HELIOCENTRIC THEORY IN THE ANCIENT TEXTS OF OUR NATION DR.M.L.RAJA, M.B., B.S., D.O.,*

ABSTRACT

Heliocentric theory, but with perfect circular model was said to have been advanced first, by Nicholas Copernicus (1473 – 1543 A.D.) of Europe. Prior to that, in Europe, Claudius Ptolemy's (~85 -165 A.D.) perfect circular model of Geocentric theory was followed. However, the ancient texts of our Nation like Veda and the astronomical texts clearly revealed not only the Heliocentric theory, but also the elliptical pathway of the planets with their calculations, much advanced than that of Nicholas Copernicus. If the astronomical facts scattered in these texts, are analyzed perfectly they will show that the Bhāratian astronomy is based on Heliocentric theory only. Even the Navagraha temple construction in our Nation itself shows the Sun's centre position, encircled by the other Graha (planets, satellite and nodes).

Key words: - Heliocentric, Geocentric, elliptical motion, epicycles, Navagraha, Mahāyuga, ecliptic, attracting force, Śīghrocca and Solar system.

INTRODUCTION

It has been scientifically proved that the Sun is nearly at the centre of the Solar system and all the nine planets are revolving round the Sun in an elliptical (not perfect circular) pathway. This is known as Heliocentric theory, where 'helio' denotes the Sun. On the contrary, if the Earth is thought to be at the centre and the other eight planets with the Sun, if thought to be of revolving round the Earth, then it is known as Geocentric theory, where 'geo' denotes the Earth.

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It has been told that Nicholas Copernicus (1473 – 1543 A.D.), an astronomer of Poland in Europe, is the first person to advance the heliocentric theory, against the background of the Geocentric perfect circular model, by Claudius Ptolemy (~85 -165 A.D.) of Greek in Europe. Copernicus was said to have developed a heliocentric model with perfect circular motion (not elliptical), with the Sun at the centre of the Solar system. This model is known as a Mathematical *tour de force* (not bad for an amateur), since it had the defect of mentioning only the perfect circular motion of the planets round the Sun, which are actually elliptical.

On the contrary, the Veda and the ancient astronomical texts of our Nation had clearly revealed the Heliocentric theory, in the remotest antiquity itself. Besides, our ancient astronomical texts reveal that the planets revolve round the Sun in an elliptical pathway and not in a perfect circular pathway. These texts adopted Epicycles, exclusively to calculate the elliptical motion of the planets. There are number of references for this heliocentric theory with the elliptical pathway of the planets, found scattered in various ancient texts of our Nation.

VEDA

The Veda are Anādi and Sanātana, that means eternal. Scholars and experts vary on the date of Veda from five thousand years to lacks and lacks of years. Nevertheless, every one is definite that the Veda are the oldest scriptures in the whole world. Veda clearly show the Sun's prime importance in the Solar system than that of the Earth and the other planets. For example,

<u>Rg</u> Veda Samhitā, 3rd Mandalam, 59th Sūktam, 1st Mantram¹ reveals,

मित्रो जनान्यातयति ब्रुवाणो मित्रो दाधार पृथिवीमुत द्याम् । मित्रः कृष्टीरनिमिषाभि चष्टे मित्राय हव्यं घृतवज्जुहोत ।। Mitro janānyātayati bruvāno Mitro dādhāra Prthivīmuta dyām । Mitraḥ krstīr animisābhi caste Mitrāya havyam ghrtavajjuhota ।। The same thing is revealed in **Kṛṣṇa Yajurveda Taittirīya Samhitā**², 3-4-11-16 mantram also. **Meaning :** 1. Mitraḥ - Sun (The Sūrya Namaskār (first) mantram worships Sun as Ohm Mitrāya Namaḥ and Ŗg Veda Samhitā 3 - 59 - 2 verse mentions Sun as Mitraḥ and as Ādityaḥ); 2. Da – offering, giving, granting; 3. Ādhāra – sustaining, supporting, holding; 4. Pṛthivī - Earth; 5.Dyu – sky; 6. Kṛṣṭī- attracting force, attracting power; 7. Animiṣā - continuous, without interruption.

