

# GEODETIC SURVEY AND MAPPING IN THE PURĀṆAS

K. Vidyata

## Abstract

India's major contributions to astronomy, geometry, and other branches of mathematics and the remarkably creative exuberance of its culture is widely known from the Sanskrit scriptures. From the same scriptures we can infer much about the nature of cartography in its broadest sense, including cosmography, over much of the span of Indian history and we may reasonably suppose that some of the indigenous maps of the past several centuries carry on traditions of considerable antiquity.

This paper will bring to light the accurate methods of geodetic survey and mapping performed by our ancient scholars that have been recorded in our *Purāṇas*.

## INTRODUCTION:

Geodetic surveying is the survey in which the curvature of the earth is taken into account and higher degree of accuracy in linear and angular observations is achieved. The geodetic surveys extend over large areas and lines connecting any two points on the surface of the earth are treated as arcs. For calculating their projected distances on the plans or maps, the correction for the earth's curvature is applied to the measured distances. These surveys are conducted with highest degree of accuracy to provide widely spaced control points on the earth surface for subsequent plane surveys.

From the time of the Vedas the ancient Indians had good knowledge of surveying and cartography. For survey and cartography developed, during the Vedic period, equally in both the realms – in agrarian and administrative spheres and in the field of sacrificial science. The latter stressed and achieved the strictest accuracy and punctiliousness in them.

In the *Brāhmaṇas* we come across varieties of concepts of representation, though they are more marked for primitiveness and crudeness. The crudeness is due to the fact that just mere concepts are mentioned here, which might have had nothing to do with the entire picture and whole process and speed of chronological evolution.

The *Śatapathabrāhmaṇa* is really a mine of information on Indian survey and cartography and on concepts of representation and primitive world map, not only of its own country but perhaps of the whole world. In due course the survey, drawing and construction of Vedis assumed the form of a separate full-fledged and rigorous science designated as the *Śulbasūtras*.

The Puranic period can be considered to be the Golden Age of survey and cartography. Just like the Vedic literature, the *Purāṇas* have also referred to the survey of the whole universe.

### **SURVEYING IN THE PURĀṆAS :**

In the *Matsyapurāṇa*<sup>1</sup>, Sage Nārada ordains the sons of Dakṣa to first examine the extent of the universe, then carry on the work of creation : भुवः प्रमाणं सर्वत्र ज्ञात्वोर्ध्वमध्य एव च । In the same strain, the *Varāha Purāṇa*<sup>2</sup> states that: Having said this he surveyed and measured the earth and sky.

Various *Purāṇas* have dealt with the apportionment of the whole earth into seven continents and again the divisions of those continents are also discussed. This shows that the ancient Indians

had good concept of very large scale survey and measurement. The following lines of the *Viṣṇu Purāṇa*<sup>3</sup> establishes the above fact :

न हि पूर्वविसर्गं वै विषमे पृथिवीतले ।  
 प्रविभागः पुराणां वा ग्रामाणां वा पुराभवत् ॥  
 न सस्यानि न गोरक्ष्यं न कृषिर्न वणिक्पथः ।  
 वन्यात्प्रभृति मैत्रेय सर्वस्यैतस्य सम्भवः ।

— Before this the surface of the earth was irregular and there was no boundary of villages and cities. There was no cultivation, no pasture, no highway for merchant; all these originated, O Maitreya, in the reign of the son of Veṇa.

Therefore, it can be concluded that the first survey was carried out in the time of Pṛthu (son of Veṇa).

The *Brahmapurāṇa*<sup>4</sup>, uses the term *gaṇaka* to imply engineers and surveyors simultaneously—

आनाय्य गणकान् . . . . . वास्तुविद्याविशारदैः ॥

—Having sent for engineers and surveyors together with architects.

The *Brahmāṇḍapurāṇa*<sup>5</sup> talks about surveying, several types of plans and accompanying cartography:

आरब्धास्तान्निकेतान्यै कर्तुं शीतोष्णवारणम् ।  
 ततस्तान्निर्मयामासुः खेटानि च पुराणि च ॥  
 ग्रामाश्चैव यथाभागं तथैव नगराणि च ।  
 तेषामायामविष्कम्भाः सन्निवेशान्तराणि च ॥  
 चक्रुस्तदा यथाज्ञानं मीत्वा मीत्वात्मनुऽङ्गलैः ॥

Different types of town-planning, demarcation of boundary by survey and measurement are thus alluded to in the *Vāyupurāṇa*<sup>6</sup>:

नगराद्योजनं खेटं खेटाद् ग्रामोऽर्धयोजनम् ।  
 द्विक्रोशं परमा सीमा क्षेत्रसीमा चतुर्धनुः ॥

The above facts reveal that extensive and accurate survey was carried on for the laying out and construction of different types of roads linking the various patterns of human agglomerations.

