a total 12% increase in its angular velocity. Normal daily mean angular velocity of Moon is 13.1763548855°. A 12% increase makes it to 14.7575174718°. What happened at the time of Mahabharata war, where Moon had an angular velocity of

14.8317567057° per day, as a very rare event with an increase of just 0.0742392339° per day°, is not at all an impossible one.

Now, by using their daily mean motion, we can calculate the position of Sun and Rahu, 13 days before Karthika Amavasya i.e. on Paurnami day. It is found that Sun was at 223º 14′ 47″ 30.51‴and Rahu was at 234º 52′ 44″ 03.66‴. Now the difference between the longitudes of Sun and Raghu was 11º 37′ 56″ 33.15‴. Moon will be at 180° apart from Sun at the end of Paurnami i.e. at 043º 14′ 47″ 30.51‴ Ketu, the descending node of Moon will always be at 180° apart from Rahu i.e. at 054º 52′ 44″ 03.66‴. Now the difference between the longitudes of Sun and Raghu or Moon and Ketu was 11º 37′ 56″ 33.15‴. The ecliptic limit for partial Lunar Eclipse is 12.2°. Hence, there was a possibility of a partial Lunar Eclipse on the Paurnami day and the Amavasya occurred in 13 days after Paurnami, as stated by Veda Vyasa. Hence it is also satisfied.

12. The season was the end of Sarad ritu and forthcoming of Hema ritu as per the statement of the Mahabharata Text at in Udyoga Parva 83rd Adhyaya 6 & 7th sloka. Since the war was started on the last day of Karthika month and ended on the 17th day of Margasirsha month, the season was definitely the end of Sarad ritu and beginning of Hema ritu. Thus, it is also satisfied.

13. Coming to Bhishma Nirvana, Bhishma fell on arrow bed on the 10th day of war. Since war was started on the last day of Karthika month, Bhishma fell on 9th day of Margasirsha month. He was on the arrow bed for 58 nights as per the statement of Bhishma himself at Anusasana Parva 167th Adhyaya 27th sloka as,

अष्टपञ्चाशतं रात्रः शयानस्याद्य मे गताः । 27 ।

In the next sloka Bhishma mentioned as,

माघोऽयं समनुप्राप्तो मासः सौमयो युधिष्ठिर । त्रिभागशेषः पक्षोऽयं शुक्लो भवितुमर्हति ॥ 28 ॥

The meaning is on the day of Bhishma Nirvana, it was Magha month as per Chandramana Calendar and it was Sukla Paksha i.e. the phase of Moon was from Amavasya to Paurnami (the bright fortnight)

Hence the number of nights were 21 to 22 in Margasirsha month (depending on whether this month had 29 or 30 days), as Bhishma fell on the 9th day of this Margasirsha month, with 29 to 30 nights in Pushya month (depending on whether this month had 29 or 30 days) and the remaining 7 to 8 nights in Magha month. Thus, Bhishma Nirvana took place after Pushya month and hence it was definitely in Uttarayana period only. Since it is of Chandramana calculation, the first day of the month will be Prathama thithi of Sukla Paksha (on the next day of Amavasya), In this calculation, the seventh thithi (Saptami thithi) after the beginning of Sun's uttarayana course is celebrated as Ratha Saptami and these seven days are required for the Sun to turn round fully to the north, as per our ancestor's view. Eighth thithi (Ashtami thithi) in Sun's uttarayana beginning is celebrated as Bhishmashtami, since Bhishma Nirvana occurred on this ashtami thithi. Thus, the Uttarayana course of the Sun started already i.e. 7 days before to Bhishmashtami

and the Ratha Sapthami was on 7th thithi and Bhishmashtami was on 8th thithi. As it was Magha Sukla Ashatami, three fourth of the Magha month were still remained. Thus, it also satisfies the second sentence of the sloka which states that three fourth was remaining. It is all as per Chandramana calendar and in Suryamana calendar, the days may differ either a few days before or after. Further, Sree Krishna told Bhishma that Bhishma was left with 56 days to live and after that he would be relieved from his body and attain the abode depending on his Karmaphala, as shown in Santhi Parva, 51st Adhyaya 14th sloka which states as,

पञ्चाशत षट् च कुरुप्रवीर शेषं दिनानां तव जीवितस्य । 14 ।

Thus, 56 days starts from the 10th day from the Margasirsha month or 11th day from the beginning of the war and ends on the previous day of Bhishma Nirvana. This gives a total of 56 days, i.e. 20 to 21 days in Margasirsha, 29 to 30 days in Pushya month and 6 to 7 days in Magha month. Thus, Bhishma Nirvana took place in Uttarayana period only, since it happened after the completion of Pushya month (Chandramana) as per above calculations. Thus it also satisfied.

Hence the astronomical events described within Mahabharata text are satisfied in the year 3143 B.C.E. at Karthika month Amavasya day. It is 41 years before the beginning of Kaliyuga (42nd year before Kaliyuga beginning). As discussed before, Kaliyuga had not begun just 36 years after Mahabharata war, but after a few years more than 36 years as shown by the internal evidences found in Mahabharata text itself in Mausala Parva (discussed already). Further it also satisfies the timing of Mahabharata war i.e. before Kaliyuga beginning as stated in Adi and Vana Parva, which is discussed already.