So this Vedic mantra reveals that the Sun sustains (holds) the Earth and the sky. The Sun has the attracting force over the Earth and the Heavenly bodies in the sky. Sun's attracting force acts continuously, without interruption over these planets. The modern science reveals that the planets of the Solar system revolve round the Sun, only because of the more attracting power of the Sun, over these planets. The same view is expressed by this Vedic mantra, which mentions that, the Sun is the attracting force, which acts continuously over the Earth and the other planets of the sky.

Further the Yajur Āranyaka³, in the verse 1 - 8 - 27, on describing the Sun, reveals as,

दादर्ध पृथिवीमभितो मयूखैः

Dādardha P<u>r</u>thivīmabhito mayūkhaiķ

Meaning : 1. Dādardha – holding; 2. P<u>r</u>thivī - Earth; 3. abhitas – on all sides; 4. mayūkhaiḥ - the light rays (power).

The Sun holds the Earth from all sides with His power (light rays), is the meaning of this Vedic mantra. Thus, these Vedic verses definitely show that the Vedic Rsies knew that the Sun is at the centre of the Solar system and all the planets including the Earth revolve round the Sun. ASTRONOMICAL TEXTS

Āryabhatta was the famous astronomer and the mathematician of our Nation of much

antiquity. He wrote three astronomical and mathematical texts namely Āryabhațțīyam and Mahā and Laghu Āryabhațța Siddhānta.

Āryabhațțīyam, 3^{rd} Sūtra of the Daśagītikā (1^{st}) chapter, ⁴ reveals as,

भगणाः ख्युघृ रवि युग सौराः ।।भृग् ब्ध Yuga bhaganāh khyughr Ravi Bhrgu Budha Sourāh Meaning: 1. Yuga – in one (Mahā) yuga of 43, 20,000 years; 2. Ravi – Sun; 3. bhaganāh -Revolutions; 4. khyughr – 43,20,000 as per Āryabhatta's coding of numbers; Kha – 2, ya – 30, u – $10,000^{\text{th}}$ place value, so yu - 3,00,000, khu - 20,000; So khyu - 3,20,000; gha - 4, r - 10,00,000^{\text{th}} place value, so ghr = 40,00,000; so khyughr = 43,20,000 (3,20,000 + 40,00,000); 5. Bhrgu = Venus (Śukran); 6. Budha – Mercury (Budhan); 7. Sourāh - (as that of) Sun.

So in this Sūtra, Āryabhațța reveals that the Sun's revolutions in one Mahāyuga (K<u>r</u>ta [Satya], Tretā, Dvāpara and Kaliyuga) of 43,20,000 years are 43,20,000. The revolutions of Venus and Mercury in one Mahāyuga are as that of Sun's, i.e. 43,20,000 revolutions in 43,20,000 years. So not only the Sun, but Venus and Mercury also revolve round in their respective orbits at the rate of 43,20,000 revolutions in 43,20,000 years. Therefore, the rate of revolution of Sun, Venus and Mercury, is one revolution per one year. It is well known that out of all the heavenly bodies in the Solar system, only the Earth revolves round in its orbit (Ecliptic), at the rate of one revolution per one year. Further, these heavenly bodies differ from each other in the number of revolutions per

year. None will have the same number of revolutions per year as that of the other. But Āryabhaţţa mentioned in this Sūtra as, **Bhrgu Budha Sourāḥ** that is, the number of revolutions of the Sun, Venus and Mercury are same in one Mahāyuga and their rate of revolution is one revolution per one year. Therefore, this number stated as the revolution of Sun, Venus, and Mercury, is nothing but the total number of revolutions of the Earth, in one Mahāyuga, imposed not only on the Sun, but also on Venus and Mercury. This is possible only in Heliocentric model, where the Earth revolves round not only the Sun, but along with the Sun, it revolves round Venus and Mercury also, at the rate of one revolution per one year, i.e. 43,20,000 revolutions in 43,20,000 years of one Mahāyuga. This is because in the Heliocentric model, Venus and Mercury are in between the Sun and the Earth, with Mercury nearer to the Sun (see figure 1).



