16 · Cosmographical Mapping

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In light of the important role of cosmology in the worldview of South Asians over the centuries, it is hardly surprising that the surviving corpus of cosmographic artifacts, many of which can be thought of as maps, is both abundant and exceedingly varied. In this chapter we consider not only those artifacts but also the underlying cosmographical concepts necessary for their comprehension. My principal concern will be with the ancient and enduring religious traditions of Hinduism and Jainism, to which we owe most of the materials we shall examine. But since the cosmological doctrines of Buddhism, which became virtually extinct in India by about the thirteenth century, have much in common with those of Hindus and Jains, they will also receive some consideration, largely by way of comparison among the several traditions. The maplike cosmographic creations of Buddhism that are known to us come mainly from regions outside the Indian subcontinent, however, and are more appropriately discussed in subsequent chapters on Southeast Asia, the Himalayan region (including Tibet), and the several countries of East Asia. For the little-known pre-Vedic cultures, from the Paleolithic through the Indus civilization, and for South Asia's numerous tribal cultures, I shall not extend my remarks here beyond the few fleeting observations made in the introductory chapter.

In the case of Islamic cosmography, the principal conceptions have been set forth in some detail in part 1, in the chapter on Islamic cosmological drawings. Hence the few remarks I shall put forward relative to Indo-Islamic creations will refer mainly to divergent works of a heterodox or eclectic nature. Note, however, that it is likely many more works will come to light than are listed in this chapter.

Of the cosmographies of other faiths represented in India I have even less to say. I have yet to come across a distinctive Sikh, Zoroastrian (Parsi), or Indo-Christian cosmographic work. But lack of awareness of such productions should not be taken to mean none exist. Here too further investigation is warranted.

Following the introductory discussion of the principal cosmological conceptions of the ancient faiths of South Asia, this chapter considers, in order, the known cosmographic artifacts of Hinduism, Jainism, and Indian Islam. Because of the diversity of the Hindu materials, I divide my analysis of them into sections dealing with cosmographic paintings and ink drawings that are not essentially astronomical in content; cosmographic globes (only six of which are known to exist); and astronomical artifacts, including sculpture, paintings, and architecture as well as astrolabes, celestial globes, and observatories. In that South Asian astrolabes and celestial globes are all fundamentally based on Islamic prototypes, which are amply discussed in the chapter on Islamic celestial mapping in part 1, their treatment here may be relatively brief. The remarkable achievements of Sawai Jai Singh II in regard to astronomical observatories demand a somewhat more extended discussion. Astronomical painting in the Jain tradition, in contrast with that of Hinduism, is so closely associated with the canonical cosmological texts that no separate section need be devoted to its exposition.

This chapter concludes with two related discussions that seek to elucidate the place of cosmography in the dominant cultures of India: first, a consideration of a variety of perceived analogues between microcosms—as incorporated, for example, in architecture, sacrificial altars, and the human body—and the universal macrocosm; second, an inquiry into the role of cosmography in shaping the mental maps of ordinary Indians, a subject fraught with interest and one on which serious research has barely begun.

UNDERLYING COSMOLOGICAL CONCEPTIONS

Commenting on the relative unpopularity of cosmological investigations among modern Indologists, R. F. Gombrich has opined that "the most discouraging feature of traditional Indian cosmology is not its fantastic and uncritical character, but its complexity." He explains that complexity as follows:

> Just as the Indian system of social organisation, caste, has grown throughout history by aggregation and inclusion, not abolishing the practices and customs of newly assimilated peoples but assigning them a low place in the social hierarchy, so Indian cosmology—which remained largely a branch of Indian mythology—rarely abandoned a theory or idea, but allowed

> it to remain alongside the new ideas, even if it was inconsistent with them.... Nevertheless, there are certain Hindu texts, the Purāṇas, composed since the beginning of our era, which concern themselves with [among other things]... the universe in space and time, that is cosmology; and the Purāṇas do make attempts to reconcile various versions and to present a systematized picture—though no two attempts give quite the same result. Systematisation proceeds, as I have just suggested, by aggregation and encapsulation; for instance, different cosmogonies are generally accommodated by making them occur successively, rather than by, say, interpreting one story as an allegorical alternative to another. It is this... which largely accounts for the notorious fact that the dimensions of both space and time in the classical Indian cosmologies are so unconscionably large; two systems are reconciled by putting the one inside the other, and making it a cosmographical or temporal part of a much larger whole.[1]

In light of these remarks it is hardly surprising that in the lengthy article on cosmogony and cosmology in the *Encyclopaedia of Religion and Ethics*, the sections on the Buddhist and Indian views are far longer than for any other religious tradition or world region; the former—the longer of the two—is in fact allotted three times the space given to the section on the views associated with Christianity.[2] Of Kirfel's book, *Die Kosmographie der Inder*, Gombrich observes, not quite accurately, that it comprises "over 400 large pages with hardly anything more than bare quotations and tables."[3] Nevertheless, for our purposes the Kirfel text, despite being directed primarily to an audience of Indologists, possesses the great merit of containing what is perhaps the most representative sample of actual photographs of Indian cosmographic productions of any hitherto published work.[4] Among other works treating the several traditions within Indian cosmology at some length, Bastian's *Ideale Welten* analyzes at greatest length the specific cosmographic views presented, rather than the conceptual schema underlying them, though not, obviously, from the perspective of a historian of cartography.[5] Sircar's approach is not so dissimilar to Kirfel's and, on cursory inspection, appears to be much in the nature of a catalog; but he strives less for completeness and more for critical analysis and comprehensibility. Moreover, to an extent unmatched by other authors cited in this essay, he considers the real-world referents of the many places named in the cosmographies.[6]

Within the present context, it will not be possible to consider, even in a cursory fashion, many of the numerous cosmographical conceptions that have enjoyed currency within the Hindu, Buddhist, and Jain traditions. But within each of these traditions I do offer some generalizations on the purposes of the cosmographies; the media employed; their scale, orientation and directionality, use of color, and symbolization; and their degree of conformity to the real world. Finally, I shall consider the pervasiveness of cosmographic imagery in a variety of noncartographic contexts.

The inconsistencies in Indian cosmography—Hindu, Buddhist, and Jain—to which Gombrich draws our attention are evident even in the earliest of texts. Sircar notes that in the *Ṛg Veda*, composed over several centuries between 1500 and 1000 B.C., there are at least five different words to refer to the earth and that the universe therein was conceived "as consisting of either two or three units, i.e., of either the earth and the sky (heaven), or the earth, the air (atmosphere) and the sky."[7] Furthermore, "each of these constituents was regarded as having three parts or layers, so that there were either six units of three earths and three heavens or nine units of three earths, three atmospheres and three skies."[8] To these the later *Yajur Veda* and *Atharva Veda* (believed to have been composed between 900 and 500 B.C.) added a hemispheric "world of light, i.e. the vault of the sky,"[9] which was in due course matched by an antipodal nether vault. Thus the world was seen as a disk—a form frequently used in later cosmographies—suspended between "two great bowls turned towards each other," and that view led in time to the long-enduring conception of the universe as a "cosmic egg" commonly designated Brahmāṇḍa (egg of Brahma).[10] A similar early conception is that of the *Chāndogya Upaniṣad* (date uncertain, but probably composed about the time of the later Vedas), which speaks of the cosmic golden womb (or fetus) (*hiraṇ-*

1. R. F. Gombrich, "Ancient Indian Cosmology," in *Ancient Cosmologies*, ed. Carmen Blacker and Michael Loewe (London: George Allen and Unwin, 1975), 110–42, esp. 111–12, frontispiece, and pls. 21 and 22.

2. "Cosmogony and Cosmology," in *Encyclopaedia of Religion and Ethics*, 13 vols., ed. James Hastings (Edinburgh: T. and T. Clark, 1908–26), 4:125–79; in particular the sections "Cosmogony and Cosmology (Buddhist)," by L. de la Vallée Poussin, 129–38, and "Cosmogony and Cosmology (Indian)," by H. J. Jacobi, 155–61. Jacobi's contribution develops more fully the notions cited from Gombrich, "Ancient Indian Cosmology" (note 1).

3. Gombrich, "Ancient Indian Cosmology," 111 (note 1).

4. Willibald Kirfel, *Die Kosmographie der Inder nach Quellen dargestellt* (Bonn: Kurt Schroeder, 1920; reprinted Hildesheim: Georg Olms, 1967; Darmstadt: Wissenschaftliche Buchgesellschaft, 1967), pls. 1–18.

5. Adolf Bastian, *Ideale Welten nach uranographischen Provinzen in Wort und Bild: Ethnologische Zeit- und Streitfragen, nach Gesichtspunkten der indischen Völkerkunde*, 3 vols. (Berlin: Emil Felber, 1892).

6. D. C. (Dineshchandra) Sircar, *Cosmography and Geography in Early Indian Literature* (Calcutta: D. Chattopadhyaya on behalf of *Indian Studies: Past and Present*, 1967).

7. Sircar, *Cosmography and Geography*, 9 (note 6).

8. Sircar, *Cosmography and Geography*, 9 (note 6).

9. Sircar, *Cosmography and Geography*, 9 (note 6).

10. Sircar, *Cosmography and Geography*, 10 (note 6).

yagarbha) splitting apart to form the heaven and the earth.[11] On the size of the universe the Vedas themselves are silent, but the *Aitareya Brāhmaṇa* informs us that "the distance between the earth and the sky is . . . 1000 days' journey for a horse," while the *Pañcaviṃśa Brāhmaṇa* puts it, more modestly, at "the altitude coverable by 1000 cows standing one upon another."[12]

Whether the conceptions presented to this point were of purely Indian origin or were borrowed from Babylonia is debatable. Kirfel thinks the Babylonian influence is significant, whereas Gombrich finds little support for that proposition.[13] This, however, is an argument we need not enter, since the concern here is not so much with cosmology per se as with cosmography; and of visible representations of the very early Indian views we have no surviving example. But at least from the middle of the first millennium B.C., by which time the Brahmāṇḍa idea had gained currency, Indian cosmological and cosmographic speculation proceeded on a wholly independent course.

Over the next thousand years or more, during which time the Epics and Puranas were composed and written, Indian cosmography became ever more complex and expansive. Not only were our own earth and universe envisaged as increasingly differentiated segments of the cosmos, but new universes, in some views infinite in number, were imagined. At the same time, in each of the three main religiophilosophical traditions of India—Hindu, Jain, and Buddhist—the cosmos became "ethicized." This was a natural outgrowth of the eschatological preoccupations of those three faiths. Each held to a belief in the transmigration of the soul in a potentially endless round of rebirths; and the expanded, generally vertically stratified universe, with numerous heavens and nether worlds, provided the field within which the soul could find its proper niche at any stage in its long journey toward or away from ultimate release (moksa in Hinduism and Jainism and nirvana in Buddhism). As a rule, within this ethicized universe "the good go up and the bad go down, the higher up you are the better," and vice versa.[14] The implication of this, from a cartographic perspective, is that the visual representation of the multidimensional universe in a two-dimensional image (i.e., a conventional map surface) sees it extended along a vertical rather than a horizontal plane. It is perhaps understandable, then, that historians of cartography, who have little trouble recognizing Western cosmographies for what they are, might fail to recognize as maps the surviving cosmographies of India, Tibet, and Southeast Asia.

If only in passing, it is appropriate to note that just as souls moved through cycles of rebirth, so did the universe itself. Thus, although we are unaware of visual representations of the universe as it may have been imagined at different stages of its existence (apart from the early Vedic primordial egg conception), it seems reasonable to suppose that such works existed and would easily be spotted by appropriately trained specialists. As with the spatial dimensions of the universe, the temporal dimensions and constitution of time are staggeringly large and complex (e.g., the life of Brahma is calculated at 311,040,000 million years), and a host of cycles within cycles is postulated. Further, time, like space, is ethicized. The age in which we are now living, for example, the Kaliyuga, said to have begun in the year of the Mahābhārata war (traditionally dated 3102 B.C.), is the least moral of all.[15] But the present Kaliyuga is but one of a thousand Kaliyugas in the present *kalpa*, a cycle of time that in turn is but one of 720 *kalpa*s in a single year of Brahma.[16]

A concomitant of the expansion and growth in complexity of the cosmos was the remarkable multiplication and evolution of its denizens. Whereas in early Vedic times it was thought that there was but one primordial deity, or at most a few, there subsequently arose in various components of the cosmos an innumerable host of gods, demigods, bodhisattvas, spirits, demons (*asura*s), and diverse terrestrial creatures, some more or less human in size, form, and behavior, others in the nature of real or mythical animals.[17] The cartographic significance of this is that in painted cosmographies, a particular component of the cosmos will be identified by the placement within a particular field—which in itself may be more or less nondescript—of some identifiable tutelary deity, creature, or plant that to the uninitiated would not be recognized as a map symbol.

The sun, the moon, the planets (Mercury, Venus, Mars, Jupiter, Saturn, and in the Indian view, Rāhu and Ketu, the ascending and descending nodes of lunar eclipses), zodiacal mansions, and asterisms (*nakṣatra*s) were also deified and rendered iconically in sculpture and in painting, sometimes individually and sometimes in related

11. Sircar, *Cosmography and Geography*, 12 (note 6).

12. Sircar, *Cosmography and Geography*, 10 (note 6). The date of the texts cited may be placed between 900 and 500 B.C.

13. Kirfel, *Die Kosmographie*, 28–36 (note 4); Gombrich, "Ancient Indian Cosmology," 117 (note 1).

14. Gombrich, "Ancient Indian Cosmology," 119 (note 1).

15. Arthur Llewellyn Basham, *The Wonder That Was India: A Survey of the History and Culture of the Indian Sub-continent before the Coming of the Muslims*, 3d rev. ed. (London: Sidgwick and Jackson, 1967), 323.

16. The numerical relations among the several units in which cosmic time is measured (*yuga*s, *mahāyuga*s, *kalpa*s, and "life of Brahma") are discussed by David Pingree in "Astronomy and Astrology in India and Iran," *Isis* 54 (1963): 229–46, esp. 238–40.

17. Quoting Rhys Davids (*Dialogues*, 1.36), La Vallée Poussin observes that in the Buddhist cosmography "four things are infinite: space, the number of universes, the number of living beings, and the wisdom of a Buddha," cited in "Cosmogony and Cosmology (Buddhist)," 137, n. 5 (note 2).

groups. In some works, including both paintings and architectural monuments, these astronomical icons formed parts of larger cosmographic ensembles, typically incorporating numerous wholly mythic elements; in other instances they were depicted in isolation.[18] Rarely, however, except on astrolabes and celestial globes, was any attempt made to represent an actual view of a portion of the heavens at a particular moment in time. Thus empirical celestial mapping, as it developed in other parts of the world, does not form a part of the Indian cartographic tradition.

Cosmographic texts also specified natural features but attributed to them fabulous sizes, shapes, and other physical properties. Certain realms came to be characterized by the presence therein of specific trees, typically of stupendous proportions, and these too became cartographic motifs. The continent (or world) containing India, for example, came to be known as Jambūdvīpa, the Rose-Apple Island, after the *jambū* tree that grew at its center. In the Buddhist view, this eponymous tree had a trunk fifteen *yojana*s in girth (the length of a *yojana* being taken as anywhere from two to nine miles), branches fifty *yojana*s long, and a height of one hundred *yojana*s.[19] Shapes (e.g., bowlike, wedgelike, square) and positions were also elements of the cosmographies. Thus, in some views oceans and mountain ranges were conceived as concentric rings, whereas in others mountain ranges followed straight lines, generally either east-west or, less commonly, north-south.

A feature common to most of the ancient Indian cosmographies is that the earth and universe are centered on an axis, specified as Mount Meru (or Sumeru), which is commonly identified either with the Pamir Mountains of Central Asia or with the sacred Mount Kailāsa (Kailas) in Tibet. Even in Vedic times some such axis was thought to exist, joining the celestial vault and the nether world, which were viewed either as in-facing bowls, as I have noted, or as giant wheels like the earth itself. The size, shape, and composition of Mount Meru and its immediate environs varied considerably from one view to another, as will be apparent from its representation in some of the illustrations in this chapter. In most views it not only soared to heights no human could attain but was also deeply rooted in the earth. On its elevation, 84,000 *yojana*s, there is considerable agreement; the depth of its roots, however, was regarded in some Hindu accounts to be a mere 16,000 *yojana*s and by the Buddhists was seen as equal to the mountain's height. Meru's shape was unlike that of other mountains. In most conceptions it comprised several distinct layers, each the domain of a different type of supernatural being; but whereas some viewed it as narrowing toward its summit, others thought precisely the opposite. Generally, however, the summit area was thought to be flat and, even in the most conservative view, quite capacious, as would befit its divine occupants. The number of sides attributed to Meru ranged from four, which was a common view, to a thousand. Around Meru were variously described buttress ranges, rocky ramparts, and other symmetrically and concentrically arranged physical features that, for want of space, I shall not even attempt to summarize.[20]

In most Hindu, Jain, and Buddhist views of the universe, there were ranged about Mount Meru, the *axis mundi*, a number of continents. One such view (fig. 16.1), identified with early Brahmanic Hinduism and Buddhism, was that there were four, one in each of the cardinal directions, like the leaves of a lotus of which Mount Meru formed the pericarp. An alternative Hindu conception, also identified—in somewhat modified form—with Jainism, was that the earth consisted of seven concentric ring continents separated by ring oceans, each continent and ocean moving outward from the central continent (also called Jambūdvīpa) and being twice as large as the continent and ocean preceding it (see the reconstructions in figs. 16.2 and 16.3). Oddly, though some texts are explicit in regard to the geometric progression of areas, the extant graphic representations of this worldview all seem to ignore it (e.g., below, figs. 16.8, 16.9, 16.10, and plate 25). But once again we have an embarrassment of riches, for there are also texts that specify nine, thirteen, eighteen, and thirty-two continents.[21]

Which of the views above is oldest cannot be said with certainty. Because most surviving cosmographies amalgamate the two major conceptions, they throw no useful light on the subject, and historical evidence suggests that hybrid views date back at least as far as the seventh century.[22]

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18. A succinct history of the changing modes of rendering astronomical icons in Indian painting, sculpture, and architecture is provided by Calambur Śivaramamurti in the article "Astronomy and Astrology: India," in *Encyclopedia of World Art*, 16 vols. (New York: McGraw-Hill, 1957–83), 2:73–77 and pls. 29–30. More specialized works will be cited below.