Points to be noted

1. The method followed to derive the positions of Graha and the occurrence of Lunar Eclipse followed by Solar eclipse in 13 days interval is unique, authentic, well established and scientific one. This method is elaborated in detail in the ancient astronomical texts of our Nation. These texts describe the method to derive the mean (Madhya) and true (Sphuta or exact) positions of the Graha, by using Ahargana calculation, mean daily velocity calculation, sine θ and cos θ trigonometric calculations, Desantara and Bhujantara corrections, thereby deriving the exact position of Graha. Hence, this method is well established and was in use for more than thousands of years, giving correct and absolute results. Further, it is using trigonometric calculations (with epicyclic and eccentric model). This is because our ancestors understood the scientific fact that the Graha revolve round the Sun in elliptical (not perfect circular) and eccentric circles. Hence it is totally scientific. Since these methods gave absolute and exact results for more than thousands of years, it is authentic. Here the methods can be shown externally, so that anyone can verify, repeat and get the results. Hence it is absolutely a scientific method.
2. Here the calendar system and calculation method is Bharatian and Nirayana method (Mesha 0° is fixed) where we need not convert the data into Sayana (Mesha 0° is in precession) and again reconverting into Nirayana method. Here the Bharatian calendar

system is used which mentions the day as thithi, nakshatra, month and year, as used in the text of Mahabharata. Hence, it is coherent with the text. Further there is no conversion of dates into Julian or Gregorian calendar system and again reconverting into Bharatian calendar. This conversion and reconversion creates much problem in deriving the dates. Due to this problem only, some of the scholars who derived the date of Mahabharata war were pushed into the compulsion of creating extra month (intercalary or adhika Masa) either in between Sree Krishna & Karna meet and the beginning of war or after the end of war and before Bhishma Nirvana. Actually, Mahabharata text did not mention any extra month in these periods. Since Bharatian calendar system is followed here, there is no need to create any intercalary month.

3. The trigonometric mathematical calculations described in the ancient astronomical texts are followed in this book. So far, no one else has followed them, in the assessment of astronomical events described in the text of Mahabharata and there by deriving the date. Thus, it is a unique method. Thus, this book is the pioneer and fore runner in following an authentic, well established and mathematical method in deriving the date of Mahabharata war.
4. The date derived here creates no contradiction but actually coherent with the traditional following of Kali era and Saptarishi era. Purana and Vruddha Garga, a very ancient rishi, mentioned that Saptarishi was stationed at Magha Nakshatra at Dvapara Kali Junction and Mahabharata war. This date derived here is well fit into this calculation. Further, more than 273 inscriptions especially Aihole etc., clearly mentioned that Kaliyuga began at 3101 B.C.E. Mahabharata text showed that Kaliyuga began after 36 years or more, from Mahabharata war. This date did not contradict this, but is in coherent with it. Besides internal evidence showed that the Mahabharata war was fought at the end of Dvaparayuga and before beginning of Kaliyuga, as stated previously. This also fully adhered in arriving the date.
5. This date will not create any shortcomings and contradictions but will be much complimentary to the derivation of chronology of Magadha Kingdom as shown in Purana and Kaliyuga Raja Vriddhanta.
6. This date will be consistent with the statements of Aryabhattiyam, Vruddha Garga, Varahamihira, Abul Fazl ibn Mubharak, Sir Alexander Cunningham and Henry Thomas Colebrooke, which are detailed earlier.

Conclusion

All these narrations clearly show that 42nd year before Kaliyuga beginning (3143 B.C.E.) satisfies the astronomical events i.e. the positions of Graha (Sun, Moon, Rahu [Ascending Node of Moon], Jupiter, Saturn, Mars, Venus and Mercury) and the occurrence of Lunar Eclipse followed by Solar Eclipse at 13 days interval within the same month of Karthika, described in the Mahabharata text. Further it also satisfies the other evidences as shown by Aryabhatta, Senior Garga Rishi, Varahamihira, Abul Fazl ibn Mubarak, Sir Alexander Cunningham and Henry

Thomas Coolbrooke and also more than 273 inscriptional evidences, especially Aihole inscription, showing the commencement of Kali era. Further it is cohesive, complimentary, coherent, consistent and reasonable and not ludicrous, contradictory and paradoxical with 1. The internal evidences described within the text of Mahabharata text mentioning that Mahabharata war was fought at Kalidvapara junction and the commencement of the Kaliyuga within short period of time, 2. The traditional calculation of Saptarishi Era and 3. The chronology of three Kingdoms (Kuru, Ikshvaku and Magadha Kingdoms) described in Purana and Kaliyuga Raja Vriddhanta. Thus, the astronomical events described within the text of Mahabharata of Veda Vyasa and other above described events are fully satisfied, when the date of Mahabharata war is fixed at 42nd year before Kaliyuga (5161 years before present at 2019 C.E. and 3143 B.C.E.).

Hence, it is strongly concluded that the date of Mahabharata war is 42nd year before Kaliyuga (5161 years before present at 2019 C.E. and 3143 B.CE.).

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