Arrangements of Planets and the Sun

On the contrary, if Āryabhațțīyam is based on Geocentric theory, Āryabhațța could not

have mentioned as Bhrgu Budha Sourāh i.e. the revolutions of Venus, Mercury and the Sun in one Mahāyuga are same and equal. Because, in Geocentric model of arrangements of Sun and the Planets, the Earth will be at the centre. Next to the Earth, it will be the Venus. Outer to this will be Mercury. Beyond this will be the Sun (see figure-2). Therefore, the time duration for each revolution of Venus, Mercury and the Sun will definitely be not equal. They vary from each other. Venus will have the shortest duration for one revolution, because it will be nearer to the centrally placed Earth, as per Geocentric theory. Mercury will require more time than that of Venus. In the same way, the Sun will take more time than these two planets. So the total number of revolutions of the Sun, Venus and Mercury in one Mahāyuga of 43,20,000 years, will also definitely be not equal. Thus, Venus will have more number of revolutions than Mercury, which in turn will have more revolutions than that of the Sun, in one Mahāyuga. Therefore, in Geocentric model, the revolutions of Venus, Mercury and the Sun will definitely be not equal and same. Only in Heliocentric model, the apparent revolutions of Venus, Mercury and the Sun, which are nothing but the Earth's revolutions round the Sun in the Ecliptic, imposed on these three, are always equal and same. Since Aryabhatta mentioned these three are equal, this itself clearly proves that here, in this Sūtra, Āryabhattīyam mentioned only the apparent motion of the Venus, Mercury and the Sun, due to the Earth's revolution imposed on them and thus, Aryabhattīyam is based on Heliocentric theory only and not on Geocentric theory.

Here the revolution of the Earth is imposed on Venus, Mercury, and the Sun, which is a practical way adopted by our ancestors for computing the change of the position of the Earth, in the Ecliptic round the Sun. For example, to access the change of position of a constantly moving object, the observer should place himself on a stationary object. Then only he can access the changes of the moving object correctly. That too, if the moving object revolves round a stationary object, then the

observer should definitely be at that stationary object around which the moving object is revolving. Our ancestors want to calculate accurately the position of the Earth in the celestial sphere, which varies constantly against the background of the fixed stars of the sky, due to Earth's revolution round the Sun, in the Ecliptic. As seen above, to calculate this change of Earth's position, one has to be at the Sun, which is not possible for any human being. So our ancestors cleverly adopted a method, where the apparent movement of the stationary Sun (as for as Earth is concerned), due to Earth's revolution round the Sun in the Ecliptic imposed on the Sun, is calculated. This is calculated with the Earth as a point of reference, against the background of the fixed stars of the sky. This is like accessing the movement of the moving train, by calculating the apparent backward movements of the trees, plants and places, which are actually stationary, as for as train is concerned. Therefore, the revolution of the Earth round the Sun in the Ecliptic, which is imposed on the Sun, becomes the apparent motion of the Sun. By calculating this apparent motion of the Sun, our ancestors calculated the actual motion of the Earth in any particular period, due to Earth's revolution round the Sun and thus computed the actual position of the Earth in the sky at various periods of time in a very practical way. This is very essential for astronomical and time calculations, which in turn is absolutely required for performing Yajña at the correct time.