19. Sircar, *Cosmography and Geography*, 41 (note 6).

20. Sircar, *Cosmography and Geography*, 37 and 39–40 (note 6).

21. Sircar, *Cosmography and Geography*, 36, 38–51, and 58 (note 6); and Hemchandra Raychaudhuri, *Studies in Indian Antiquities*, 2d ed. (Calcutta: University of Calcutta, 1958), 43–45 and 66. Both texts discuss the conflation of the diverse conceptions in various Puranas.

22. That the inconsistencies in the cosmographic views of the Puranas and other early texts were apparent to their compilers is suggested by the argument in the *Vāyu Purāṇa* that "it is useless for men to offer . . . to prove or disprove anything in the description of the earth . . . , that [such] conceptions . . . are beyond the scope of human thinking . . . and that such matters . . . should be taken for granted" (Sircar, *Cosmography and Geography*, 36 [note 6]). Even among the texts advancing a particular conception, there were numerous disagreements on the names of continents and of their several constituents and physical features.

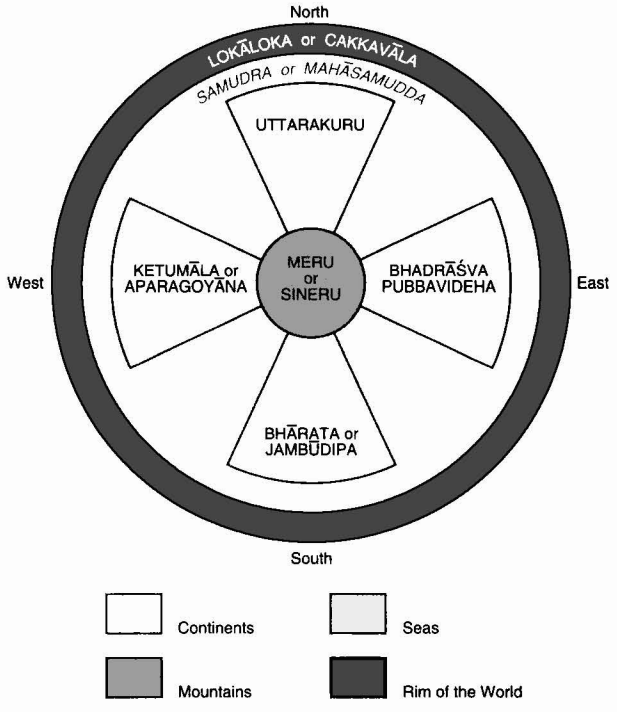


FIG. 16.1. EARLY BRAHMANIC HINDU AND BUDDHIST CONCEPTION OF THE *CATUR-DVĪPA VASUMATĪ* (FOUR-CONTINENT EARTH). This is an idealized view of one of the simpler conceptions of the earth held by ancient Hindus. In time it came to be modified so that the continents to the north and south of Meru differed from those to the east and west. But a throwback to this pristine form is evident in a portion of the globes portrayed in figures 16.14 and 16.18 below, for example.
After Joseph E. Schwartzberg, ed., *A Historical Atlas of South Asia* (Chicago: University of Chicago Press, 1978), pl. III.A.1, adapted from D. C. (Dineshchandra) Sircar, *Cosmography and Geography in Early Indian Literature* (Calcutta: D. Chattopadhyaya on behalf of *Indian Studies: Past and Present*, 1967), pl. I.

There was a high degree of consensus as to the names of the northern and southern *dvīpa*s (continents)—Kuru or Uttarakuru and Jambūdvīpa (though Bhārata was also often used for the latter)—but the names of the eastern and western continents differed widely in the Hindu and Buddhist traditions.[23] Similarly, whereas in the seven-continent view there is general accord in the Puranic texts on the names of the first and seventh *dvīpa*s—Jambū and Puṣkara—there is considerable diversity in the order of the others and also in their sizes and component *varṣa*s (parts).[24] Mere toponymic differences from one cosmography to another may have little effect on their overall visual appearance, yet to those able to read the abundant text found in so many of the extant works, the lack of concordance may loom as a serious problem. This problem was noted as early as the eleventh century by the great Muslim scholar al-Bīrūnī; but whether his concern was more with the Puranic texts, which seems most likely, or with actual cosmographic artifacts, which is also a possibility, is not known.[25]

A remarkable aspect of many Indian cosmographies is that they do not perceive distant realms as less glorious than their own revered home region (whether Jambūdvīpa or Bhāratavarṣa). In this they differ from the cosmographies of most other cultures. As Eck observes, "as we move outward from Rose-Apple Island into the *terrae incognitae* of the outer islands, the world is not imagined to be shadowy and dangerous, but on the contrary is imagined to be more and more sublime. These outer islands are not thought of as heavens, since the heavens rise in the vertical dimension of the Brahmanda, but life is idealized beyond the horizon."[26]

This idealization of distant continents or, in some views, of distant worlds would help explain why certain visual representations of portions of the cosmos, particularly as conceived by Jains and, to a lesser extent, by Buddhists, appear so strange to the uninitiated. A painted rectangle studded with glowing jewels may appear to a Western observer as being merely an abstract design, whereas to a devout Jain it might represent a specific world with a definite name and a fixed place in the cosmos.

The foregoing may be seen as a spatial analogue of the temporal conception that the age in which the world at present exists, the Kaliyuga, is the least happy and least holy of times. Also noteworthy in many cosmographic conceptions is the peripheral southerly position of Jambūdvīpa, displaying a certain lack of geocentricity that stands in marked contrast to the Jerusalem-centered or Mecca-centered cosmographies of the West.

23. Sircar, *Cosmography and Geography*, 40–41 (note 6).

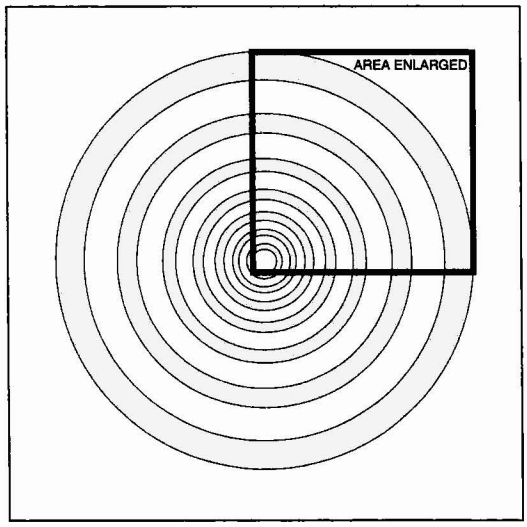
24. With respect to India, a realm called Bhāratavarṣa, now equated with the subcontinent, was presented "sometimes as a part of the Jambu-dvıpa, and sometimes as identical with the latter. Likewise, the Sāgarasaṃvṛta-dvīpa, said to be the ninth part of the Bhārata-varṣa, is regarded also as co-terminous with the whole of the Indian subcontinent (together with parts of Central Asia)" (Sircar, *Cosmography and Geography*, 37 [note 6]). Similarly, Jambūdvīpa was variously described as the southern continent, as the central continent, and as the entire earth.

25. Raychaudhuri, *Indian Antiquities*, esp. 37 and 40–41 (note 21). Abū al-Rayḥān Muḥammad ibn Aḥmad al-Bīrūnī's comments on the corruption of the Puranic texts are found in his *Ta'rīkh al-Hind* (Description of India); see, for example, *Alberuni's India: An Account of the Religion, Philosophy, Literature, Geography, Chronology, Astronomy, Customs, Laws and Astrology of India about A.D. 1030*, 2 vols., ed. Eduard Sachau (London: Trübner, 1888; Delhi: S. Chand [1964]), 1:238.

26. Diana L. Eck, "Rose-Apple Island: Mythological and Geographic Perspectives on the Land of India," unpublished manuscript sent to me on 20 November 1983.

Radically different from the cosmographies discussed to this point is the one that views the world as "a tortoise, its arched shell the heaven, its flat underside the earth."[27] Although this view retains an elevated world center, it conspicuously lacks a Mount Meru. The origin of this idea is rooted in the Brahmanas (mid-first millennium B.C.), but its elaboration appears to have occurred only in the time of the later Puranas (fourth to sixth century A.D.) and of the *Mārkaṇḍeya Purāṇa* in particular. This conception, the *kūrmaniveśa* (tortoise abode), was of particular importance to astrology, and "astrologers prepared special topographical lists to which they gave the name of *Kūrma-vibhāga* (divisions of the globe),"[28] which found their way into some major works on astronomy.

27. Gombrich, "Ancient Indian Cosmology," 116 (note 1).
28. Raychaudhuri, *Indian Antiquities*, 48 (note 21).



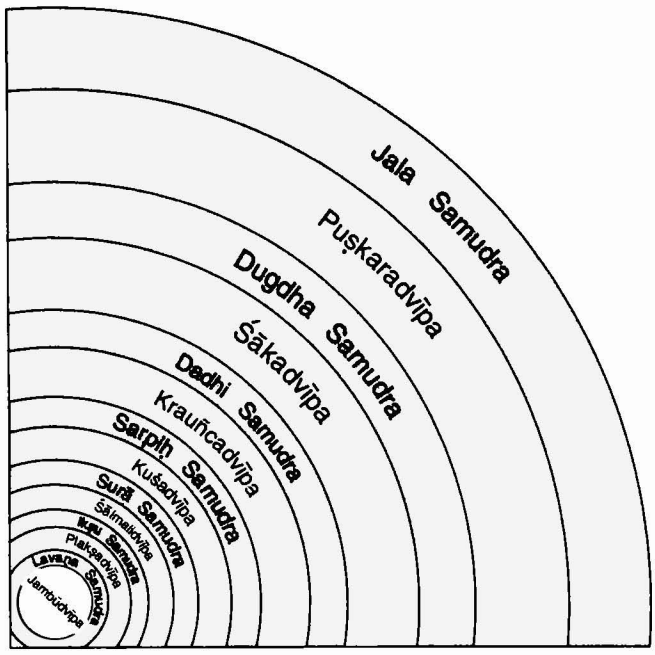


FIG. 16.2. HINDU AND JAIN CONCEPTION OF THE *SAPTA-DVĪPA VASUMATĪ* (SEVEN-CONTINENT EARTH). The seven named continents here alternate with seven seas. Starting with the innermost, Lavaṇa Samudra, the names of the seas translate as Salt Sea, Sugarcane Juice Sea, Wine Sea, Clarified Butter Sea, Curd Sea, Milk Sea, and Water Sea. The area of each successive continent is double that of the continent immediately inward from it, and the same relationship obtains for the dimensions of the rivers and mountains on those continents and the seas that separate them.
After D. C. (Dineshchandra) Sircar, *Cosmography and Geography in Early Indian Literature* (Calcutta: D. Chattopadhyaya on behalf of *Indian Studies: Past and Present*, 1967), pl. II.

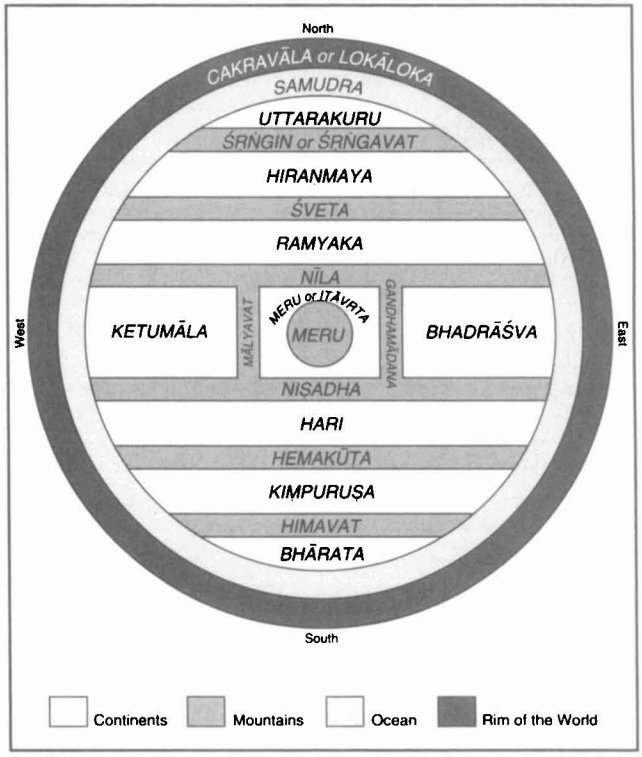


FIG. 16.3. PURANIC CONCEPTION OF THE DIVISIONS OF JAMBŪDVĪPA, THE INNERMOST CONTINENT OF THE *SAPTA-DVĪPA VASUMATĪ*. Comparing the names on this diagram with those of figure 16.1 makes it clear that this is a derivative conception. Here Ketumāla and Bhadrāśva retain their positions as the western and eastern continents, but the earlier Uttarakuru and Bhārata, in the north and south, have each been divided into three major parts separated by east-west mountain ranges.
After Joseph E. Schwartzberg, ed., *A Historical Atlas of South Asia* (Chicago: University of Chicago Press, 1978), pl. III.D.3, adapted from D. C. (Dineshchandra) Sircar, *Cosmography and Geography in Early Indian Literature* (Calcutta: D. Chattopadhyaya on behalf of *Indian Studies: Past and Present*, 1967), pl. V.

> The world as known to the *Kūrma-vibhāga* . . . is represented as resting upon Vishṇu in the form of a tortoise with its head to the east. It is divided into nine parts each of which is assigned to a triad of *nakshatras* (lunar mansions or constellations). Peoples and countries are enumerated with the corresponding *nakshatras* as they were distributed over the various parts of the tortoise's body, starting with the middle region and then running round the compass from the east to the north-east. The special object of this mode of division is to determine what *janapadas*, countries or districts, suffer disaster when the respective lunar mansions with which they are associated are harassed by malignant planets.[29]

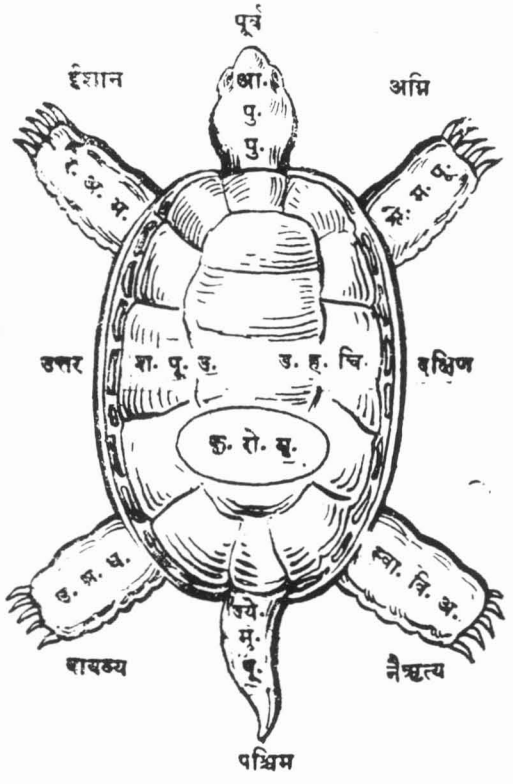


FIG. 16.4. THE WORLD SEEN AS A *KŪRMAVIBHĀGA* (DIVISIONS OF THE GLOBE), A PURANIC CONCEPTION OF THE MID-FIRST MILLENNIUM A.D. This diagram indicates for each of its nine divisions a set of three *nakṣatra*s (lunar mansions that exert an influence over the peoples and countries occupying that division). For example, on the head of the tortoise, signifying the eastern region of the earth, under the influence of the constellations Ārdrā, Punarvasu, and Puṣya, twenty-seven affected regions, peoples, mountains, and cities are listed in the *Mārkaṇḍeya Purāṇa*. These include places that can be identified with locales in the present areas of Uttar Pradesh, Madhya Pradesh, Bihar, Orissa, Bengal, and Assam (all in north-eastern India); "cannibals dwelling on the sea-coast"; and places whose present-day referents cannot be ascertained (e.g., Mount Jambū).
This drawing incorporates, among hundreds of other diagrams used as aids for divination, the Puranic conception described above. In this diagram, only the Sanskrit initials are provided. From Gaṇeśadatta Pāṭhaka, ed., *Narapatijayacaryāsvarodaya of Śrī Narapatikavi* (Varanasi: Chowkhamba Sanskrit Series Office, 1971), diagram on 109.

