

SEISMOLOGICAL ZONES OF VARĀHAMIHIRA

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(Received 18 February 1998)

Varāhamihira, an astronomer of the 6th Century AD made an attempt to list out the various concepts on the origin of earthquakes and demarcated certain seismological zones (भूकम्प मण्डल) based on geographical location, occurrence of earthquakes when moon transits certain constellations. He named these zones as: आग्नेय (*Āgneya*), वायव्य (*Vāyavya*), ऐन्द्र (*Aindra*) and वारुण (*Vāruṇa*). He also indicated the *velas* in which the earthquakes occur in these zones and the indications a week ahead. The various schools of thinking about the origin of earthquakes as mentioned by Varāhamihira can be broadly correlated with modern concepts on the origin of earthquakes. The geographical locations of his earthquakes are in tune with the modern zones of high seismicity in the Himalayan frontal arc. When the directions suggested by his zones are plotted in the corresponding geographical locations they show a sense of correlation with the modern stress zones. In some areas like Nepal-Bihar border, the information from the modern seismological studies is limited whereas Varāhamihira's directions suggest more directions. It is possible that a detailed study of the Nepal Himalayan area based on Varāhamihira's observations may result in a better understanding of the stress directions in these parts. The present study indicates that the seismology developed during Varāhamihira's time is quite interesting and cannot be ignored particularly while discussing about the history of geological sciences. Such a study may contribute its might to modern seismology and even supplement modern studies.

Key words : Directions, Modern Stress zones, Seismological zones, Varāhamihira.

INTRODUCTION

Earthquakes are disturbances in the earth manifested in the form of convulsions shaking the surface of the earth and causing imbalances leading even to demolition of buildings, loss of human and other life and catastrophe. An earthquake is one of the worst natural calamities having claimed an estimated 50 million lives and inflicted damages worth hundreds of billions of dollars in the recent history. The July 27, 1976 Tangshan earthquake in China claimed 5,00,000 lives whereas the October 18, 1989 Loma Preita

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earthquake of magnitude 7.3 in California is estimated to be the most expensive natural disaster, costing some 6 billion dollars. India is unique as far as earthquakes are concerned. The Himalayan frontal arc is one of the most active intracontinental regions in the world.

Most of the books on history of geological sciences are silent on the corresponding developments in ancient India. Here is an attempt to show that the seismological ideas developed during Varāhamihira's time should be given a proper place in world seismology particularly in the history of seismology.

Varāhamihira has a unique place in Indian Earth Sciences. His *Brhatsamhitā* besides chapters on gem stones, contains one chapter on Ground Water Search ((उ)दकार्गलाध्याय) and another chapter on the Earthquakes (भूकम्प लक्षणाध्याय). His spirit of meaning: - "म्लेच्छाहि यवनास्तेषु सम्यग्शास्त्रमिदं स्थितं ऋषिवत्तेपि पूज्यंते" Even if they are Greeks the scientists would be honoured like the *Rsis* can be emulated one and all.

The भूकम्प लक्षणाध्याय of Varāhamihira's *बृहत्संहिता* describes origin of earthquakes as:

क्षिति कम्पमाहुरेके बृहदन्तर्जलनिवासि सत्व कृतम् । भूभार खिन्न दिग्गज विश्राम समुद्भवंचान्ये ॥
अनिलोअनिलेन निहतः पतति सस्वनं करोत्यन्ये । केचिददृष्टकारितमिदमन्ये प्राहुराचार्याः ॥

According to one school that of Kāśyapa, (Jha, 1977, pp. 199) the earthquakes are caused by the great aquatic force. Another school (that of Garga) holds the view that the earthquakes are generated when the elephants which hold the weight of the earth take rest. (Similar idea is also expressed in *Rāmāyaṇa* of Vālmiki, *Bālakāṇḍa*, sarga 40). Another school (that of Vaśiṣṭha) holds that the collision with loud sound of the terrestrial and celestial winds cause earthquakes. Other teachers (Vṛddha Garga) hold that the earthquakes are caused by unseen causes. Varāhamihira did not criticize any of these causes holding the view that the earthquakes are caused by more than one cause.

Modern seismology does not have a foolproof formula for the prediction of the earthquakes. The causes attributed to earthquakes include the plate separations in the midoceanic ridge regions (the great aquatic forces) and the attractive forces between celestial and terrestrial objects (moon's perigee — Murthy, 1990; when the greatest increase in the rotation of the earth about its axis takes place with a consequential rapid reduction in the radius of the earth and with a corresponding increase in the radial compression and tangential compression in the mantle — Murthy, 1990; at times of moderately high and fluctuating solar activity — Simpson, 1968). The accumulated stress when two plates collide and move against each other after reaching a particular tolerable limit tries to readjust and gets released in the form of earthquakes (This adjustment may correspond to the figurative expression of cause of earthquakes *viz.*, the elephants which hold the weight of the earth when move their head for readjustment of the pressure of weight, the earthquakes are caused).