Further, the actual number of true revolutions of Venus and Mercury round the Sun, in their respective orbits, in one Mahāyuga of 43,20,000 years, are also correctly mentioned in the astronomical texts of our Nation. These values are mentioned as **'Śīghrocca'** of Venus and Mercury. For example, **Āryabhaṭṭīyam**, **4**th **Sūtra of the Daśagītikā** (**1**st) **chapter**, ⁵ mentioned as,

चन्द्रोच्च र्जुष्ठिबध बुध सुगुशिथृन जषबिखुछ शेषार्काः ।

Candrocca rjuskhidha, Budha sugusithrna,

Bhrgu jaşabikhuchr, Seşārkāh

Meaning : 1. Candrocca – Ucca place of Moon; 2. Budha – Mercury (Budhan); 3. Bh<u>r</u>gu – Venus (Śukran); 4. suguśith<u>r</u>na – 1,79,37,020; 5. jashabikhuch<u>r</u> - 70,22,388 (These two are as per number coding of Āryabhaţţa); sa – 90, u – 10,000th place value, so su – 9,00,000; ga – 3, u – 10,000th place value, so gu- 30,000; śa – 70, i - 100th place value, so śi – 7,000; tha – 17, <u>r</u> – 10,00,000th place value, so th<u>r</u> – 1,70,00,000; na -20, a – 1st place value, so na – 20; so suguśith<u>r</u>na – 1,79,37,020; ja – 8, a – 1st place value, so ja – 8; şa -80, a – 1st place value, so şa – 80; ba -23, i - 100th place value, so bi - 2,300, kha – 2, u – 10,000th place value, so khu – 20,000; cha -7, <u>r</u> – 10,00,000th place value, so chr – 70,00,000; so jasabikhuchr - 70,22,388.

So, this Sūtra reveals that in one Mahāyuga of 43,20,000 years, **the Śīghrocca** i.e. the true actual revolutions of Mercury is 1,79,37,020 and that of Venus is 70,22,388. The following table shows that these values match exactly with the values given by modern astronomy, which are calculated with most advanced technology and equipments.

| As per Āryabhațțīyam, number of revolutions | | Thus, sidereal days for one revolution | | |
|---|--------------|--|------------------|--|
| in one Mahāyuga of 43, 20,000 years | | Āryabhațțīyam | Modern Astronomy | |
| Śīghrocca of Mercury | 1,79, 37,020 | 87•96988 | 87•9693 | |
| Śīghrocca of Venus | 70,22,388 | 224 • 69814 | 224 • 7008 | |

The explanation for the Śīghrocca of the planets is clearly given in the book, Vațeśvara Siddhānta

and Gola of Vațeśvara, critically edited with English translation and commentary by K.S.Sukla, published by Indian National Science Academy, New Delhi in part two, page no. 165. Here it is explained that the Śīghrocca of a planet is either the Sun (the Earth) or the Planet itself, whichever of the two moves faster. Therefore, in the case of Mercury and Venus where these two planets move faster than the Earth, the Śīghrocca of these planets are, the planets themselves. In the case of Mars, Jupiter and Saturn, the Earth moves faster than these planets, so the Śīghrocca of these planets are the Earth's revolution in the Ecliptic, which is mentioned as Sun, because the Earth's revolution round the Sun in the Ecliptic, is imposed on the Sun, as shown before.

Further it should be noted that Āryabhatta never mentioned anything as Śīghrocca (actual true revolution) of the Sun, like that of Mercury and Venus, because he knew that only Mercury and Venus revolves round the Sun, where as the Sun has only the apparent motion, due to Earth's motion round the Sun in the Ecliptic, imposed on the Sun. Thus, Āryabhatta mentioned that, Mercury and Venus have both the true motion and this apparent motion (due to the Earth's motion imposed). However, for the Sun, Āryabhatta mentioned only the apparent motion (due to the Earth's motion imposed). Thus, Āryabhatta knew that the Sun has no true revolution (Śīghrocca), as that of Mercury and Venus, i.e. Sun is not at all revolving round any planet including the Earth. Other astronomical texts our Nation also described these details in the same way as that of Aryabhattīyam. There also no Śīghrocca (true actual revolution) is mentioned for the Sun. Only apparent motion of the Sun due to Earth is given in these texts. This aspect is clearly shown in Vateśvara Siddhānta and Gola of Vateśvara in the 17th Sūtra of the 3rd Section 'Pratimandala spaśtokarana vidhih' of the 2nd Chapter 'Sphutagatyadhikārah'⁷ as,