Regrettably, but not unexpectedly, the data of the *kūrmavibhāga*, though partly relating to the geography of the day, do not permit an accurate historical reconstruction of the map of ancient India, "due in large measure to the futile attempt of making the shape of India conform to that of a tortoise."[30]

Figure 16.4 is a reproduction of the *kūrmavibhāga* from a modern edition of a medieval astrological text, the *Narapatijayacaryā*, which was intended as a guide to divination.[31] This popular work, composed by Narapati in A.D. 1177, "describes various arrangements (*cakras*) of letters associated with time divisions and astrological entities, magical pictures of animals and objects (also called *cakras*), and arrangements of *nakṣatras* [asterisms], months, and numbers relative to the directions (bhūmis), all of which promote the military victory of their user."[32] The edition the figure was taken from contains scores of other diagrams that served purposes analogous to that of the *kūrmacakra*. I am unable, however, to specify how many of those diagrams relate primarily or largely to geographical referents. Pingree lists more than a hundred known manuscripts of the *Narapatijayacaryā*, as well as nine published editions over the period 1882 to 1955.[33] How many additional editions have been published since 1955 is not known. But the *Narapatijayacaryā* is only one among many technical texts on omens and divination (*saṃhitā*). The earliest of these is the *Gargasaṃhitā* (first century B.C. or A.D.), and the most important is the *Bṛhatsaṃhitā* of the sixth-century astronomer Varāhamihira.[34] A search through the thousands of surviving *saṃhitā* manuscripts would surely

29. Raychaudhuri, *Indian Antiquities*, 49 (note 21).

30. Raychaudhuri, *Indian Antiquities*, 49 (note 21). Niklas Müller, *Glauben, Wissen und Kunst der alten Hindus in ursprünglicher Gestalt und im Gewande der Symbolik* (Mainz: Florian Kupferberg, 1822; republished in facsimile form with afterword by Heinz Kucharski in Leipzig, 1968), provides an engraving of Müller's attempt to represent this conception of the cosmos (pl. I*).

31. Gaṇeśadatta Pāṭhaka, ed., *Narapatijayacaryāsvarodaya of Śrī Narapatikavi* (Varanasi: Chowkhamba Sanskrit Series Office, 1971), diagram on 109. For a synoptic reconstruction of the *kūrmavibhāga*, see Sircar, *Cosmography and Geography*, pl. VII, with relevant text on 90–98 (note 6).

32. David Pingree, *Jyotiḥśāstra: Astral and Mathematical Literature*, A History of Indian Literature, vol. 6, fasc. 4 (Wiesbaden: Otto Harrassowitz, 1981), 77.

33. David Pingree, *Census of the Exact Sciences in Sanskrit*, 4 vols., Memoirs of the American Philosophical Society, ser. A, vols. 81, 86, 111, and 146 (Philadelphia: American Philosophical Society, 1970, 1971, 1976, and 1981), 3:137–42.

34. Pingree, *Jyotiḥśāstra*, esp. chap. 4, "Divination," 67–80 (note 32).

reveal many diagrams of potential interest to historians of cosmography, but the task is so vast and its scholarly requirements are so formidable that such an undertaking could not be considered in the compilation of the present work. Nevertheless, I will illustrate below two examples (figs. 16.12 and 16.13) of the genre of astrological diagrams included in the *Narapatijayacaryā* and similar texts.

Divination with the aid of almanacs containing diagrams with terrestrial spatial referents—among others—is common in India, and practitioners of the art are sought out not only by simple village folk but by members of the elite as well. In the most common form of astrology, casting horoscopes, one "maps" on a chart (of which there are several standardized forms, depending on the system being followed) the position of the sun, moon, and planets at the moment of the client's birth; but of this I shall say nothing more. Other types of "mapping" take place on a person's body. In her work on the village of Pahansu, the anthropologist Gloria Goodwin Raheja describes the process as follows:

> Settling in a new village or town involves, in the indigenous conceptualization, a matching of the person with these places, and inappropriate matchings may result in inauspiciousness. Ordinary villagers do not have a comprehension of the techniques used by the astrologer to determine whether the match will be auspicious or inauspicious, but they are aware of the sort of mapping of village to person that is involved. The mapping is carried out in the following manner.
>
> Beginning with the lunar asterism (*nakṣatra*) that corresponds with the first letter of the name of the village, the twenty-eight *nakṣatras* are mapped onto the "body" in the order in which the asterisms appear in the heavens. Thus, taking Pahansu as an example, Buddhu Pandit [the village astrologer] would start with *uttarā phālgunī*, the asterism that is associated with the Hindi syllable *pa*, and map the *nakṣatras*. . . .
>
> [Raheja here provides a table indicating seven asterisms each that are associated with the client's forehead, back, heart, and feet.]
>
> Having constructed the *nakṣatra* "body" in this way, the astrologer then notes the *nakṣatra* that corresponds to the first syllable of the name of the man who wishes to settle in the village. If that *nakṣatra* has "fallen" (*paṛnā*) on the forehead or heart, then the match between village and person is propitious, and the man's family will prosper there; if it falls on the back or the feet, inauspiciousness will afflict him if he settles in that village. In this procedure, the lunar asterisms are arrayed in an order specified by the particular village, and this ordering determines where the person's own name-asterism will fall. It is in this particular matching of the person with the village that the potential for auspiciousness or inauspiciousness lies.[35]

Yet another type of mapping Raheja describes relates to the way a farmer would seek to learn of an auspicious time and place to dig a well. In this case the astrologer would map the day's *nakṣatra*

> onto the space defined by the boundaries of the fields in which the farmer wishes to dig a well. The farmer gives a rough map (*nakṣā*) of his fields to [the astrologer, who] superimposes a diagram (*cakra*) of the directions over this. The squares of the diagram are propitious or not propitious for the digging because of their conjunction with the various asterisms. If the day's *nakṣatra* falls on a square that is unfavorable, then another day is chosen. Inauspiciousness (*kuśubh*) is produced if one acts in the context of an unfavorable conjunction of times and spaces.[36]

Along with this narrative, Raheja includes the diagram, oriented with east at the top. It shows the center, northeast, southeast, southwest, and north as auspicious (though only during the specified times) and the remaining three cardinal directions and northwest as inauspicious.[37] Finally, Raheja describes the procedures followed in the village of Pahansu before building a house. These are analogous to those I have just cited and also relate conceptually to practices described in the final section of this chapter concerning microcosmic analogues of the cosmos.[38]

Within the vast corpus of Indian cosmographic literature, references to regions, physical features, and peoples of the real world were not limited to texts on divination. In virtually all the Puranas the sections known as the *bhuvanakośa*s (dictionaries of the world) combined not only accounts of the cosmos in its largest sense and of the general constitution of the earth, but also an abundance of geographical detail of a relatively localized nature. Unfortunately the lines of separation were not clearly drawn, and it is difficult even for the trained Indologist to ascertain when a particular text crosses the threshold between speculative fancy and empirical description.[39] In fact there exists no clear separation between the two. Portions of what is described appear to be based on dim transmuted memories of ancient

35. Gloria Goodwin Raheja, *The Poison in the Gift: Ritual, Prestation, and the Dominant Caste in a North Indian Village* (Chicago: University of Chicago Press, 1988), 52–53.

36. Raheja, *Poison in the Gift*, 53–54 (note 35).

37. She has also provided me with a copy of the rough sketch map to which the narrative relates; personal communication, 19 January 1989.

38. Raheja, *Poison in the Gift*, 54–56 (note 35).

39. Eck, "Rose-Apple Island," 8–12 (note 26). These pages also discuss the sections of the Puranas and of the *Mahābhārata* known as *tīrtha mahātmya*s, which supplement the sacred geographic texts of the *bhuvanakośa*s and contain abundant references to real-world localities.

Aryan homelands far to the north of India; other passages seem to be distorted accounts, received perhaps through non-Aryans, of lands well beyond the then Aryan frontier; and still other descriptions are of real enough places within the Aryanized portions of India, but seen through the mystifying prism of religion.[40] Comparable observations can also be made in regard to the mixture of the real and the unreal in the texts of the Buddhists and the Jains, though both of those religions have been even more inclined to invention than were the ancient Hindus. In specific regard to the Jains, Sircar was moved to observe that they merited "thanks . . . for their power of imagination and passion for useless description in which they appear to have excelled the Puranic writers."[41]

A much-used and troublesome word in the cosmographic texts is *dvīpa*, which is variously rendered as continent, island, or island continent. Originally *dvīpa* "meant nothing more than a land between two sheets of water (usually rivers)" and was thus analogous to the contemporary Hindi/Urdu *doab* (interfluve).[42] This could help explain the early application of the term to certain island regions such as Videha (in this case the Malay Archipelago), but it would convey little sense in regard to desert regions such as Śākadvīpa (the Desert of Sistan). An argument sometimes invoked in regard to some of the arid *dvīpa*s in Central Asia is that they were seen metaphorically as islands in an "ocean" of sand, that is, essentially as oases. In any event, the surviving cosmographies indicate that *dvīpa*s could be separated by mountain ranges as well as by intervening seas.

The confusion about what a *dvīpa* might refer to is noteworthy because it provides a possible explanation of the persistent error on European maps derived from the *Geography* of Ptolemy or, more precisely, from later maps that sought to incorporate Ptolemy's geographic coordinates. These maps posited an enormous island of Taprobane (Sri Lanka) to the south of an India that is nonpeninsular in form. If one assumes that the Puranic Dākṣiṇātya or Dakṣiṇāpatha (the southern region or Deccan) was perceived as a *dvīpa* beyond the east-west trending Vindhya Mountains, then it might have been taken as a great southern island without any recognition of its separateness from ancient Laṅkā. Gossellin's commentary on Ptolemy lends support to that view:

> The deep embayment of the Gulf of Cambay, which is to the south of Gujarat, was able to appear to them [ancient navigators] as the beginning of the strait that they knew should separate Taprobane from India. A sense of order made them continue this strait up to the Gulf of the Ganges [Bay of Bengal], across the continents and from that time forward the eastern peninsula of India, considered as an island, could be confused with Ceylon to which one [i.e., the geographers of Alexandria] assigned the entire extent which that part of Asia ought to have had.[43]

The Jain conception of the world of man, Manuṣyaloka (below, fig. 16.24), appears to be derived from the Puranic view (fig. 16.3) that sees Jambūdvīpa within its encircling Lavaṇa Samudra (Salt Sea). But Manuṣyaloka also extends beyond that ocean to include all of a second continent, Dhātakīkhaṇḍa, the ring ocean beyond that, and half of a third ring continent, Puṣkaradvīpa, stopping at the circular chain of mountains midway across the ring. Thus, Manuṣyaloka is also styled the *adhai-dvīpa*, or earth of two and a half continents, reflecting the pervasive Jain fascination with numerology. Figure 16.5 depicts the key elements in the Jambūdvīpa of the Jains. Within this continent are subregions, also called *dvīpa*s or continents, that are separated by six east-west mountain ranges and, within what would be the large equatorial region, Videha, two north-south ranges, thus yielding a total of nine continents—three northern, three middle, and three southern—including the bowshaped Bhārata, the southernmost of all. Alternatively, one may speak of seven continents if one takes the three in the middle as a single entity. But whereas the original Puranic view saw the surrounding oceans as girdled by a single peripheral mountain ring, the Cakravāla (round perimeter) or Lokāloka (world-nonworld, i.e., the place where the world and the nonworld meet), the Jain texts expanded the number of concentric island continents to six, thereby bringing the total number of basic units to the conventional seven if one now considers the central Jambūdvīpa as a single entity.[44] And a post-Gupta work—date unknown, but not earlier than the mid-sixth century—named no fewer than sixteen inner and sixteen outer islands, each with an ocean beyond.[45] Nevertheless, relatively few surviving Jain depictions of this earth system show a large number of ring continents; one or two-and-a-half appears to be the usual number portrayed.

40. Joseph E. Schwartzberg, ed., *A Historical Atlas of South Asia* (Chicago: University of Chicago Press, 1978), presents a set of maps (pp. 13, 14, and 27, plus relevant text on 162–65 and 182–83) that convey some sense of the extensiveness of historical geographic detail to be gleaned from the Vedas, the Epics, and the Puranas. In addition to these and other texts previously cited, the *Romaka Siddhānta*, a Sanskrit text probably dating from the sixteenth century, "displays considerable accurate knowledge of lands beyond India (Afghanistan, Iran, Central Asia); there are others as well from the 17th and 18th centuries" (David Pingree, personal communication, 21 December 1988; but he is not aware of any maps accompanying these works).

41. Sircar, *Cosmography and Geography*, 59 (note 6).

42. Raychaudhuri, *Indian Antiquities*, 68 (note 21).

43. Pascal François Joseph Gossellin, *Géographie des Grecs Analysée; ou, Les systêmes d'Eratosthenes, de Strabon et de Ptolémée comparés entre eux et avec nos connoissances modernes* (Paris: Imprimerie de Didot l'Ainé, 1790), 135, my translation. I thank Marie-Thérèse Gambin of the University of Paris VII for transmitting the relevant text. David Pingree takes issue with the argument presented here (personal communication, 21 December 1988).

44. Sircar, *Cosmography and Geography*, 57 (note 6).

45. Sircar, *Cosmography and Geography*, 58 (note 6).

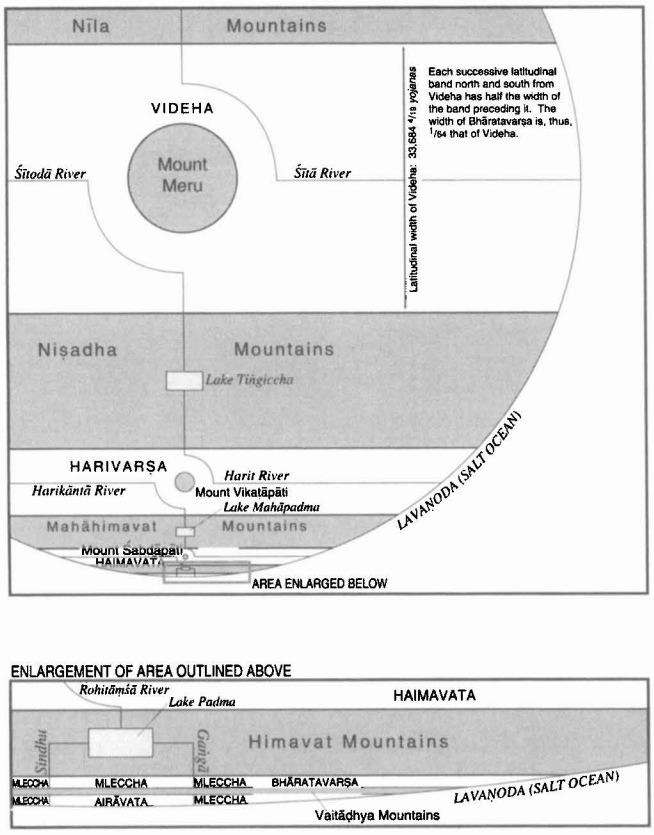


FIG. 16.5. SELECTED ELEMENTS OF A PORTION OF JAMBŪDVĪPA AS CONCEIVED BY THE JAINS. This diagram (a little more than one-fourth of the entire Jambūdvīpa) preserves the scalar relations stipulated in the Jain texts, in which the middle region, Videha, has twice the width, north-south, of the two adjacent mountain ranges, which are in turn twice as wide as the succeeding regions, Ramyaka (off the map to the north) and Harivarṣa, and so forth, until the northernmost and southernmost regions, Airāvata and Bhāratavarṣa (India), are reached. (Also beyond the northern limit of this diagram are the Rukmin and Śikharin Mountains, the equivalents of the Niṣadha and Mahāhimavat Mountains, and the Hairaṇyavata region, the equivalent of Haimavata.) Similar scalar relations obtain in respect to the heights and depths of the mountain chains; the length, breadth, and depth of lakes within the mountain ranges; the number of tributaries entering the pairs of rivers flowing east and west out of these lakes, and so forth. Not indicated in this view are the numerous east-west regional divisions within Videha and the one and a half continents and the Kāloda Ocean outward from Jambūdvīpa and the Lavaṇoda (Salt Ocean) that compose the rest of Manuṣyaloka. These are shown in figure 16.24.

The inset diagram shows an enlargement of a small area in the southernmost part of Jambūdvīpa, including much of Bhāratavarṣa and the Himavat (Himalaya) Mountains. A narrow mountain range, the Vaitāḍhya, through which the Gaṅgā and Sindhu rivers flow via great tunnels, divides Bhāratavarṣa into northern and southern halves, each with three *khaṇḍa*s (divisions). Of the six *khaṇḍa*s, five are domains of the Mleccha (barbarians) and only one, the southernmost, belongs to the Aryans.

Adapted from N. P. Saxena and Rama Jain, "Jain Thought regarding the Earth and Related Matters," *Geographical Observer* 5 (1969): 1–8; with additional data and nomenclature from Willibald Kirfel, *Die Kosmographie der Inder nach Quellen dargestellt* (Bonn: Kurt Schroeder, 1920; reprinted Hildesheim: Georg Olms, 1967; Darmstadt: Wissenschaftliche Buchgesellschaft, 1967), 214–33, 251.