### CONCEPT OF GEODETIC SURVEY :

The *Śivapurāṇa*<sup>7</sup> states:

अस्त्युत्तरस्यां दिशि वै गिरीशो हिमवान् महान् ॥  
 पूर्वापरौ तोयनिधी सुविगाह्य स्थितो हि यः ।  
 नानारत्नाकरो रम्यो मानदण्ड इव क्षितेः ॥

— There is the Himalayan mountain, esteemed like a deity, in the north of Bhārata. It stretches from the eastern ocean to the western one, as if it were a measuring rod for the measurement of the earth.

The above verse indicates that the ancient Indians had some notion of geodetic survey and this has been affirmed by concurrence of evidences and facts. The two astronomical treatises, *Brahmasiddhānta*<sup>8</sup> and *Somasiddhānta*<sup>9</sup>, written between 500-821 A.D. bear indisputable testimony to this.

### CARTOGRAPHY IN THE PURĀṆAS :

The chapter *Dāna-Māhātmya* of the *Matsyapurāṇa*<sup>10</sup> furnishes abundant information about some maps or representations made with bricks, metals and other materials that were in vogue for religious purposes in the gift making ceremonies.

The *Vāyu*<sup>11</sup> and *Liṅgapurāṇa*<sup>12</sup> affirm the fact that map-making and diagram drawing were definitely known and practised, especially in connection with astronomical studies, which positively included geography also:

चक्षुः शास्त्रं जलं लेख्यं गणितं बुद्धिसत्तमाः ।  
 पञ्चैते हेतवो ज्ञेया ज्योतिर्गणविचिन्तने ॥

— Eyes, treatises, water, maps or diagrams and mathematics or computation and survey are the five things which are instrumental in the study of stars or heavenly bodies.

All the maps of Jambudvīpa and the world were prepared on sheets of metals generally for the purpose of making gifts to Brāhmaṇas for the ritual *dharādāna*, *bhūmidāna* or *brahmāṇḍadāna*. The *Caturvargacintāmaṇi*<sup>13</sup> by Hemādri on the *Matsya Purāṇa*<sup>14</sup> states:

अथातः संप्रवक्ष्यामि धरादानमनुत्तमम् ।  
पापक्षयकरं नृणाममाङ्गल्यविनाशनम् ॥  
कारयेत् पृथिवीं हैमीं जम्बुद्वीपानुकारिणीम् ।  
मर्यादापर्वतवतीं मध्ये मेरुसमन्विताम् ॥  
लोकपालाष्टकोपेतां नववर्षसमन्विताम् ।  
नदीनदशतोपेतामन्ते सागरवेष्टिताम् ॥

— Now I tell you the method of all-excelling *Dharādāna* (making gift of earth), which wipes out sin and all that is inauspicious. One should get the earth (replica or diagram or map of it) prepared of gold, having the shape of Jambudvīpa with Maryādā mountains and Meru range in the centre, Lokapālas, nine *varṣas*, hundreds of rivers and streams and encircled by ocean.

In the *Bhaviṣyapurāṇa*<sup>15</sup> also three similar verses occur regarding the preparation of the map of Jambudvīpa, but their diction and the tone have become more ritualistic and sacerdotal and less geographic.

According to the *Brahmāṇḍa* and other *Purāṇas* the dimensions of the Meru and adjoining mountains and other geographic features are very vast. To show such vast dimensions as 9000, 34000 and 40000 *yojanas* on the map is impossible. Hemādri<sup>16</sup> gives the following method for representing such vast dimensions as:

अत्र शतसाहस्रादियोजनपरिमाणानां पृथिव्यादीनां कर्तुमशक्यत्वात् योजनसहस्रस्थाने  
अर्धाङ्गुलादिमानं परिकल्प्य यथोक्त-संख्यातारतम्यमनुष्ठेयम् । नदीनदशतोपेतमिति नद्यो  
भागीरथीप्रभृतिकाः नदाः शोणादयः तेषां साकल्येन विधातुमशक्यत्वात् यावच्छक्यमनुकारः कर्तव्यः ।

अन्ते सागरवेष्टीतामिति यद्यपि यावत्परिमाणा पृथ्वी तावानेव सागरः तथाप्यनुकारमात्रोपदेशात् शक्यानुकारमात्रमाचरणीयम् ।

— Since it is impossible to show extremely large dimensions, for example, one lakh *yojanas* and so on, of the earth and its other features, it may be assumed that 1000 *yojanas* are represented by  $\frac{1}{2}$  *añgula* and (similarly) other dimensions can be reduced for easy representation. Again if it is not possible to show all the rivers, like Gaṅgā and Śoṇa only a few important ones which can be possibly shown should be selected. Further though the dimension of the ocean is the same as that of the earth, still the former cannot be shown in totality, so it must be reduced and exhibited as much as is possible.