शीघ्रयोः स्यात्तत्रैवाशेषमन्तरं तत्स्पष्ट स्पष्ट: द्वाभ्यामिन्दुज शुक्रावेकेन व्र घ्रशीतकरौ \mathbf{H} syāttatraivāśesamantaram Śīghrayoh Tatspasta spastah ghraŚītakarau Śukrāvekena Dvābhyām Induja vra Meaning: 1. Śīghrayo - Śīghra correction; 2.spasta – true position; 3. dvā - two; 4. Induja – Son of Indu (Moon) – Mercury (Budhan); 5. Śukra – Venus (Śukran); 6. eka – one; 7. Ghraśīta – Who removes coolness - Sun; 8. Śītakara – Who gives coolness – Moon.

This Sūtram mentions that two corrections, namely Śīghrapala and Mandapala are to be applied to Mercury and Venus, where as only one correction (Mandapala) is to be applied to the Sun and the Moon. This is because the Sun has only the apparent motion due to the Earth and no actual true revolution (Śīghrocca) and the Moon has only true revolution round the Earth and no apparent revolution imposed on it. However, Mercury and Venus have both.

Āryabhaṭṭīyam in the 15th Sūtra of Kālakriyā Pāda (3rd) chapter⁸ mentions as, भानामधः शनैश्चर सुरगुरु भौमार्क शुक्र बुध चन्द्राः । एषामधश्च भूमिर्मेधीभूता खमध्यस्था।।

Bhānāmadhaḥ Śanaiścara Suraguru Bhauma Arka Śukra Budha Candrāḥ I Eṣāmadhaśca Bhūmir me dhī bhūtā Kha madhyasthā 11

Meaning: 1. Bhānām –of the Asterisms; 2. adhaḥ - below; 3. Śanaiṣcara – Saturn; 4. Suraguru - Jupiter (Guru of the Gods – Devaguru); 5. Bhauma – Mars (who came from Earth - Bhū); 6. Arka – Sun; 7. Śukra – Venus (Śukran); 8. Budha - Mercury (Budhan); 9. Candraḥ - Moon (Candran); 10. Bhūmi - Earth; 11. me (中) – exchange (barter); 12. dhī - perception (understanding); 13. bhūtā -

occurred, happened; 14. Kha – Celestial sphere; 15. madhya- centre; 16. sthā - situated.

The first line of this 15th Sūtram mentions the order of the seven Graha, based on their increasing angular velocity. Because, in the previous two Sūtra, Āryabhatta described the linear and the angular velocities of these Graha. In next 16th Sūtram, he used the same order of these Graha, even without the necessity of renaming them, to describe the method of deciding the Lords of the week days, where he clearly mentioned it is based on 'Sighrah' of the Graha - increasing angular velocities of these seven Graha. In this Sūtram, the second line mentions the Earth and immediately following the word 'Earth', it mentions मे धी भता, which means मे - exchange, धी - perception or understanding, भूता - occurred or happened here. What was the exchange made? Since the exchange is mentioned immediately after mentioning the Earth, then it is pertaining to the Earth's place in the fore mentioned order of Graha only. Then with whom, the Earth's place was interchanged? As already discussed, for an easier and practical way of computation, the Earth's revolution round the Sun in the Ecliptic, is imposed on the Sun and it is calculated as the apparent motion of the Sun. Therefore, the places of the Sun and the Earth are interchanged here. In the order of Graha with increasing angular velocity, here the Sun is placed, in between Mars and Venus, which is nothing but the place of the Earth, both by its actual position in the celestial sphere and by its angular velocity also. This is further emphasized by the order of the Graha mentioned in this 15th Sūtram, where the Sun is mentioned not after the Mercury, but in between the Mars and the Venus, exactly where the Earth is placed. Actually, Mercury is nearer to the Sun than Venus and Venus is nearer to the Earth than Mercury (Figure 1 & 2). However, in this 15th Sūtram, it is mentioned that the Venus and Mars are next to the Sun, but not the Mercury. Therefore, the Earth's place was