To this point our concern with cosmography has been almost exclusively in regard to the earth. But our planet constitutes only an infinitesimal portion of the universe. That perception was shared by all three of the major indigenous religions of India, and each gave rise to a number of conceptions of the universe, some of remarkable complexity. Not only that, Buddhists and Jains came to believe in an infinite number of universes. Hindus, by contrast, seemed content to believe that a limited number of named gods—Indra, Varuṇa, Vāyu, Agni, Āditya, Yama, and so on—created their own worlds, just as Brahma created our earth and its associated heavens, netherworlds, and hells—seven or more of each, depending on the text consulted. However, "the notions as to the situation of these worlds (except those of Indra and Yama) seem always to have been rather vague."[46]

For our own universe, the Hindu views also appear relatively simple. One such view, expounded in the Purāṇas, is "that each generating principle or element envelops the one generated by it. The gross elements combine into a compact mass, the world-egg (brāhmāṇḍa), which rests on the waters, and is surrounded by seven envelopes—water, wind, fire, air, Ahaṁkāra [a substance producing the 'conceit of individuality'], Buddhi [the 'thinking substance'], and Pradhāna [an amalgam of darkness, activity, and goodness]."[47]

The universes envisioned by the Jains are far more complex and wondrous than those of Hinduism, though compounded of many of the same elements and similar also in presenting a vertical sequence of hells, netherworlds, earth, and heavens. Jains also postulated that their multiplicity of universes occupied only a portion of cosmic space. Each universe is called a Lokākāśa, and beyond it is the Alokākāśa, "an absolute void . . . perfectly impenetrable to anything, either matter or souls." Coterminous with the Lokākāśa are "Dharma and Adharma, the substrata of motion and rest, . . . [and] the indispensable conditions . . . of all existing things."[48]

Jains envisage our own universe as consisting of a series of netherworlds increasing regularly in size with distance below the world of man and a series of heavenly realms above it that increase regularly in size up to a certain limit and then decrease regularly beyond that limit (fig. 16.6).

46. Jacobi, "Cosmogony and Cosmology (Indian)," 159 (note 2).
47. Jacobi, "Cosmogony and Cosmology (Indian)," 159 (note 2).
48. Jacobi, "Cosmogony and Cosmology (Indian)," 161 (note 2).

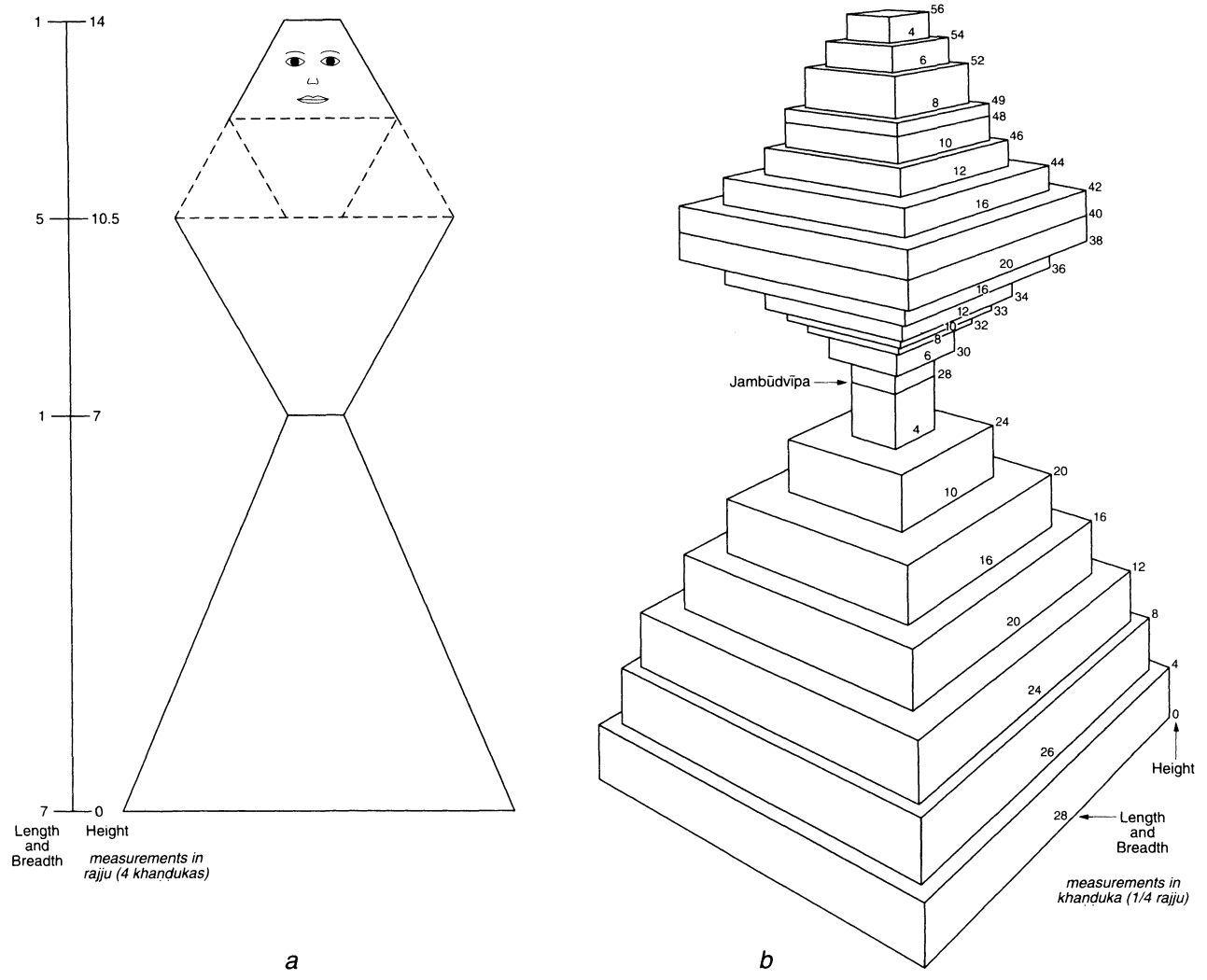


FIG. 16.6. ALTERNATIVE CONCEPTIONS OF THE FORM OF THE JAIN UNIVERSE. The dimensions in *rajju*s (see text for definition) are explicit for conceptions *a* and *b*. In each view there is a succession from the lowest and widest hell up to the middle level, that of Jambūdvīpa, with widths of seven and one *rajju*, respectively; then to successively wider heavens, the widest of which has a breadth of five *rajju*s, and finally, successively narrower heavens, the uppermost being one *rajju* in width. Figure 16.29 below provides a view in conformity with conception *b*.

After D. C. (Dineshchandra) Sircar, *Cosmography and Geography in Early Indian Literature* (Calcutta: D. Chattopadhyaya on behalf of *Indian Studies: Past and Present*, 1967), pls. III and IV.

Each heaven and hell had its own special properties. Figuratively, the ensemble was seen as a woman (or man) standing with arms akimbo, presumably a throwback to the Vedic myth of the Puruṣa (cosmic or primeval man).[49] The dimensions of the several portions of the Jain universe are a triumph of the human imagination. The unit in which they are measured is the *rajju*, literally a rope, which is defined as "the distance which a male celestial being flies in six months at the rate of 2,857,152 *yojanas* in one *samaya* or the shortest unit of time."[50] And a *samaya* has been translated as a "blink, which is about 1/5 of a second."[51]

Since Buddhism virtually disappeared from India proper not long after the establishment of the Delhi Sultanate (A.D. 1206), there is little likelihood of uncovering on the subcontinent many surviving representations of the cosmographic conceptions associated with that faith,

49. Gombrich, "Ancient Indian Cosmology," 130 (note 1). The same schema is presented in numerous other works.

50. A. Ghosh, ed., *Jaina Art and Architecture*, 3 vols. (New Delhi: Bharatiya Jnanpith, 1974–75), 3:516, n. 2. Several other sources, including Kirfel, *Die Kosmographie*, 210 (note 4), give the figure 2,057,152 instead of the 2,857,152 cited here, which indicates that a typographical error occurs in the Ghosh text.

51. Gombrich, "Ancient Indian Cosmology," 121 (note 1). An appendix to Kirfel, *Die Kosmographie*, 331–39 (note 4), provides a synoptic set of tables of spatial and temporal measures specified in the ancient literature of Hinduism, ancient Indian Buddhism, and Jainism.

apart from those embodied in stupas and other enduring architectural monuments.[52] Although there are a number of surviving South Asian Buddhist texts that describe the structure of the cosmos, none of these, so far as I am aware, incorporates relevant illustrations.[53] Hence I shall defer any additional discussion of the underlying cosmological conceptions of the Buddhists until the chapters on Tibet and Southeast Asia in volume 2, book 2, where it will be more apposite.

Cosmographies in the Hindu Tradition

Paintings and Ink Drawings Not Primarily Astronomical in Content

Compared with the surviving cosmographies of the Jain tradition—an exceedingly large number—those clearly identifiable with Hinduism are surprisingly few. The reasons for this seeming paradox are provided in the following section on Jain cosmography. With the exception of simple representations of the cosmic egg, all the examples I know are hybrid in that they combine elements of two or more of the conceptions noted above in regard to the structure of the cosmos. Simpler views were undoubtedly once made, but they do not appear to have been preserved, and it seems probable from the Puranic texts that compound views originated very early in Indian history.

A remarkably striking depiction of the *hiraṇyagarbha*, literally "golden womb or fetus," has been reproduced in a number of publications.[54] Described as the golden egg or germ that "symbolizes the birth of the cosmos. . . . [and the] source of energy for all being," the *hiraṇyagarbha* is shown floating in a field of "primordial waters."[55] Its upright position suggests that even in this nascent form the universe comprises a vaulted dome and a correspondingly shaped nether region.

Somewhat more complex is the conception illustrated by figure 16.7, which shows, according to Rawson, the "primary divisions within the fertilized world-egg."[56] This interpretation is in keeping with an enduring Tantric tradition within Hinduism that is shot through with sexual imagery. But whether or not it is correct, it does seem clear that the nine divisions of the egg that are portrayed are those of Jambūdvīpa illustrated in figures 16.3 (rotated ninety degrees) and 16.9, with three continents each to the right and left of the central continent, Ilāvṛta, one continent each above and below, and within Ilāvṛta, a proto-Meru, the emerging *axis mundi*. Separating these variously colored continents are bands that are also of various hues, indicating mountain ranges. The outer ring ocean and mountain range (Lokāloka) are missing, however. Here the world egg is lying on its side, in contrast to the vertical position of the earlier mentioned *hiraṇyagarbha* and of figure 16.3. One supposes, therefore, that east lies at the top of the painting. But possibly the orientation was an expedient one, adapting the painting to the shape of the page in the manuscript containing it, whose nature cannot now be ascertained.

A third and still more differentiated cosmography appears in figure 16.8, which "shows a world . . . very similar to that described in the Epics and Purāṇas."[57] The painting is unquestionably in the tradition of Vaishnavism, one of the two principal divisions within Hinduism,

52. A particularly important survival, however, is the giant, partially obliterated fresco of a *bhavacakra* (wheel of life) in the porch section of Cave 17 at Ajanta, which Walter Spink dates from about A.D. 470, as opposed to the more conventionally accepted date of about 530. The problem is discussed by Spink in "The Vākātakas Flowering and Fall," in a forthcoming volume of proceedings of an international conference on the art of Ajaṇṭā, held at Maharaja Sayajirao University in Baroda in 1988, ed. Ratan Parimoo. Since the work in question is said to be the basis for a similar painting in Samye monastery in Tibet, which will be discussed and illustrated in the *History of Cartography*, volume 2, book 2, I will not deal with it further at this point.

53. Although the texts themselves lack illustrations, the authors of a number of modern secondary sources have constructed illustrations based on them. Two are especially noteworthy. The first is a diagram of the *cakkavāla* (world disk), seen from above and in horizontal cross section, scaled as nearly as possible to the stipulated dimensions of the Pali *abhidhamma* (higher doctrine) by Daniel John Gogerly in *Ceylon Buddhism*, 2 vols., ed. Arthur Stanley Bishop (Colombo: Wesleyan Methodist Book Room; London: Kegan Paul, Trench, Trubner, 1908), vol. 2, frontispiece. The other, titled "The Components of the Cosmos," provides a more encompassing three-dimensional oblique perspective view reconstructed from the fifth-century *Maṇimēkalai*, the only surviving Indian Tamil Buddhist text, by Paula Richman in *Women, Branch Stories, and Religious Rhetoric in a Tamil Buddhist Text*, Foreign and Comparative Studies/South Asian Series 12 (Syracuse: Maxwell School of Citizenship and Public Affairs, 1988), diagram on 85, key on 86, and methodological note, "The Design of Figure 2: Buddhological and Cartographic Considerations," on 175–76 and 242. The Gogerly diagram is also reproduced in W. Randolph Kloetzli, *Buddhist Cosmology, from Single World System to Pure Land: Science and Theology in the Images of Motion and Light* (Delhi: Motilal Banarsidass, 1983), 32. Additionally, Kloetzli provides a series of seven tables that indicate systematically the organization of the cosmos according to various Buddhist schemata (pp. 33–39). Finally, in his discussion of bibliographical resources, he singles out numerous works that include "diagrams of the 'cakravāla-cosmology' " (pp. 146–50), not all of which I have had an opportunity to examine. A more succinct treatment, also by Kloetzli, appears in his article "Buddhist Cosmology," in *The Encyclopedia of Religion*, 16 vols., ed. Mircea Eliade (New York: Macmillan, 1987), 4:113–19.

54. Ajit Mookerjee, *Tantra Art: Its Philosophy and Physics* (New Delhi: Ravi Kumar, 1966), 68 and pl. 33 (p. 58); Anand Krishna, ed., *Chhaavi: Golden Jubilee Volume: Bharat Kala Bhavan, 1920–1970* (Varanasi: Bharat Kala Bhavan, 1971), cover illustration; and Walter M. Spink, *Krishnamandala: A Devotional Theme in Indian Art*, Special Publications, no. 2 (Ann Arbor: Center for South and Southeast Asian Studies, University of Michigan, 1971), fig. 5, p. 1.

55. Mookerjee, *Tantra Art*, 68 (note 54).

56. Philip Rawson, *The Art of Tantra*, rev. ed. (New York: Oxford University Press, 1978), fig. 161 (p. 197).

57. Collette Caillat and Ravi Kumar, *The Jain Cosmology*, trans. R. Norman (Basel: Ravi Kumar, 1981), 58.

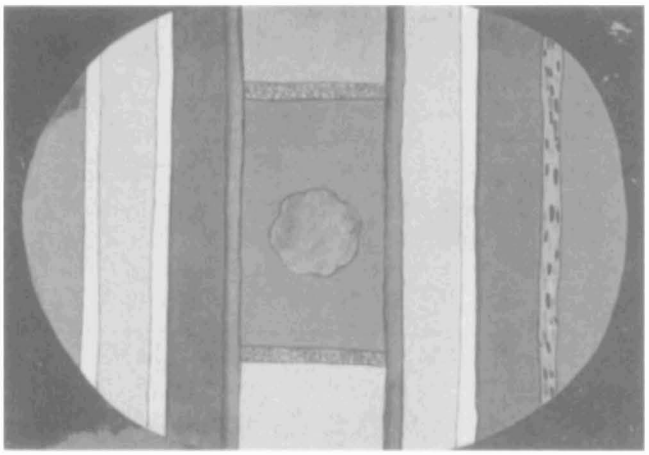


FIG. 16.7. PRIMARY DIVISIONS WITHIN THE COSMIC EGG. Though this diagram bears no text, it is immediately recognizable as a representation of the cosmographic conception illustrated by figure 16.3 above (rotated ninety degrees). It is gouache on paper, Rajasthani, and dated eighteenth century. Size of the original: 27 × 42 cm. From Ajit Mookerjee, *Tantra Art: Its Philosophy and Physics* (New Delhi: Ravi Kumar, 1966), pl. 43 (p. 70), by permission of Ravi Kumar.

characterized by worship of the lord Vishnu in his various forms and avatars with which particular realms of the universe are associated. Vishnu's most important incarnation, Krishna, for example, is here shown in paradise (Vaikuṇṭha), while Varāha, the Boar avatar, is shown in the cosmic waters from whose depths he raised the earth after it had been cast there by a demon.[58] This complex diagram includes various heavens and hells, above and below the earth, depicted in its middle register; seven protective sheaths around Brahmāṇḍa, the cosmic egg; and numerous figures from Indian mythology, only a few of which are identified in the legend.

A nineteenth-century Rajasthani painting not illustrated in this work, similar in many respects to the one described above but representative of the Shaivite branch of Hinduism, whose principal deity is Shiva, has been reproduced by the Belgian art historian Armand Neven.[59] This painting, however, though devoid of text, is much more highly structured and symmetrical than the foregoing work. The seven heavens and hells are more clearly differentiated from one another, and each is illustrated with its characteristic denizens or objects. The oblong shape of the previous cosmography is retained, as are the seven enveloping rings. At the base of the seven Pātālas is a large turtle, sustaining all the higher levels. The principal difference between the two paintings lies in the rendition of the middle band, which represents not only Jambūdvīpa, in which the nine continents noted in figure 16.3 are similarly arrayed, along with Mount Meru, but also to the left (north) and right (south), truncated arcs of the six additional concentric ring continents surrounding it. Most of the cosmography is seen ranged along a vertical axis, but the middle band is rotated ninety degrees, so that we view it horizontally as if from a point above Mount Meru. This device, as we shall see, also characterizes many Jain cosmographies.