From this it is flagrantly evident that ancient Indians had understood and developed the concept of scale and in this sphere their knowledge, concept and methodology was almost the same as we have today.

In the *Padmapurāṇa*<sup>17</sup> also there is a reference which informs us of the knowledge of scale where a dimension of 50 corer *yojana* was shown :

इत्युत्त्वा भूपत्नी सा दास्या तामुद्घाटयत् ।  
मञ्जूषां तत्र संस्थं च पुस्तकं पाणिनाग्रहीत् ॥  
तत्रावलोकयामास साऽवतारान् समासतः ।  
पूर्वं ततस्तु भूगोलं पञ्चाशत्कोटियोजनम् ॥

The following lines from the *Bhaviṣyapurāṇa*<sup>18</sup>, relating to *brahmāṇḍa dāna* alludes to a great reduction of the monstrous size of the Brahmāṇḍa through scale to make the mapping of the same possible :

तस्याङ्गे कल्पयेद् राजन् भुवनानि चतुर्दश ।  
वितस्तेरङ्गुलशतं यावदायामविस्तरम् ॥

From the above mentioned chapters of the Purāṇas relating to *dharā* or *brahmāṇḍadāna* we can gather porfuse information on the construction or preparation of world map.

The *Liṅgapurāṇa*<sup>19</sup> and *Caturvargacintāmaṇi*<sup>20</sup> tell us of preparation of world map on a gold sheet having the shape of a quadrilateral and measuring one cubit (*hasta*) on one of its sides. From this it is evident that ancient Indians not only had the knowledge of scale, but could show the entire earth on a flat quadrilateral just like the Mercator's projection of today:

सुवर्ण मेदिनीदानं प्रवक्ष्यामि समासतः ।  
 पूर्वोक्तदेशकाले तु कारयेन्मुनिभिः सह ॥  
 लक्षणेन यथापूर्वं कूपे वा मण्डपेऽथवा ।  
 मेदिनीं कारयेद्विद्यां सहस्रेणापि वा पुनः ॥  
 एकहस्ता प्रकर्तव्या चतुरस्रा सुशोभना ।  
 सप्तद्वीपसमुद्राद्यैः पर्वतरैर्भिसंवृता ॥  
 सर्वतीर्थसमोपेता मध्ये मेरुसमन्विता ।  
 अथवा मध्यतो द्वीपं नवखण्डं प्रकल्पयेत् ॥  
 पूर्ववन्निरखिलं कृत्वा मण्डले वेदिमध्यतः ।  
 सप्तभागैकभागेन सह तद्विधिपूर्वकम् ॥

Hemādri<sup>21</sup> gives a very long quotation from the *Brahmāṇḍapurāṇa*, which provides the best and most detailed description of world map drawing on a flat surface (of the earth) with the use of a scale. Moreover, there is no better recorded description of ancient Indian cartography than this.

World maps were drawn for other than sacerdotal purpose is evident from the *Padmapurāṇa*<sup>22</sup>. It also reveals that these maps were prepared and maintained in a book form and kept with care and this practice appears to have been in vogue prior to Ptolemy (150 A.D.). It is clear from this that ancient Indians prepared Atlases also.

The *Bhaviṣyapurāṇa*<sup>23</sup> goes a step further and delineates about the map of the fourteen *bhuvanas* also. This *bhuvana* map was

prepared on a square piece of cloth, which had a side measuring nearly eleven feet. Thus it totally resembled a large-sized wall map of today :

सप्तहस्तं पटं कृत्वा चतुरस्रं सुसंहतम् ।  
 अभिन्नाङ्गं दृढं शुद्धं शुद्धस्फुटिकवर्चसम् ॥  
 . . . . .  
 प्रारंभं कारयेद्राजतत्पटे तस्मिन्न्यथोदितम् ।  
 मध्ये च लेखयेद् राजाञ्जम्बूद्वीपं सविस्तरम् ॥  
 तस्य मध्ये स्थितो मेरुर्मेरीरुपरि देवताः ।  
 दिशासु लोकपालानां पुरोष्ठौ सुरसंयुताः ॥  
 सप्तद्वीपवती पृथ्वी सप्त चैव कुलाचलाः ।  
 सागराः सप्त चात्रैव नद्यो हृदा सरांसि च ॥

As part of *brahmāṇḍadāna* ceremony the map of the whole universe was constructed in the shape of two hemispheres aspiring to be true to scale and joined together. Thus we come to know that our ancients also made Globes<sup>24</sup>.

## CONCLUSION :

The above textual articulations indicate the expertise of Pauranic Indians in the art of surveying and map-making. The westerner, F. Wilford<sup>25</sup>, also records that he has seen the map of the world and various other maps prepared according to the Pauranics and Indian astronomers. Therefore, the above citations concurrently prove without a doubt that these maps must have been in vogue from very ancient times.