Summary of *Bhūkampa maṇḍalas* according to Varāhamihira:

Mandal a	Countries	Constellation	Indications a week ahead	Relation With Velas
1. वायव्य <i>Vāyavya</i> (North-west)	1. Saurashtra 2. Kuru 3. Magadha 4. Dasarna 5. Matsya	1. <i>Aśvini</i> 2. <i>Mṛgaśirā</i> 3. <i>Punarvasu</i> 4. <i>Uttaraphālguni</i> 5. <i>Hastā</i> 6. <i>Citrā</i> 7. <i>Svāti</i>	The sky filled with dust; dust gets up from the earth; strong winds break trees; sun's rays are obscured.	<i>Vāyavya Velā</i> complementary <i>Aindra Velā</i> adverse and <i>Āgneya Velā</i> causes death of head of state
2. आग्नेय <i>Āgneya</i> (South-East)	1. Asmaka 2. Anga 3. Vahlika 4. Tangana 5. Kalinga 6. Vanga 7. Dravina 8. Sabara	1. <i>Bharaṇī</i> 2. <i>Kṛttikā</i> 3. <i>Puśyā</i> 4. <i>Maghā</i> 5. <i>Purvaphālguni</i> 6. <i>Viśākhā</i> 7. <i>Purvabhādra-padā</i>	Digdaha in the middle of the day fallking of stars and meteorites. devastating fire supported by wind; water resources adversely affected.	<i>Āgneya Velā</i> complementary <i>Vāruṇa Velā</i> adverse and <i>Vāyavya Velā</i> causes death of head of state
3. ऐन्द्र <i>Aindra</i> (East)	1. Kasi 2. Yugandhara 3. Paurava 4. Kirata 5. Kira 6. Abhisara 7. Hala 8. Madra 9. Arbuda 10. Saurashtra 11. Malwa	1. <i>Rohiṇī</i> 2. <i>Anurādhā</i> 3. <i>Jyeshthā</i> 4. <i>Uttarāśadhā</i> 5. <i>Śravaṇā</i> 6. <i>Dhaniṣṭhā</i> 7. <i>Abhijit</i>	Huge clouds; great thunder and lightning.	<i>Aindra Velā</i> complementary <i>Vāyavya Velā</i> adverse and <i>Vāruṇa Velā</i> brings in peace and prosperity
4. वारुण <i>Vāruṇa</i> (West)	1. Gonarda 2. Chedi 3. Kukura 4. Kirata 5. Vaideha	1. <i>Ārdrā</i> 2. <i>Aśleṣā</i> 3. <i>Mūlā</i> 4. <i>Pūrvāṣāḍā</i> 5. <i>Śatabhiṣā</i> 6. <i>Uttarābhādra-padā</i> 7. <i>Revāī</i>	Heavy rains; destruction of persons living on the sea coasts and river banks	<i>Vāruṇa Velā</i> complementary <i>Āgneya Velā</i> adverse and <i>Aindra Velā</i> brings in peace and prosperity

Compiled based on References: Jha, 1977 and Shastri, 1969.

Vāyavya Velā : first quarter of the day and first quarter of the night:

Āgneya Velā : quarter of the day and second quarter of the night:

Aindra Velā : third quarter of the day and third quarter of the night:

Vāruṇa Velā : fourth quarter of the day and fourth quarter of the night:

The *Bṛhatsaṃhitā* discusses four maṇḍalas - 1 आग्नेय (Āgneya), 2. वायव्य (Vāyavya), 3. ऐन्द्र (Aindra) and 4. वारुण (Vāruṇa). The details of these zones are shown in the enclosed table.

The directions suggested by the four names viz. SE; NW; E and W are quite interesting. They do not suggest any direction with reference to any one of the geographical places say Ujjaini or any other place.

The figure (1) shows the seismological zones of Varāhamihira plotted on a map. Since during time of Varāhamihira there were no position fixing like degrees, minutes, seconds and parts thereof of latitudes and longitudes his locations were approximate. But a general idea about these provinces as we know today can be taken into consideration. The locations closely tally with the modern zones of high seismicity as shown in the publication - 'Seismic Zoning Maps of India' by Jai Krishna, published in the *Current Science*, 1992, v. 62, No. 1 & 2.

The figure (2) shows the directions of Varāhamihira's maṇḍalas superimposed on certain geographical locations of Varāhamihira's भूकम्प मण्डलसु nearer to the modern stress zones of Rajendran et al., 1992. The figure (3) is the map showing the stress directions in the corresponding areas, on same scale, to give an idea of the probable correlation between the modern directions and the directions suggested by Varāhamihir. The broad correlation is to indicate that the directions of Varāhamihira, as understood by some means by them have a general coherent correlation with the modern stress zones. The scientific spirit in analyzing the directions of earthquakes during Varāhamihira's time are worth noting.

The directions of Varāhamihira's Earthquake zones correspond to the general directions perpendicular to the compressional stress in those geographical provinces suggesting a positive correlation. In some areas like Nepal-Bihar border, the information from the modern seismological studies is limited whereas Varāhamihira's directions suggest more directions. It is possible that a detailed study based on Varāhamihira's observations may result in a better understanding of the stress directions in these parts. The seismological zoning of Varāhamihira is quite ingenious and is an example of the highly developed Indian seismology well before 6th century AD.

REFERENCES

1. Jai Krishna (1992), 'Seismic zoning maps of India', *Current Science*, 62, 1&2, 17-23.
2. Jha, Pt. Achutananda, Ed. (1977) *Bṛhatsaṃhitā*, pp. 199-206.
3. Murthy, S.R.N. (1990), Correlation of Deep Shock Earthquakes with the Dynamic Centre of the Solar System, *Jour. Geol. Soc. India*, 35, pp. 535-538.
4. Rajendran, K. Talwani, P. and Gupta, H.K. (1992) 'State of stress in the Indian subcontinent: A review', *Current Science*, 62, 1, pp. 86-93.

5. Shastri, Ajay Mitra (1969) *India as seen in the Br̥hatsamhitā of Varāhamihira*. Motilal Banarsidass, Varanasi, p. 556
6. Simpson, J.F. (1968) Solar activity as triggering mechanism for earthquakes, *Earth and Planetary Science Letters*, v.3, no.5.