Yet another cosmography of Rajasthani provenance, from around the turn of the eighteenth century, is presented in figure 16.9. This illustration includes all three supreme deities of the Hindu pantheon, with Brahma, the creator, occupying a central position and, as in figure 16.8, a number of lesser deities as well, in various areas of Jambūdvīpa. The portion of the tripartite cosmos depicted lies within a middle stratum, Rajas (the phenomenal world), below Sattva (the world of superior consciousness), and above Tamas (the netherworld). Since all three major strata (*trilokas*) are intersected by the seven spokes radiating out from Jambūdvīpa, the cosmos is divided into twenty-one *lokas* (zones).[60]

Of particular interest in figure 16.9 is the iconic representation, through color and other devices (e.g., the nature of specific deities) of time as well as space, and the heroic attempt to integrate the two in a two-dimensional field. The representation of Meru by a lotus, a common cosmographic motif, is also noteworthy. Here the lotus has eight petals, whereas in many other contexts it has four (cf. figs. 15.3, 16.1, 16.14, and 16.18). Seen in this cosmography, unlike those previously discussed, are four rivers emanating from Meru and flowing to the edge of Jambūdvīpa, a feature that is also characteristic of the cosmographic conceptions of Buddhism and Jainism. Other Hindu cosmographies on which these rivers appear include the globes depicted in figures 16.14, 16.15, and 16.18 and in plate 26. Also to be noted here, for the first time, are the seven radial spokes. Although Mookerjee does not comment on their material nature and function, they do find echoes in some Jain cosmographies. Finally, we may note that the elephants representing the four cardinal directions are placed near the corners of the map, which strictly speaking should represent the intermediate directions (NE, SE, SW, and NW). Presumably this was done for aesthetic reasons, which overrode any desire for exactitude.

From an uncertain locality in southern India comes a cosmography (fig. 16.10) that is strikingly different in some respects from others presented to this point, yet remarkably similar in other ways. The similarities include

58. Basham, *Wonder That Was India*, 302–9 (note 15), provides a succinct account of the place of Vishnu and his avatars in Hindu mythology and of the important myths associated with each.

59. Armand Neven, *Peintures des Indes: Mythologies et légendes* (Brussels: Crédit Communal de Belgique, 1976), fig. 10 (p. 12) and 68.

60. Ajit Mookerjee, *Tantra Asana: A Way to Self-Realization* (New York: George Wittenborn; Basel: Ravi Kumar, 1971), pl. 37, text on 66.

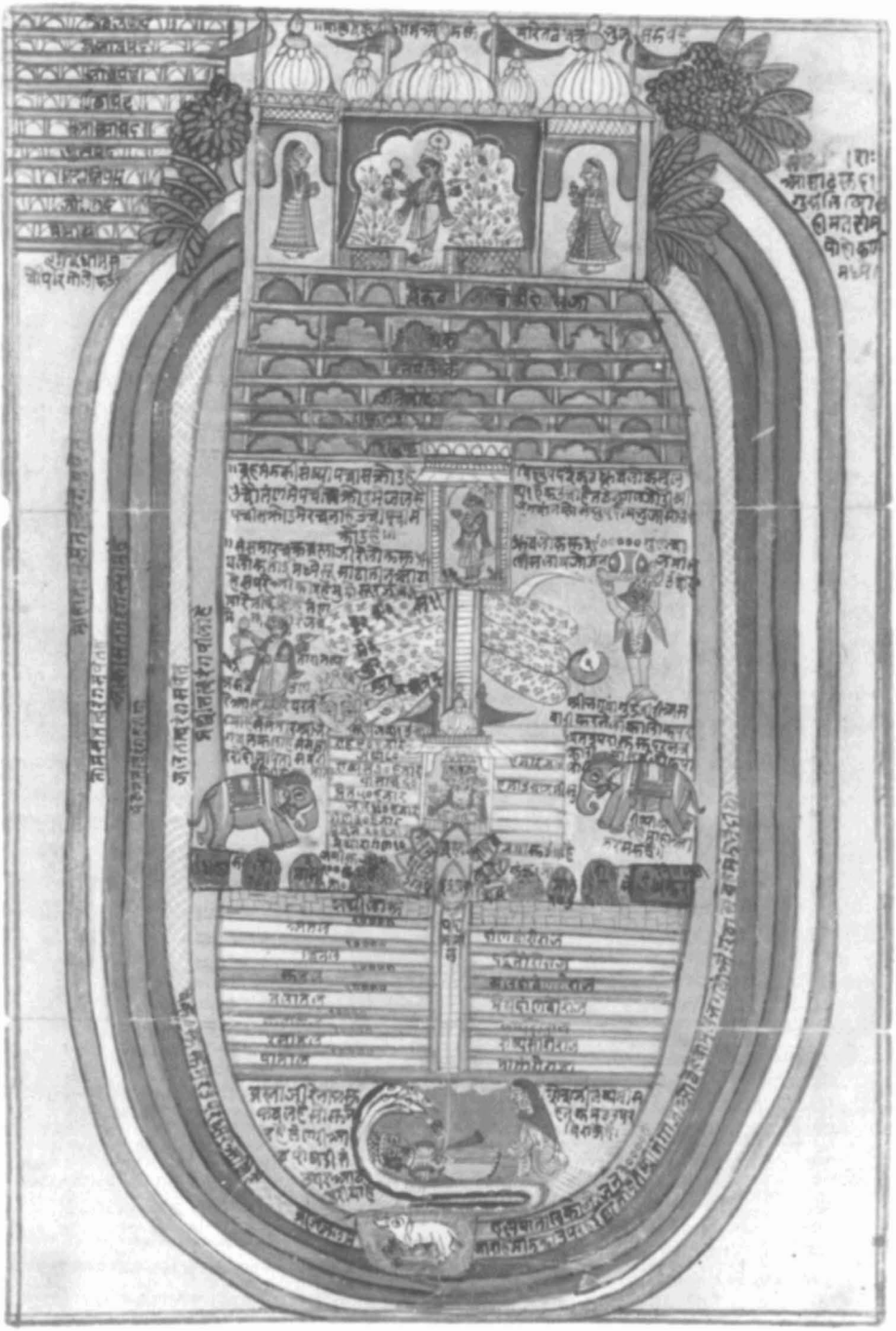


FIG. 16.8. VAISHNAVITE HINDU COSMOGRAPHY. This painting is gouache on paper, Rajasthani, eighteenth century. Collette Caillat and Ravi Kumar describe it, in part, as follows: "A brief glance shows the cosmic egg, surrounded by seven wrappings. Inside, at the bottom, in the depths of the cosmic waters are the Tortoise, the Boar, and Viṣṇu seated upon [the Serpent,] Śeṣa; from Viṣṇu's navel protrudes the lotus upon which Brahmā sits. The universe is divided into two vast aggregates. In the lower part, are the seven levels of underground regions called Pātālas, here very close together. Then barely outlined, is the lowest infernal region, of Naraka; in the upper section are the seven levels, *bhūr*, *bhuvar*, *svar*, etc., starting with the earth, continuing with space (which with its wonderful inhabitants goes right up to the course of the sun), and going still higher, to end at their peak in the paradise called Vaikuṇṭha, an enchanting spot where Kṛṣṇa dwells" (Collette Caillat and Ravi Kumar, *The Jain Cosmology*, trans. R. Norman [Basel: Ravi Kumar, 1981], 58).
Size of the original: not known. By permission of Ravi Kumar, Basel, Switzerland.

the oblong shape of the universe, even more evident here than in the preceding view, its essentially vertical axis, the exterior sheathing of the universe by ten nested rings, the existence of eleven upper heavens and ten lower hells, two turtles below the lowest hell, a five-headed serpent atop one of the turtles, the positioning of Jambūdvīpa between the heavens and hells, and the placement around Jambūdvīpa of a number of annular continents. But absent from this view is any addiction to the auspicious number seven in respect to the features just noted. The most distinctive feature of the painting is the grouping in a line above Mount Meru of symbols depicting the planets (including the sun and moon) and their paths, along with associated deities. The two small chariots on either side are said to represent the "eclipse cycle."[61]

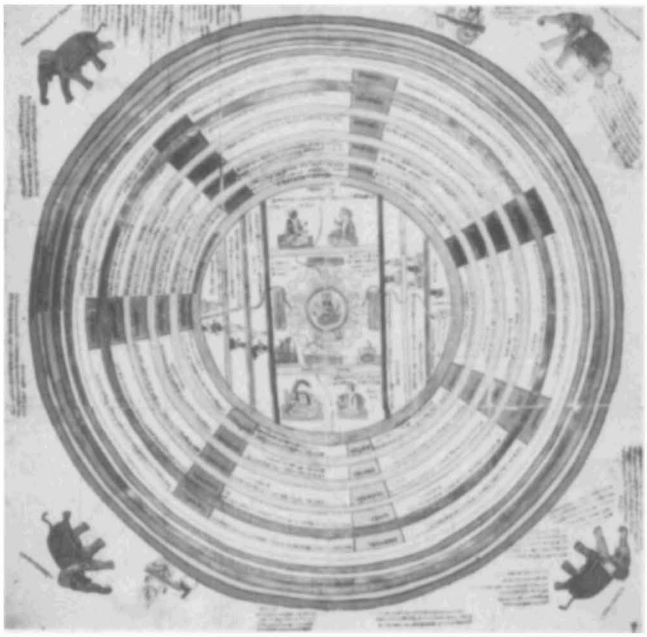


FIG. 16.9. BRAHMĀṆḌA (EGG OF BRAHMA). This gouache-on-paper rendition of the egg of Brahma is probably from Rajasthan, ca. 1700. Here, Brahma, the creator and the first deity of the Hindu trinity, occupies a central position, while Vishnu the preserver and Shiva the destroyer are seated above him (left) and below (also left). Other deities, each with a specific function in terms of world creation, preservation, and destruction appear within the ninefold central world/continent, Jambūdvīpa, which is in turn within Rajas, the middle major stratum of an essentially tripartite universe. The five innermost circles, those intercepting the seven spokes, represent mountain ranges in the following sequence, from the center outward: Suvarṇa (Gold), Puṣpaka (Flower), Devānīka (Abode of Angels), Meru (*sic*, at the center of the earth, though that is not evident here), and Mandarācala (where the earth joins the rest of the universe). The colors for these five rings are also said to signify periods of time in the following sequence: blue for the time prior to the earth's formation, gold for the Satyayuga (era of truthfulness), purple for the Dvāparayuga (era of degradation), yellow for the Tretāyuga (when good and evil coexist), and grey for the Kaliyuga (age of darkness). The seven outer circles represent different colors of the cosmos. The four elephants (Diggaja) conventionally represent the protectors of the four cardinal points. The two chariots, pulled by seven horses (upper right) and by a deer (lower left), signify the Sun (day) and Moon (night) respectively. The individual horses symbolize the seven Hindu planets.
Size of the original: not known. From Ajit Mookerjee, *Tantra Asana: A Way to Self-Realization* (New York: George Wittenborn; Basel: Ravi Kumar, 1971), 66 and pl. 37, by permission of Ravi Kumar.

Another south Indian cosmography, the largest I have seen or know about, is found in the waiting hall of the renowned Mīnākṣī (Meenakshi) temple in Madurai. Painted in oils on canvas, its dimensions are about 4.25 × 4.25 meters. The work, executed by N. S. R. Regunathan and entitled *Bhūgolam* (Globe/Geography), is one of a pair. The other member of the pair—discussed below—is entitled *Khagolam* (Celestial dome). The two works, painted in A.D. 1963 and 1966, are said to be replacements for similar productions, made in 1568, that were accidentally whitewashed and destroyed. Painted in a rich palette, with seas and continents in a variety of colors, the work has abundant text in the Tamil script and language and many numbers in the Westernized Arabic form that indicate the dimensions of and distances between various parts of the cosmos. The work includes the central continent, Jambūdvīpa, with its now familiar ninefold division and a north-south vertical axis. From a very prominent Mount Meru in the center of Jambūdvīpa flow four rivers, one in each cardinal direction (though not quite symmetrically disposed), and around Meru are nine or ten ring continents (depending on whether one includes Lokāloka, the outermost ring) with intervening seas, much as in figure 16.9. A survey of other major Indian temples would almost certainly reveal other cosmographies of this and other genres.[62]

There is yet another remarkable eighteenth-century cosmographic painting from the south Indian state of Tamil Nadu, which I was allowed to view briefly, but not to photograph, at the Sarasvati Mahal Library attached to the former royal palace of Thanjavur (Tanjore). It is an exceedingly complex work, painted on wood, possibly in oils, in a miniature style (ca. 60 × 40 cm). The painting appears to be either the model from which a very large wall painting was copied or a copy made from the wall painting, possibly to preserve the content of the latter before it was lost through dismantling or neglect. In either event, the small painting has the same content and layout as one described by Adolf

61. Kapila Vatsyayan, "In the Image of Man: The Indian Perception of the Universe through 2000 Years of Painting and Sculpture," in *Pageant of Indian Art: Festival of India in Great Britain*, ed. Saryu Doshi (Bombay: Marg Publications, 1983), 9–14, esp. fig. 6.

62. I thank B. Arunachalam for calling my attention to the paintings cited in this paragraph.

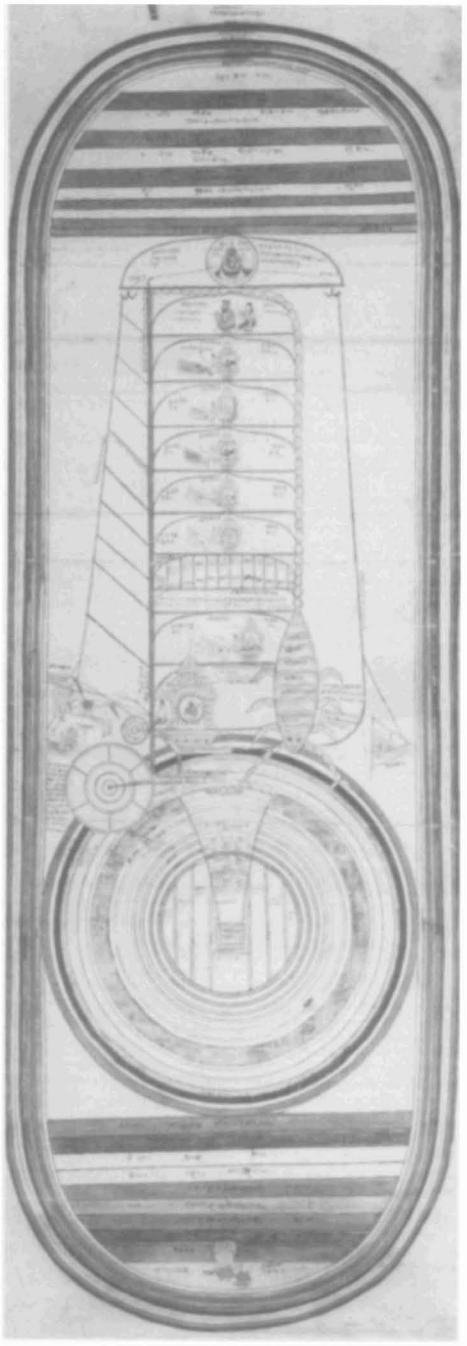


FIG. 16.10. THE PATH OF THE PLANETS. Though containing many elements in common with figures 16.8 and 16.9, this cosmography conveys a clearer sense of the vertical stratification of the universe. Jambūdvīpa, rotated ninety degrees from its horizontal plane, and the sky above it—both a part of the middle stratum of that universe—occupy most of the painting. Within the sky above Meru are the sun, the moon, and the five visible planets, their associated deities, and Rāhu and Ketu (deities associated with eclipses). The artifact is gouache on paper (?), from Deccan or Tamil Nadu, ca. 1750.
Size of the original: 160 × 48 cm. Courtesy of the Board of Trustees of the Victoria and Albert Museum, London (I.S. 09329).

Bastian in 1892, but this larger work was not visible in the library in 1984.[63] The purposes of the painting, as of many other cosmographies, were obviously both didactic and eschatological. But the emphasis appears to have been more on the world and the actions of ordinary mortals than is the case with other works previously discussed. The painting deals not only with the various components of the Brahmanical Hindu universe and their associated deities, sacred trees, animals, and other denizens, but also with the zodiac, various types of sacrifice, important pilgrimage places (pictured in four groups, by region, for the whole of India), virtuous and evil acts and their rewards and punishments, types of rebirth, and types of hell. Since Bastian provides a very full account of this work and a pen-and-ink outline showing the spatial relationship of its several parts, I shall not discuss it further.

In several of the Hindu cosmographies described to this point, I have noted the placement of major and lesser deities within various portions of the cosmos; but to the Hindu mind it would also be no less appropriate to show the cosmos within a particular deity. Plate 25 shows one among many similar artistic interpretations of that potentiality. It is inspired by an episode recounted in the *Bhagavadgītā* section of the *Mahābhārata* during which Lord Krishna demonstrates his power to the hesitant warrior Arjuna by making the whole universe appear within his body.[64]

In fact, there is much in this illustration—despite what is stated above—that is situated outside the body of Krishna, including what seems to be the equivalent of the oblong sheaths of the universe noted in figures 16.8 and 16.10. I am not able to provide the meaning of these other elements.

That the universe is shown in plate 25 as resting on a snake and in other views on a tortoise or even on a snake supported by a tortoise serves to underscore the variety and inconsistencies within Hindu mythology and the latitude that artists and art historians enjoy in portraying and interpreting it. The tortoise, we have seen, was a minor element in several cosmographies, but it also occupies a principal position, as noted above, in the *kūrmavibhāga* texts.