## Endnotes :

1. *Matsyapurāṇa*, V. 10.
2. *Varāhapurāṇa*, VII. 6.
3. *Viṣṇupurāṇa*, I. 13. 82-4.
4. *Brahmapurāṇa*, 47. 2-3.
5. *Brahmāṇḍapurāṇa*, Pūrvabhāga. VII. 93-5.
6. *Vāyupurāṇa*, VIII. 117.
7. *Śivapurāṇa*, II. 3. 1. 14-6.



8. *Brahmasiddhānta*, p. 12, v. 93: वृत्तस्य षण्णवत्यंशो दण्डवच्च समः स तत् ।
9. *Somasiddhānta*, p. 6, v. 1: भचक्रात् षण्णवत्यंशा समभूया च सैव हि ।
10. *Matsyapurāṇa*, Ch. 83.
11. *Vāyupurāṇa*, 52. 123.
12. *Liṅgapurāṇa*, 61. 62-3.
13. *Caturvargacintāmaṇi*, Dānakhaṇḍa, p. 290.
14. *Matsyapurāṇa*, 284. 1-3.
15. *Bhaviṣyapurāṇa*, 165. 8-10.
16. *Caturvargacintāmaṇi*, Dānakhaṇḍa, p. 297.
17. *Padmapurāṇa*, Uttarakhāṇḍa, 217. 4-5.
18. *Bhaviṣyapurāṇa*, 177. 6.
19. *Liṅgapurāṇa*, Uttarabhāga, 32. 1-6.
20. *Caturvargacintāmaṇi*, Dānakhaṇḍa, p. 296.
21. *Ibid.*, p. 307-10.
22. *Padmapurāṇa*, Uttarakhāṇḍa, 217. 1-9.
23. *Bhaviṣyapurāṇa*, 191. 7-24.
24. *Ibid.*, 177. 3-8.
25. *Asiatic Researches*, Vol. VIII, p. 270-71; Vol. X, p. 140.

#### BIBLIOGRAPHY:

1. *Agni Purāṇa*, Text with Eng. tr. by M.N. Dutt, Parimal Publications, Delhi, 2001.
2. *Brahma Purāṇa*, Rajendranath Sharma, Nag Publishers, New Delhi, 2007.
3. *Brahmāṇḍa Purāṇa*, Chowkhamba Krishnadas Academy, Anandasrama Publications, Varanasi, 2012.
4. *Brahmasiddhānta*, ed. by Vindheswari Prasad Dvivedi, Chowkambha Sanskrit Series, 1912.
5. *Brahmavaivarta Purāṇa*, Text with Eng. tr. By Sen Rajendranath, The Panini Office, Bhuvaneswari Ashram, Bhadurganj, Allahabad, 1920.
6. *Bhāgavata Purāṇa*, Text with Eng. tr. by C.L. Goswami, Gita Press, Gorakhpur, 1971.
7. *Bhaviṣya Purāṇa*, Venkatesvara Press, 1953.

8. *Caturvargacintāmaṇi*, by Hemādri, ed. by Pandit Sadāśiva Dīkṣita, Varanasi, 1902.
9. *Garuḍa Purāṇa*, Text with Eng. tr. by M.N. Dutt, New Bharatiya Book Corporation, Delhi, 2007.
10. *Liṅga Purāṇa*, Text with Eng. tr. by Nagar Shanti Lal, Parimal Sanskrit Series N0.114, Parimal Publications, Delhi, 2011.
11. *Manudharmaśāstra*, by K. Motwani, Ganesh & Co. publishers, Madras, 1958.
12. *Matsya Purāṇa*, Text with Eng. tr. by a Board of scholars, Parimal Publication, Delhi, 2007.
13. *Padma Purāṇa*, ed. by Rao Sahib Mandate and Visvanath Narayana, Anandasrama Press, 1894.
14. *Śiva Purāṇa*, Text with Eng. tr. by Sharma Sudarshan Kumar, Parimal Publications, Delhi, 2008.
15. *Somasiddhānta Saṅgraha*, ed. by Vindheswari Prasad Dvivedi, Chowkambha Sanskrit Series, 1912.
16. *Vāyu Purāṇa*, Text with Eng. tr. by Sharma Sudarshan Kumar, Parimal Publications, Delhi, 2008.
17. *Varāha Purāṇa*, Text with Eng. tr. by Ahibhushan Bhattacharya, All India Kasiraj Trust, Varanasi, 1981.
18. *Viṣṇu Purāṇa*, Text with Eng. tr. by Wilson H.H, Parimal Publications, Delhi, 2011.
19. *Viṣṇudharmottara Purāṇa*, Venkatesvara Press, 1913.
20. *Asiatic Researches or Transactions of the Society instituted in Bengal*, Vol. VIII and X, London, 1808 and 1811.