interchanged with that of the Sun here. Thus, the order with increasing angular velocity is, Saturn, Jupiter, Mars, the Earth, Venus, Mercury, and the Moon. The modern astronomy with advanced scientific computations, places them in this order only. Then in the second line, the Sun's place was interchanged with that of the Earth. Therefore, the second line deals with the matter pertaining to the Sun only. Thus, the second line mentions clearly that the Sun is at the centre, 'Kha Madhya' i.e. Heliocentric.

Any celestial body or place in the sky that exerts an attracting force on other celestial bodies and others, is named as Graha in our Nation. Of which, Navagraha are the nine Graha that exert a definite influencing effect on the Earth. They lie in the space outer and closer to the Earth. Therefore, the Graha may be a Star (the Sun), planets (Mercury, Venus, Mars, Jupiter and Saturn), a natural satellite of the Earth (the Moon), or the ascending and the descending nodes of the Moon (Rāhu and Ketu). The other celestial bodies and places in the sky without this amount of influence over the Earth, even if they lie exterior to the Earth, will not be listed in Navagraha. Therefore, Graha is not a synonym to planet.

 \bar{A} ryabhațț \bar{I} yam, 13th S \bar{u} tra of the Daśag \bar{I} tik \bar{a} (1st) chapter ⁹ gives the direct proof as,

सूत्रमिदं भूग्रहचरितं भपञ्ज्रे दशगीतिक ज्ञात्वा याति भित्वा परं ब्रह्म परिभ्रमणं स ग्रहभगण Daśagītika sūtramidam Bhūgrahacaritam Bhapañjare jñātvā l Grahabhagana paribhramanam sa yāti bhitvā Param Bramha - 1 1 **Meaning** : 1. Daśagītika – The Sūtram of Daśagītika chapter of Āryabhattīyam; 2. idam – this, here; 3. Bhū - Earth; 4. Graha - graha; 5. caritam - going, moving; 6. Bha - star; 7. pañjare -cage (celestial sphere); 8. jñātvā - Knowledge.

Here, Āryabhattīyam mentions that by knowing these Daśagītika Sūtra which reveals the

motion of the Earth and the Graha on the celestial sphere (sphere of asterisms or Bhagola), one attains the Supreme-Brahman, after piercing through the orbits of the planets and the stars. Therefore, this Sūtra directly mentions the motion of the Earth and its movement in the Ecliptic, on revolving round the Sun. Only in Heliocentreic theory, the Earth' movement round the Sun is taken as a Natural happening, where as in Geocentric theory, the Earth is said to be stationary (not moving), placed at the centre of the Solar system. So, these verses of Āryabhaṭṭīyam clearly and directly prove that Āryabhaṭṭā knew the fact of Earth's revolution round the Sun and only with Heliocentric model as a base, he wrote Āryabhattīyam.

Varāhamihira, the famous astronomer of our Nation, in his **B**<u>r</u>hat Samhitā in the 12^{th} Śloka of the 2^{nd} Chapter, Sāmvatsara Sūtrādhyāyaḥ mentioned as,

भू भगण म्ररमण संस्थानाद्यक्षावलम्बकाहव्यसि चरदलकाल । राश्युदयच्छाया नाडीकरण प्रभृतिषु क्षेत्रकालकरणेष्वभि ज्ञः ।। Bhū bhagana bhramana samsthānādhyakṣāvalambakāhavyasi caradalakāla । Rāśyudayacchāyā nāḍīkarana prabhrِtiṣu kṣetrakālakaraneṣvabhi jñaḥ।। Meaning: 1. Bhū - The Earth ;2. Bhagana – Revolution; 3. Bhramana - Rotation; 4.Jña: -Knowledge.