Apart from the reconstruction of the *kūrmacakra* (fig. 16.4), I have seen no cosmography in which the various components of the *kūrmavibhāga* are delineated. But from Nepal we do have a relevant painting (fig. 16.11)

63. Bastian, *Ideale Welten*, vol. 1, pl. 1 (note 5). The basis for assigning this painting to the eighteenth century lies in its mention in a catalog of the collections of the library prepared with the assistance of one "Scharfoji Raja," said to be a student of the German missionary Schwarz, who worked in Tanjore in the latter half of the eighteenth century (noted by Bastian, 1:273).

64. Aman Nath and Francis Wacziarg, *Arts and Crafts of Rajasthan* (London: Thames and Hudson; New York: Mapin International, 1987), 167–68.

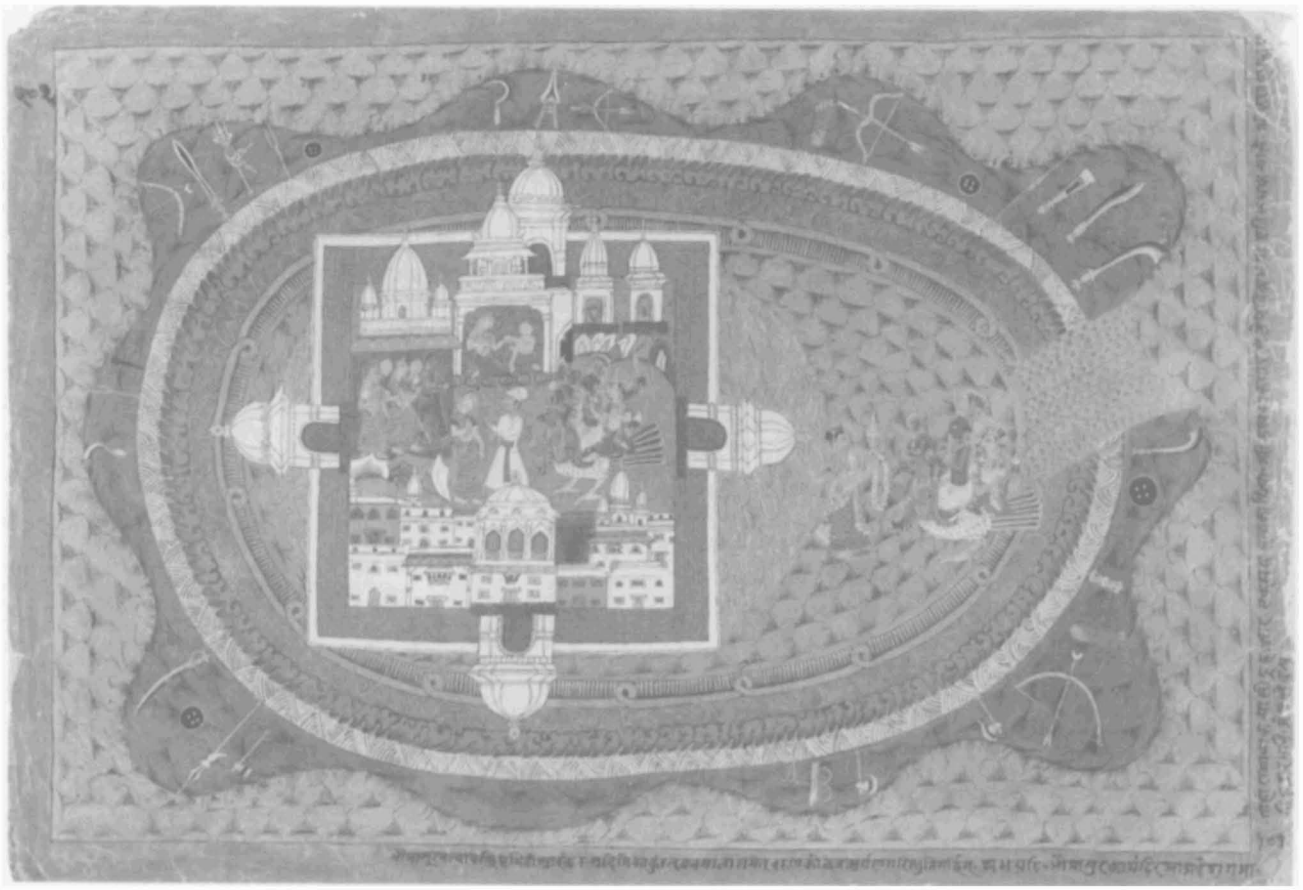


FIG. 16.11. KRISHNA AND HIS CONSORT DESCEND TO PRĀGJYOTIṢA (ASSAM), SITUATED ON A TORTOISE-SHAPED EARTH. This delightful painting, gouache on paper, Nepali, eighteenth century, is from one of many printed recensions of the *Bhāgavata Purāṇa*, recounting some of the exploits of Lord Krishna. It combines the cosmographic conception of a tortoise-shaped earth with the idea of concentric ring continents and oceans.
Size of the original: 38.1 × 55.8 cm. By permission of the Los Angeles County Museum of Art (M.72.3.1), gift of the Michael J. Connel Foundation.

from an eighteenth-century illustrated recension of portions of the *Bhāgavata Purāṇa*, a text dating from the eighth century that recounts the life of Lord Krishna. The scene depicts Krishna with his consort, descending from the sky on his avian mount to the palace of the demon Narakāsura, king of Prāgjyotiṣa (modern Assam). The palace is here placed on the back of a tortoise, which is symbolic of the earth as a whole.[65] A noteworthy feature of the painting is its inclusion of two peripheral ring oceans (one in blue swirls and the other in a white basket-weave pattern) separated by a ring of red mountains as well as an inner ocean (in a blue basket-weave pattern) on which the palace rests. Thus it does incorporate in an altered form some of the elements that have been previously noted in Hindu cosmographies.

Innumerable paintings of this type, in which individual cosmographic elements—Mount Meru, Mount Kailāsa, the Gaṅgā (Ganges) River, a particular celestial abode, and so forth—form a major component, appear in South Asian art. Comparable works are also common in sculpture. Regrettably, even a general inventory of works that have been published was deemed not to be practicable in compiling this history.

From various places in Rajasthan come a group of generically similar geometric diagrams that may be regarded as essentially cosmographic even though the names they contain relate largely, if not entirely, to terrestrial localities distributed over regions that vary widely in extent. Four of these were brought to light by Gole,

65. Pratapaditya Pal, *Art of Nepal: A Catalogue of the Los Angeles County Museum of Art Collection* (Berkeley: Los Angeles County Museum of Art in association with University of California Press, 1985), large color plate P35b on p. 77, illustration on p. 228, and caption on 229; also idem, *Nepal: Where the Gods Are Young* ([New York]: Asia Society, [1975]), fig. 85b (p. 114), and text on 133.

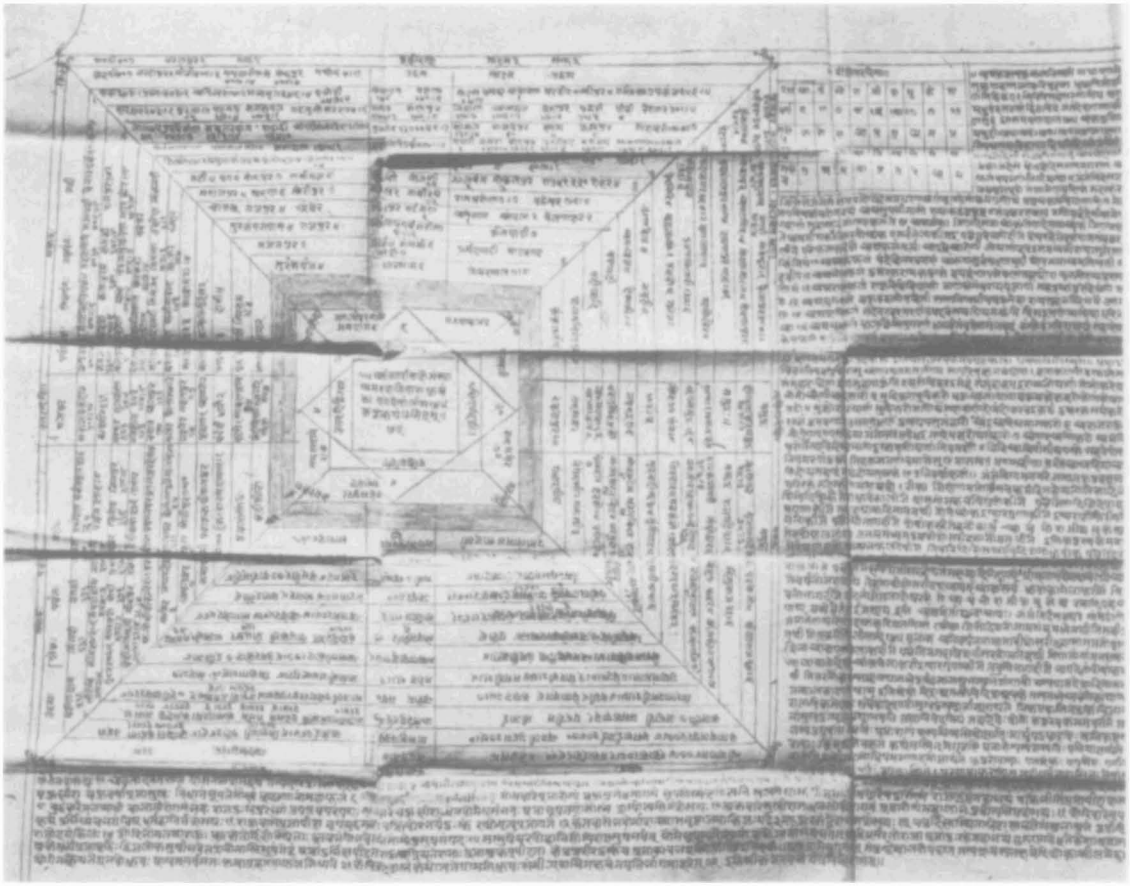


FIG. 16.12. SQUARE FORM OF DIVINATION CHART CENTERED ON AVANTI (UJJAIN). The provenance and date of this chart are unknown, but it is probably from Rajasthan. Charts of this type were and still are used to determine when certain named areas depicted in cardinal and intermediate directions from the central point would be under inauspicious influences from various heavenly bodies. Thus they would guide their users not to undertake activities in or with respect to those areas at particular times. East on such charts is invariably at the top, but relative distances and directions of the named places are not as a rule geographically accurate. What is mapped here is a set of relationships between forces operating within the macrocosm and a portion of the earth.
Size of the original: 30 × 40 cm. By permission of the Rajasthan Oriental Research Institute, Jodhpur (acc. no. 21277). Photograph courtesy of Susan Gole, London.

and a fifth was sent to me by Ram Charan Sharma in a letter suggesting that other similar works exist.[66] At least two of the four published diagrams appear to have a purpose similar to that of the *kūrmavibhāga* and other *cakra*s described above. One of these appears as figure 16.12. On this diagram, described as a *phalcakra*, and on one other, the sacred city of Avanti (modern Ujjain) occupies the center of the square. On the remaining two diagrams the central places are Jaipur and the small Rajasthani town of Sojat. Outward from the central place the squares are divided into more or less evenly spaced registers and also into directional fields corresponding to the four cardinal directions, all of which are named, and either four or eight intermediate directions. East is invariably at the top. Within each register appear a number of place-names, but the actual geographic direction of the place-names with respect to the focal location frequently does not accord, even approximately, with the direction given by the diagram, and similar discordances were evident concerning the areas signified by the various directionally designated parts of the *kūrmavibhāga*. Relative distance relationships with respect to the focal place are also unreliably presented.

In the second of the two Avanti-centered *phalcakra*s she describes, Gole provides a selective list of places and

66. Susan Gole, *Indian Maps and Plans: From Earliest Times to the Advent of European Surveys* (New Delhi: Manohar Publications, 1989), 23–24 and 50–53. The specific maps illustrated are from: (*a*) the Rajasthan Oriental Research Institute, Jodhpur, Acc. 21277, cloth, ca. 40 × 30 cm, in Hindi, undated; (*b*) the S. R. C. [Sri Ram Charan] Museum of Indology in Jaipur, uncataloged, paper (partially missing), 32 × 41 cm, in Hindi, dated Samvat 1785 (A.D. 1728); (*c*) Rajasthan Shodh Sansthan, Jodhpur, cat. no. 231, paper, 19 × 16.5 cm, in Rajasthani, late seventeenth century; and (*d*) from the publication *Hitaishi*, 1941–42, paper, 30 × 30 cm, in Dhundari (a Rajasthani dialect), date of original unknown.

directions from among the much larger number actually shown. Listed below are the places on her list that could be identified, followed (in parentheses) by the approximate azimuths from Avanti of the directions and places cited:

North (0°): Kedaram (Kedarnath?, 20°)
Northeast (45°): Mathura (20°), Gwalior (35°)
East (90°): no location cited
Southeast (135°): Champāner (250°)
South (180°): Mecca (275°), Hinglaj (285°), Shiraz (300°)
West (270°): Dhar (215°)
Northwest (315°): Bikaner (335°), Kabul (335°), Nagarkot (modern Nagrota, 5°)

This list of places is noteworthy in that in addition to such sacred Hindu places as Kedarnath, Mathura, and Hinglaj (now in the Pakistani province of Baluchistan), it includes such prominent and distant Islamic cities as Mecca, Shiraz, and Kabul. This leads one to speculate on the reasons for including certain places within such diagrams and excluding others that are closer or more important. Conceivably, the specific content of the chart may be determined by the needs and travel patterns of the client who had it prepared. In the case just discussed, that individual might have been a Hindu trader who was concerned not only with pilgrimages to holy places in India but also with long-distance commerce with Afghanistan, Iran, and Arabia. In earlier days royal patrons concerned about the likely efficacy of military campaigns in directions away from their capital were undoubtedly among those for whom *phalcakra*s were prepared.

The smallest and simplest of the four charts Gole illustrates is centered on the ancient fortress town of Sojat, in the Marwar region of Rajasthan. This town also figures prominently in an important topographic map discussed in the following chapter (figs. 17.17 and 17.18). The chart comes from a manuscript of historical tales dated Samvat 1703 (A.D. 1659) and shows several dozen villages grouped in twelve directions from the focal town, some of which Gole has been able to trace on modern Survey of India maps. The most recent of the four charts, based on Jaipur, was published in 1941 or 1942 but very likely is a redrawing of an older original. It appears to contain more information than any of the others discussed and "gives the distance in *cos* beside each name, and the ownership of each *jagir* (assignment of land, or the revenue from it), [and hence] might have been made for revenue purposes."[67]

The map Sharma sent to me (fig. 16.13) resembles those published by Gole in some respects and differs significantly in others. Sharma's letter describes it as follows: "Rare old map of India indicating Mountains, Rivers, Cities in twenty-four sub-directions of main eight directions. 250 years old 'Jaipur Rashi Chakra' [*rāśi cākra* = zodiac] is included in this old map. It starts from Ujjain in centre."[68] The dimensions of the work are not known, but judging from the size of what appears to be a window grating against which it was placed for photographing, it might be on the order of 1 by 1.5 meters. Rendered in black and red ink on paper (probably several pieces pasted together), the map proper occupies about two-thirds of the field it was drawn on. Above it are twenty-one lines of Sanskrit text, in two columns. Although these are partially illegible and have yet to be translated, they begin

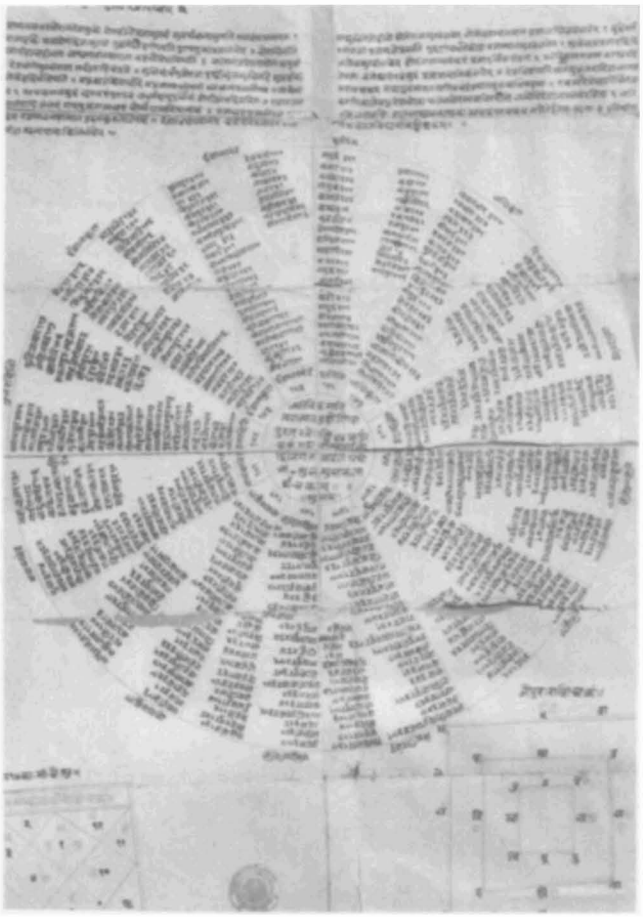


FIG. 16.13. CIRCULAR FORM OF DIVINATION CHART CENTERED ON AVANTI (UJJAIN). This chart is gouache and ink on paper, Rajasthani, eighteenth century. The general purpose and the manner of its construction and use are presumably similar to those of the more common square divination charts of the type illustrated in figure 16.12. The number of places named in this example, approximately four hundred, is particularly high.
Size of the original: not known. By permission of the S. R. C. [Sri Ram Charan] Museum of Indology, Jaipur.

67. Gole, *Indian Maps and Plans*, 53 (note 66).

68. Letter dated 14 September 1989 from Ram Charan Sharma "Vyakul," founder and director of the S. R. C. Museum of Indology in Jaipur, where the map is held. The map was sent in the form of a color photograph, 12.7 × 17.5 cm.

with a conventional invocation to Gaṇeśa, the god who brings good fortune. A standard horoscopic chart occupies the lower left corner of the field, and in the lower right are three nested squares, with a series of Sanskrit initials written along the sides of each. These initials include both simple letters and vowel-consonant compounds. They are not arranged symmetrically but are partially in the auspicious form of a swastika. The three squares may serve the same function as the successive registers of the four maps previously described.

The principal way the map proper differs from those described earlier is in its circular, rather than square, form. The approximately four hundred names displayed on it are arranged in twelve spokelike fields, radiating outward from the map's central circular field, in which eight short lines of text are written. This partly illegible text, which has not been translated, begins with the name of the legendary king Vikramāditya, conqueror of Avanti (Ujjain), after whom the widely used Vikrama era (beginning in 58 B.C.) is named. Four of the map spokes are labeled with the cardinal directions, with east at the top of the map. Between each pair of cardinal directions are two spokes, one with a name ending in the suffix *-kun* (?) and the other, invariably clockwise from it, ending in the suffix *-khaṇḍa* (region). The rest of the name is derived from that of one of the Dikpālas, the gods who preside over the cardinal and intermediate directions. On the map under discussion, only the deities for the intermediate directions are identified. As an example, beginning with the eastern map spoke and proceeding clockwise, we have Pūrvadishi (toward the east); Agnikun and Agnikhaṇḍa (the *kun* and *khaṇḍa* of the Dikpāla Agni, the fire god who presides over the southeast); Dakṣiṇadishi (toward the south); and so forth. The twenty-four "subdirections" Sharma alludes to derive from the fact that each of the twelve spokes contains two columns of names, a long one averaging about twenty-one names, extending from the center to the circumference, and a short one averaging about a dozen names, adjacent to it clockwise and ending at the map's outer edge. Apart from length, there is no obvious difference in the nature of the two columns. Next to each name is a number, and there are a few instances where numbers appear next to a blank space. The numbers occur in no apparent order. Not all names or numbers can be read, but among the great majority that can be, the numbers range from 2 to 400, seemingly with no repetitions. The twelve spokes are also numbered (starting from the east and proceeding clockwise) as follows: 146, 147, 147, 148, 148, 148, 150, 151, 151, 152, 153, and 153.

It seems reasonable to assume that each of the twelve spokes of this map represents one of the zodiacal mansions, that the places named within each spoke are those most affected (presumably malignly) when a particular zodiacal sign is in the ascendent, and that the numbers joined to the names have some sort of numerological or calendrical significance. Inspection rules out the possibility that distances from either Ujjain or Jaipur are indicated. Very likely they are used, in combination with the zodiacal signs and the initial letters on the chart in the lower right corner, in formulas that indicate the auspiciousness or inauspiciousness of given directions and places at particular times. We see here a likely parallel between this map (and others of its genre) and the various divination practices described in the introductory section of this chapter in respect to the *kūrmavibhāga* and the village rites described by Raheja (p. 339). As in the case of the Avanti (Ujjain)-centered map analyzed above, there is no evident relation here between the actual azimuths of the identifiable places named and their directions from the center of the map.

Among the readable names that I could recognize (perhaps a fifth of the total) were places in all quarters of the Indian subcontinent, including a number at present in Pakistan, but none from beyond the historical limits of India. There is, however, a distinct bias toward the north and the west. If, as might be surmised, a greater number of the unrecognizable toponyms are those of insignificant places in the north and west of India, then the bias just noted would be even more pronounced. Most of the recognizable names are of cities and towns, a number signify specific rivers or other physical features, and a few are regional designations. Among the names on the map are a number of generic designations, the most common being *samudra* (sea), listed no fewer than nine times and in no apparent order. *Parvata* (mountain) appears twice and *garh* (fort) three times. But no case of a repeated proper name was noted. Who might have commissioned this enigmatic map, and why, has yet to be ascertained.[69]

David Pingree, who saw poor copies of each of the four charts illustrated by Gole before their publication, expressed the opinion that despite their similarities in appearance and area of provenance, the charts are not all of the same type. The two that are centered on Avanti (and presumably the one transmitted by Sharma as well), he writes, seem "similar in principle to the *cakras* in the *Narapatijayacaryā* . . . [while the others] are quite different."[70] Conceivably, then, the divinatory charts of the former type became sufficiently popular in Rajasthan, and gained enough of a vogue as a medium for portraying spatial data, that their form was copied even when the purpose to be served had little or nothing to do with divination. Additional research on this uniquely Indian cartographic genre is obviously needed.

69. The assistance of Richa Nagar, who transliterated the toponyms of the map, and of William Malandra, who helped in interpreting some of the text and symbolism, is gratefully acknowledged.

70. Personal communication, 21 December 1988.

COSMOGRAPHIC GLOBES

Apart from painted cosmographies, a half-dozen cosmographic globes (*bhūgolas*), all based largely on Puranic texts, are known to exist. Of these, I studied five before preparing the following account. These are of types described by Hindu astronomers, as far back as Āryabhaṭa (b. A.D. 476).[71] Two of these five globes are found today at the British Museum in London, and one each are at the Victoria and Albert Museum, also in London; the Museum of the History of Science at Oxford; and the Bharat Kala Bhavan in Varanasi. I shall refer to them henceforth as the BM(A), BM(B), VA, Oxford, and BKB globes. The sixth globe was reported to Gole by N. P. Joshi of the Archaeological Survey of India, who saw it in an Indian village whose location I do not know.[72]

The simplest of the five globes studied, the VA globe, is a solid wooden sphere, about nineteen centimeters in diameter (fig. 16.14). This globe is believed to have been made in Orissa in the early to mid-nineteenth century.[73] On it land is colored mainly in yellow, mountain ranges in a lighter peach tone, rivers in white, oceans in several colors, among which gray is most common, and text in red.

The northern hemisphere of this globe shows Jambūdvīpa according to the four-continent earth conception (*catur-dvīpa vasumatī*). It is depicted by a lotus with four petals whose tips virtually reach the equator. East-west mountain ranges extend across each petal: there are three ranges on each of two petals (those that appear to be centered on 0° and 180° longitude) and only one on each of the others (those that appear to be centered on 90° east and west longitude). The northernmost and southernmost of the former set of ranges are shown as forested. Near what would be the northern pole, a circle within a square denotes Mount Meru, and that appears within a larger square just north of the northernmost mountain ranges. From near Mount Meru, originating within the larger square, rivers flow southward through the middle of each continent. Painted in the four inlets of ocean that separate the northern hemisphere continents are aquatic animals, boats, and four white palaces signifying the cities of Laṅkā, Romaka, Siddhapura, and Yamakoṭi, described by astronomers as occupying cardinal points on the equator.[74] The southern hemisphere differs completely from the northern. With its six ring continents and intervening oceans, it is essentially like that of the four globes still to be discussed. Interestingly, three of the southern ring oceans are in colors other than the prevailing gray—tan, pink, and turquoise.

Substantial text, written in a rather tiny Devanagari script, appears on the globe, but neither transliterations nor translations are available at present. Finally, there are unnumbered black tick marks at five-degree intervals along the prime meridian, along another meridian approximately 150 degrees to the west (in the northern hemisphere only), and around the equator.

Much older and more interesting than the preceding globe is a not-quite-spherical thin brass container on which is inscribed not only a hybrid cosmography, but also a wealth of minute pictorial detail and text in Devanagari script. This artifact (plate 26), held by the Museum of the History of Science at Oxford, has been the object of detailed scholarly scrutiny by Simon Digby, who considers it not only from the perspective of traditional Indian cosmology, but also as an art historian.[75] Supplementing Digby's observations are a pair of diagrams kept within the sphere that provide a complete inventory of the regional features it portrays. Many of these features are also found on the BKB globe (fig. 16.15 below), to which Digby's observations also are largely applicable.

Rather exceptionally, the creator of the *bhūgola* at Oxford, one Kṣemakarṇa, undoubtedly a Brahman, inscribed on it both his own name and the date of his work, Śaka 1493 (A.D. 1571). The area of provenance, however, is not known. Digby presents evidence for several possibilities but seems to favor the view that the globe was fashioned for a wealthy patron from Saurashtra. He also suggests that the globe's function was primarily utilitarian, probably for storing food or condiments, and that "the depiction of the regions of the earth upon it was an elegant conceit suggested by its shape."[76]

The mean equatorial diameter of the *bhūgola* is about 26 centimeters, and its height 22 centimeters. Joined by a hinge at the equator, both hemispheres are slightly flattened, but the northern one, though essentially round, comes to a rather gently sloping polar peak. Tick marks at one-degree intervals are inscribed around the equator,

71. For the reference to descriptions by astronomers of globes of this type I am indebted to David Pingree (personal communication, 21 December 1988).

72. In addition to the six globes noted in this paragraph, numerous celestial globes of Indian provenance are to be found in museums in South Asia, Europe, and North America. There is also one eighteenth-century wooden globe in Jaipur, with text in Sanskrit, that appears to be adapted from a European prototype. It will be discussed briefly in the chapter on geographical mapping below.

73. Simon Digby, "The Bhūgola of Kśema Karṇa: A Dated Sixteenth Century Piece of Indian Metalware," *AARP* (*Art and Archaeology Research Papers*) 4 (1973): 10–31, esp. 12–13; Gole, *Indian Maps and Plans*, 26 (note 66); Rawson, *Art of Tantra*, fig. 125 (p. 149) (note 56).

74. These identifications were made by David Pingree (personal communication, 21 December 1988).

75. A substantially greater part of Digby's analysis ("Bhūgola" [note 73]) relates to the art-historical aspects of the globe rather than to the cosmographic aspects. The work is also briefly described by Gole, *Indian Maps and Plans*, 26 and 74 (note 66). Digby's article is illustrated abundantly, though not especially well, in black and white; Gole's presentation includes a single, but very clear, color illustration.

76. Digby, "Bhūgola," 10 (note 73).

FIG. 16.14. COSMOLOGICAL GLOBE. This relatively simple globe, painted on wood, dates from the early to mid-nineteenth century. The northern hemisphere conforms closely to the *catur-dvīpa vasumatī* (four-continent earth) conception depicted in figure 16.1, while the southern hemisphere reflects the *sapta-dvīpa vasumatī* (seven-continent) concept illustrated by figure 16.2.
Diameter of the original: ca. 19 cm. Courtesy of the Board of Trustees of the Victoria and Albert Museum, London (I.M. 499-1924).

and small circles are etched in at ninety-degree intervals. The *bhūgola*'s cosmography draws primarily on Puranic sources but modifies their content in light of knowledge derived from post-Ptolemaic Sanskrit astronomers, reconciling the two "in an unscriptural but rational manner."[77] The upper half of the container represents the continent of Jambūdvīpa, and the subequatorial remainder, except for the anomalously positioned islands of Laṅkā and Palaṅkā (= ?), is given over to the other six ring-shaped continents and their intervening oceans in concentric latitudinal bands. These continents necessarily diminish in size toward the southern pole, "in contrast to the common Purānic account in which they increase in size by geometrical progression (2, 4, 8 . . .). As on the *bhūgola* the largest ring of land is the closest to the Equator, they also in fact enclose one another in inverse order to that prescribed in the Purānas."[78] Digby notes that "theoretical distances" are inscribed in *yojana*s at the equator, but not below it; but he neglects to indicate which features those distances apply to.[79] Meru—over which, astronomers reasoned, Dhruva (the Pole Star) was situated—is positioned at the northern pole rather than at the center of the four quarters of the world, which was the usual Puranic view. This placement meant that if the southernmost Puranic continent, Bhāratavarṣa (India), and the presumably northernmost Puranic continent, Uttarakuru, were to remain opposite one another, the latter would also have to be displaced to the equator 180 degrees away, longitudinally, from the former. And

77. Digby, "Bhūgola," 11 (note 73).
78. Digby, "Bhūgola," 12 (note 73).
79. Digby, "Bhūgola," 12 (note 73).

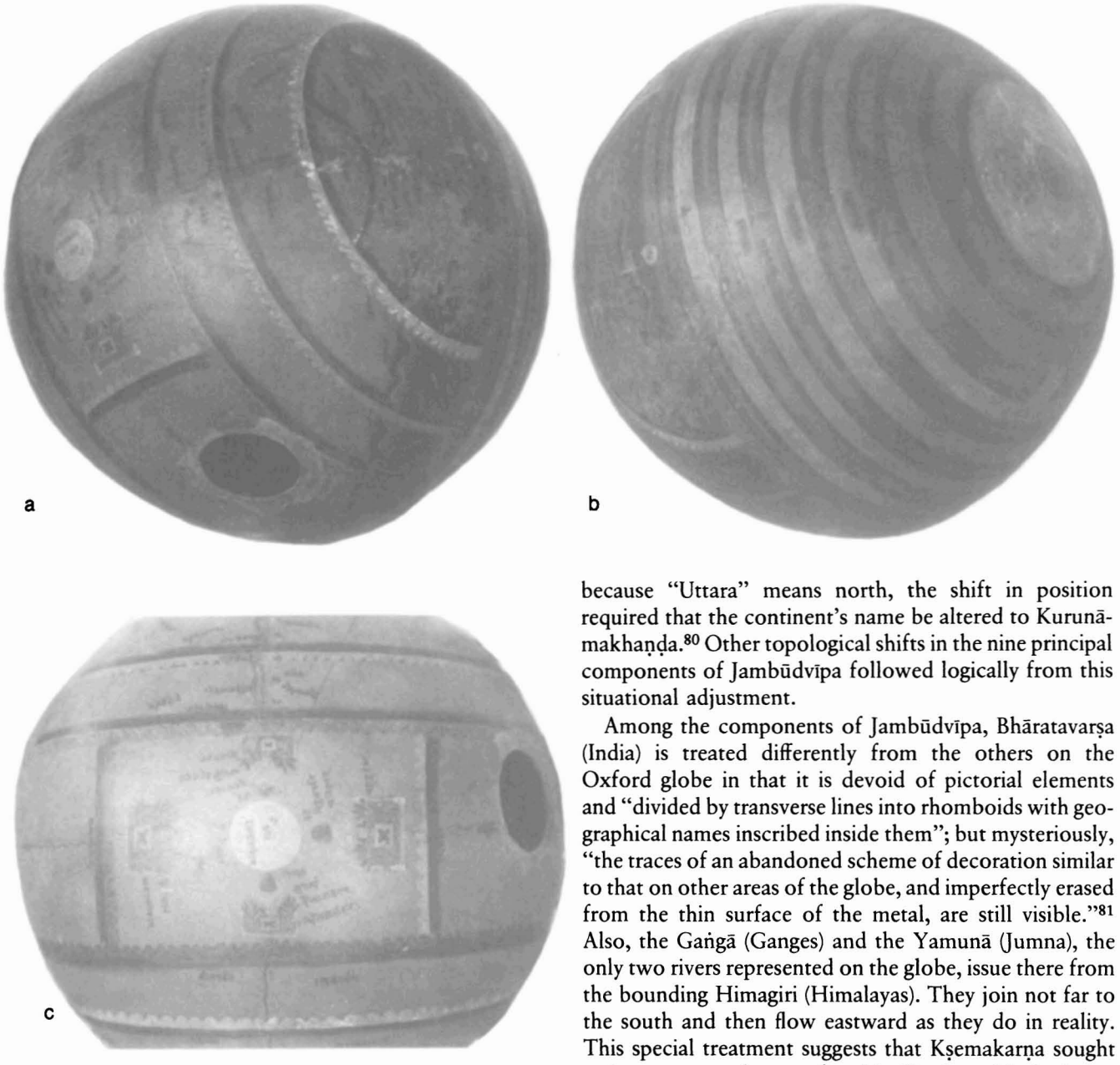


FIG. 16.15. COSMOGRAPHIC/GEOGRAPHIC GLOBE. Although its provenance within India is not known, this oil paint on papier-mâché globe is probably early eighteenth century. Though quite different in appearance, it is conceptually similar to the one portrayed in plate 26. Here I present several perspectives: (*a*) View of most of the northern hemisphere. Mount Meru is the bright circle at center left and Bhāratavarṣa (India) the semicircular region at right. (*b*) View of six concentric ring continents of the southern hemisphere, with Bhāratavarṣa at the far left. (*c*) View centered on Mount Meru (the northern pole) encompassing the continent of Ilāvṛtakhaṇḍa (the rectangular area around Meru) and neighboring continents. The Gaṅgā and Yamunā rivers flow toward the top of the picture. For an additional view of the portion of the globe providing geographic details of India and nearby regions, see plate 30.
Diameter of the original: ca. 45 cm. By permission of Bharat Kala Bhavan, Varanasi. Photographs by Joseph E. Schwartzberg.

because "Uttara" means north, the shift in position required that the continent's name be altered to Kurunāmakhaṇḍa.[80] Other topological shifts in the nine principal components of Jambūdvīpa followed logically from this situational adjustment.