Here, Varāhamihira clearly mentioned that the Earth (Bhū) is both revolving (Bhagana) and rotating (Bhramana), which an astrologer should know thoroughly (Jña). Thus, even before Varāhamihira's period itself, both the revolution of the Earth round the Sun and the rotation of the Earth on its own axis, are well known to our ancestors.

Further, on performing the Sandhyā Vandanam and the Sūrya Namaskāra Yogāśana, the

Sun is worshiped with the Sūrya Namaskāra Mantram as,

ध्येयः सदा सवितृ मण्डल मध्यवर्ती नारायणः सरसिजासन सन्निविष्टः । केयूरवान् मकर कुण्डलवान् किरीटी हारी हिरण्मय वपुर्धृत शंख चक्रः ।।

Dhyeyah sadā savit<u>r</u> mandala madhyavartī Nārāyanah sarasijāsana sannivistah l Keyūravān makarakundalavān kirītī hārī hiranmaya vapurdh<u>r</u>ta śańkhacakrah l **Meaning :** 1. Savit<u>r</u> – Sun; 2. Savit<u>r</u> mandala – Solar system; 3. madhyavartī - at the centre. This mantra clearly mentions that the Sun, worshiped as 'Sūrya Nārāyana,' is at the centre of the Solar system. This mantra is in practice in all parts of our Nation, during the performance of **'the Sandhyā Vandanam'** as Sūrya Nārāyana Vandanam, since ancient time itself.

Besides, in our temples when we revolve round the Navagraha, we can clearly see that the Sun is always at the centre of the Navagraha. The other eight Graha are placed around the Sun. This method of construction exists in all parts of our Nation, since time immemorial itself. Therefore, Veda, ancient astronomical texts of our Nation like Āryabhaṭṭa's Āryabhaṭṭīyam, Varāhamihira's Brhat Samhitā, Vaṭeśvara Siddhānta and Gola of Vaṭeśvara, the daily spiritual practices and the method of construction of Navagraha temples clearly show that our Bhāratian Astronomy is correctly based on Heliocentric theory only and thus Heliocentric theory was known to our ancestors in the remotest antiquity itself.

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- 8. Āryabhațțīyam in the 15th Sūtra of Kālakriyā Pāda (3rd) chapter, *op.cit*, page 102.
- 9. Āryabhațțīyam, 13^{th} Sūtra of the Daśagītikā (1^{st}) chapter, *op.cit*, page 31.
- 10. Brhat Samhitā of Varāhamihira, 12th Śloka of the 2nd Chapter, Sāmvatsara Sūtrādhyāyah.

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DIACRITICAL MARKS FOR ROMAN TRANSLITERATION OF

DEVANAGARI SCRIPT

- 1. Short Vowels
 - अ.- A, a इ.- I, i उ.- U, u ऋ.- R, r लृ.]
- 2. Long Vowels
 - आ Ā, ā ई Ī, ī ऊ Ū, ū ए E, e ओ O, o ऐ - Ai, ai औ - Au, au
- 4. Non-aspirant S
- 5. Consonents

| क्- K, k | ख् - Kh, kh | ग् - G, g | घ्- Gh, gh | ङ् - Ń, ń |
|-------------------------------------|--------------|-------------------|---------------|--------------------------|
| च् - C, c | छ् - Ch, ch | ज् - J, j | झ् - Jh, jh | ञ् - Ñ, ñ |
| ट् - Ț,ț | ठ् - T़h, țh | ड् - <u>D</u> , d | ढ् - Dh, dh | ण् - <u>N</u> , <u>n</u> |
| त् - T, t | थ् - Th, th | द् - D, d | ध् - Dh, dh | न् - N, n |
| प् - P, p | फ् Ph, ph | ब् - B, b | भ् - Bh, bh | म् - M, m |
| य् - Y, y | र् - R, r | ल् - L, l | व् - V, v | |
| श् - Ś,ś | ष् - Ṣ, ṣ | स् - S, s | ह् - H, h | |
| 6. Compound letters - क्ष् - Ks, ks | | र्ज् - Jñ, jñ | त्र् - Tr, tr | |