Among the components of Jambūdvīpa, Bhāratavarṣa (India) is treated differently from the others on the Oxford globe in that it is devoid of pictorial elements and "divided by transverse lines into rhomboids with geographical names inscribed inside them"; but mysteriously, "the traces of an abandoned scheme of decoration similar to that on other areas of the globe, and imperfectly erased from the thin surface of the metal, are still visible."[81] Also, the Gaṅgā (Ganges) and the Yamunā (Jumna), the only two rivers represented on the globe, issue there from the bounding Himagiri (Himalayas). They join not far to the south and then flow eastward as they do in reality. This special treatment suggests that Kṣemakarṇa sought to impart some degree of verisimilitude to his depiction of India. But if so, that desire did not take him very far.

The nine rhomboidal regions (*khaṇḍas*) constituting Bhāratavarṣa include Kumārikākhaṇḍa, which the anonymous nineteenth-century transliterator/translator/interpreter of the *bhūgola*'s text identifies (mistakenly) with "N.W.P." (i.e., the former North-Western Provinces, merged with Oudh to form the United Provinces in 1877) and eight surrounding regions.[82] Proceeding clockwise from the north, the regions are Vāruṇakhaṇḍa,

80. Digby, "Bhūgola," 12 (note 73).
81. Digby, "Bhūgola," 13 (note 73).
82. Sircar, *Cosmography and Geography*, 54 (note 6), notes the Puranic division of Bhāratavarṣa into nine *khaṇḍas*.

designated as "the sea" because of the identification of the god Varuṇa with Neptune; Gāndharvakhaṇḍa, "where the Ganges flows"; Indrakhaṇḍa, identified as the "abode of mankind" (translating the accompanying Sanskrit gloss); Kaserukhaṇḍa; Tamrakhaṇḍa, "the copper portion"; Gabhastikhaṇḍa; Somakhaṇḍa; and Nāgakhaṇḍa (the region of snakes). In general these regions seem to be following lists enumerated in the early Puranas, but Kumārikākhaṇḍa is sometimes used synonymously with the whole of Bhāratavarṣa.[83] Not included among the nine regions of Bhāratavarṣa, but situated immediately to their south, is Laṅkā, the mythical geographic antecedent of which is well known. Within several of the regions are named specific places that exist in India to this day: Kurukṣetra (Kurukshetra), site of the legendary battle described in the *Mahābhārata* epic in Vāruṇakhaṇḍa (the sea; but there is no mention in the epic that the battle was fought on, or even near, the sea); the major temple town, Jagannath; and Dwarika (Dwarka), another key temple town in Nāgakhaṇḍa. All three are in locales that accord fairly well with their actual geographic locations: north, southeast, and northwest.

Though most of Digby's analysis relates to the pictorial elements of the *bhūgola*, here it suffices to note that those elements were mainly secular, as would be in keeping with the object's primarily nonreligious purpose. Objects depicted include dancers, musicians, a hunting scene, vegetation, secular architecture, furniture, and household goods. Yet minute images of deities, Shaivite sages, a temple in the jungle, and a temple cart are also shown. The deities seem mainly to occupy spaces on or fairly close to Meru, on whose summit are Brahma, Vishnu, and Rudra (an Apollo-like Vedic god). Shiva, flanked by prostrate devotees, appears elsewhere on the globe. Thus the work does not appear to be obviously associated with any particular branch of Hinduism.

The most detailed of the five globes studied in terms of both cosmographic and geographic detail is a work of unknown provenance, probably dating from the mid-eighteenth century, and now at the Bharat Kala Bhavan in Varanasi (fig. 16.15). Though the BKB globe was purchased from an art dealer in Jaipur, a Rajasthani origin for it seems out of the question because Amer (Amber), the capital of the important Kachwaha Rajput state before the construction of Jaipur, is badly misplotted, being placed in the Gaṅgā-Yamunā Doab. Other misplottings (to be discussed below, in the section on world maps) seem to rule out a northwest, west, or south Indian origin. On the other hand, the prominence given to Jagannath temple in the state of Orissa suggests that general region as a source area. But then, one wonders, if the nineteenth-century dating of the wooden VA globe (fig. 16.14), thought to be from Orissa, is correct, how could the much more sophisticated BKB globe, also thought to be east Indian, significantly predate it? In dating the globe, the omission of the name Jaipur (founded in 1728) and the inclusion of Amer are noteworthy, as is the inclusion of Calcutta (founded in 1690). One should not, however, conclude from these facts that the globe had to date from the period 1690–1728, for Jaipur would not have overshadowed Amer—at least in the minds of non-Rajasthanis—until some time after its founding, and it was not until near the middle of the eighteenth century that Calcutta became significantly more prominent than other European factories along the Hooghly River that are not indicated on the globe.

Although the globe is constructed without gores and appears to be a solid structure, it is in fact of fairly thin papier-mâché construction, only a few millimeters thick. The process entailed was: to make a large ball of string; to apply wet papier-mâché to it; to paint the dried papier-mâché as desired and add the script (all Devanagari) in ink; and finally, to remove the string from the globe through a preplanned hole in the surface. In many places the painting has chipped off and the writing has been worn away. Here and there changes in the original legends appear to have been made, which suggests that the globe received considerable use and was the object of discussion and possibly even controversy.

The essential point to make about the BKB globe is that conceptually it seems to differ little from the one at Oxford. In particular, it seeks to reconcile the received wisdom derived from the Puranas with the empirical data of subsequent astronomy.

That the two globes are as far removed from one another in time as they are (probably close to two centuries) and very likely also in space (assuming that the west Indian location of Saurashtra for the Oxford globe and a northeast Indian location for the BKB globe are correct) leads one to wonder if there was not among the pandits of India an enduring late and widespread cosmographic school of thought that was responsible for creating these two artifacts, the two BM globes (discussed below), and perhaps others yet to be found. Support for such a position is provided by the existence at the Bhandarkar Oriental Research Institute at Pune of an undated series of six ink drawings on paper (fig. 16.16) that are simply labeled "six geographical charts," but seem to provide a nearly perfect fit for the BKB globe.[84]

The chief difference between the BKB and Oxford globes is the wealth of real-world geographic detail on the former, even though almost all of that detail is confined to Bhāratavarṣa (India) and nearby regions. Like the Oxford globe, the BKB *bhūgola* has six concentric ring

83. Sircar, *Cosmography and Geography*, 33–34, 54, and passim (note 6).

84. Cataloged as item no. 93 of 1907–15, New No. Section 18.

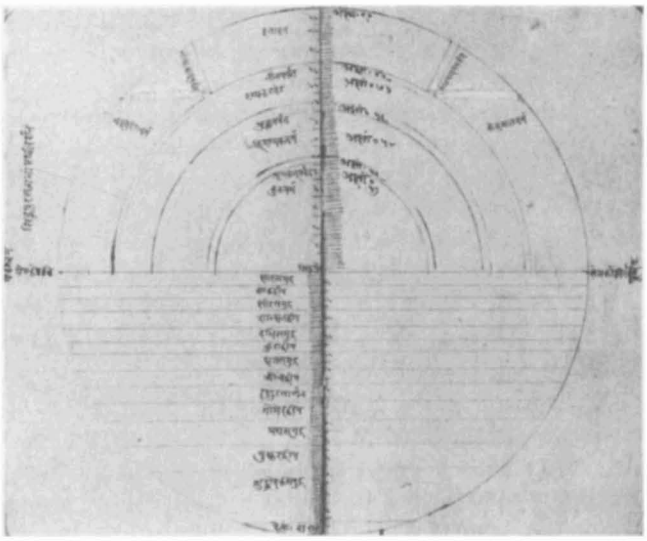


FIG. 16.16. PROJECTION FOR A COSMOLOGICAL GLOBE. This drawing is undated (nineteenth century?), and its provenance is unknown. It is one of a collection of six perspectives, all in ink on paper. The set of diagrams, though of a much later date than the globes illustrated in plate 26 and figure 16.15, would have served admirably as a guide to their construction. It suggests the existence of some unknown text prescribing the latitudinal and longitudinal limits used to delineate the major components of the globes.
Diameter of the original: 23.7 cm; size of folio: 28.5 × 24 cm. By permission of Bhandarkar Oriental Research Institute, Pune.

continents with intervening seas ranged south of the equator, and the seventh continent of Jambūdvīpa, with nine principal subdivisions, occupying the whole of the northern hemisphere. The number of toponyms and the amount of place detail, both real and mythological, it contains appear to be far greater, and it is relatively lacking in pictorial content. Few of the images it does contain (and none in the northern hemisphere) are of deities or of an anthropomorphic nature. But from a more narrowly cartographic point of view, the principal difference is that the major geographical divisions of the BKB globe are laid out with a concern for exactitude in their latitudinal and longitudinal limits. This is clear because the globe includes an equator ticked off in one-degree segments, numbered every five degrees, and a similarly graduated prime meridian extending from the northern pole at Sumeru (Mount Meru), through Ujjain, the Indian city whose observatory provides the prime meridian for Hindu astronomy, to Laṅkā on the equator.[85]

An especially noteworthy feature of the BKB globe is its use of clear color conventions: light brown for undifferentiated areas of land, dark brown for mountains in the southern hemisphere and for coastlines, various colors for mountains in the northern hemisphere (e.g., white for Himachal, the Himalayas), blue for rivers, ivory for oceans in the southern hemisphere, dark blue for oceans in the northern hemisphere, text in dark brown, and important points and areas in gold. The important points/areas include: Sumeru (northern pole), Sumeruvaḍavānala (southern pole), Laṅkā (centered at 0°, 0°), Yamakoṭi (0°, 90°E), Romakapattana (Rome, 0°, 90°W), and Siddhapura (0°, 180°) (cf. the four cities depicted on the VA globe). And as with the Oxford globe, Uttarakuru, the northern continent of the Puranas, is shifted so that it becomes the western continent, Uttarakurukhaṇḍa, just north of the equator and opposite Laṅkā, but without the rectification of the morpheme "uttara" (north) that we noted on the Oxford globe.[86]

In the northern hemisphere of the BKB globe, four lakes, each bordered by a characteristic tree, the eponymous trees of Jambūdvīpa, are ranged about Sumeru, centered at 0°, 90° east and west, and 180° of longitude. From each of these lakes, rivers flow due south along the respective meridians. Special treatment, however, is accorded the Gaṅgā and Yamunā, which flow along the prime meridian in close parallel courses (in each of the other quadrants there is only a single river) until, crossing the Himachal (at roughly 45°N)[87] and passing another unnamed range south of Kashmir, they turn more or less correctly to the southeast at Kurukṣetra, the legendary site of the great Mahābhārata war, not far northwest of Delhi. Other details will be provided below in the discussion of world maps.

A distinctive feature of the southern hemisphere is that on each of the ring island continents are seven named *parvata*s (mountains), from which named *nadī*s (rivers) flow into the sea. These *parvata*s are arranged in rows as if along seven spokes of a wheel extending toward the equator from Sumeruvaḍavānala. This recalls the seven spokes that created the twenty-one *loka*s depicted in figure 16.9.

Of particular interest are the figures depicted in the first

85. A peculiar aspect of the BKB globe is that it appears to be graduated into 365 degrees, rather than 360 degrees, along the equator. The explanation seems to be that round numbers—5, 10, etc.—are written in the middle of five-degree bands, with tick marks for each degree and an emphasized mark at every fifth degree; the series of numbers, however, starts with 0 and ends with 360, five degrees to its left, rather than coincident with the 0 band. Since the painting on this part of the globe appears to be retouched, and since the paint on part of the equatorial region to the west has flaked away, it is possible that the error just noted did not exist on the globe as it was originally painted.

86. I am indebted to Sarala Chopra of the Bharat Kala Bhavan, Varanasi, for her assistance in identifying the locations noted in this paragraph and those to be noted in subsequent discussion below of the geographic portion of this globe and also the many iconographic elements derived from Hindu mythology.

87. The latitude at which the symmetrical arc of the Himachal crosses the prime meridian appears to be 40°, but since the arc begins in the east from the equator at 45°E longitude (the paint is chipped away at the western terminus), it seems probable that the 40°N crossing of the prime meridian is an error and that 45° was in fact intended.

and second seas northward from the southern pole, regrettably too faint to be seen in figure 16.15*b*. In the southernmost sea, the Vaishnavite gods Nārāyaṇa and Lakṣmī (Vishnu's wife) also appear, seated on Śeṣa, the cosmic snake, who like the turtle Kūrma (and sometimes together with Kūrma) is thought to support the universe. In the second sea are Vishnu himself and associated symbols of Vaishnavism (e.g., elephant, seven-headed horse, conch, bow, water jar, moon, and wishing tree [*kalpavṛkṣa*]). In many Hindu legends, particularly some of a cosmogonic nature, Vishnu is associated with the ocean (e.g., the churning of the cosmic ocean, in which the snake, Śeṣa, serves as the rope and, in some accounts, Meru serves as the churning rod). This suggests that the BKB globe may have had a Vaishnavite connection.

The two most recent, the most similar, and the smallest of the five globes—BM(A) and BM(B)—are those in the Department of Oriental Antiquities at the British Museum.[88] Both are etched in metal, the BM(A) globe (figs. 16.17 and 16.18) in bronze and the BM(B) in copper. The former is dated Samvat 1915 (A.D. 1867). Although the latter bears no date, its similarity to the former suggests rough contemporaneity. Both globes were acquired by the museum in 1886. In neither case is the provenance known.

Conceptually, both globes resemble the ones at Oxford and the BKB but lack their elaborate ornamentation. The BM(A) globe, with equatorial and polar circumferences of 35.2 and 34.4 centimeters, is slightly larger than the BM(B), whose circumference is 30 centimeters, and somewhat more elaborate. Each globe originally consisted of two separately fabricated hemispheres welded together at the equator. But whereas BM(A) remains intact, with a seal that is virtually imperceptible, BM(B) has broken in two. This accident was fortuitous in that it provides a glimpse into the globe's interior, which had been filled with porous, vitreous slag. Molten slag was obviously poured into the globe through a hole in the north polar region that was subsequently plugged with a metal seal representing the region of Mount Meru. Given the weight of BM(A)—heavy, but not as heavy as if it were solid bronze—we may assume that its construction followed the same procedure as for BM(B).

Both globes abound in Sanskrit text, but none has as yet been translated. Hence all references to proper names in the description that follows are predicated on inferences based on the apparent analogies between these and other cosmographies, both globes and two-dimensional representations.

On both globes the partitioning of the northern and southern hemispheres is essentially like that of the Oxford globe, though the proportions differ. On the Oxford globe and on BM(B) the ring continents and oceans of the southern hemisphere are more or less equal

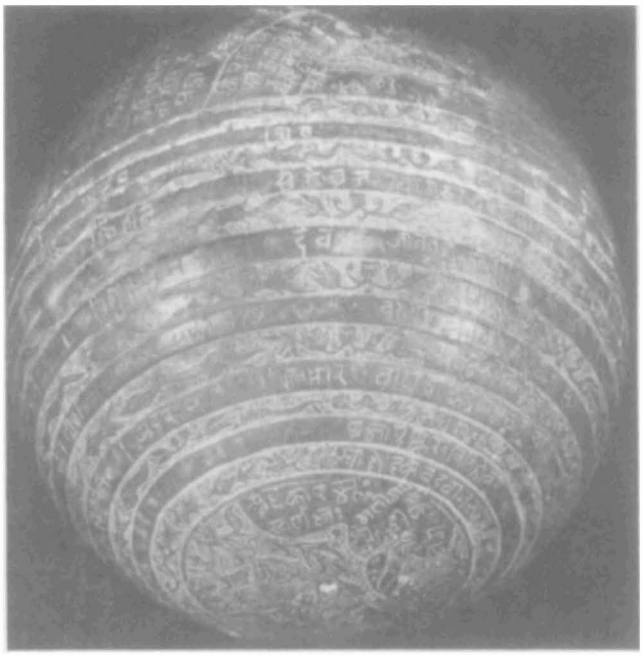


FIG. 16.17. SOUTHERN HEMISPHERE OF A COSMOGRAPHIC GLOBE. This globe is etched in bronze, cast in two hemispheres, and joined at the equator. Its provenance within India is unknown, and it is dated Samvat 1915 (A.D. 1867). This view depicts the seven concentric ring oceans and the intervening ring continents of the southern hemisphere. The former are identifiable by fish etched into the surface. In addition, one sees a small part of the northern hemisphere (compare fig. 16.18) in the upper portion of the photograph.
Equatorial circumference: 35.2 cm; diameter: 10.1 cm. By permission of the Trustees of the British Museum, Oriental Collections, London (cat. no. 86.11-27 1).

in width, except for the broader southernmost polar sea (covering about seventeen degrees of arc) on BM(B). On BM(A), however, the southern ring continents are about two-thirds the width of most of the ring oceans, while the south polar sea is inexplicably large, extending to what would be approximately 58°S latitude (probably intended as 60°S). A more fundamental difference lies in the etching on BM(A) of four continents, similar to those of the VA globe but more widely spaced, extending outward from Mount Meru like petals of a lotus, roughly halfway to the equator. These are superimposed on the basic layout of the Puranic conception presented in figure 16.3, and each petal continent (cf. figs. 15.3 and 16.1) extends beyond the limits of the continent/region of Ilāvṛta that surrounds Meru. An inexplicable peculiarity of the petal continents is that three of them come to points, whereas Ketumāla, the fourth (whose axis one might take as 90°W), has a distinctly different, blunt

88. I hereby express my gratitude to Simon Digby, who brought these globes to my attention. Their accession numbers are 86.11-27 1 and 86.11-27 2.

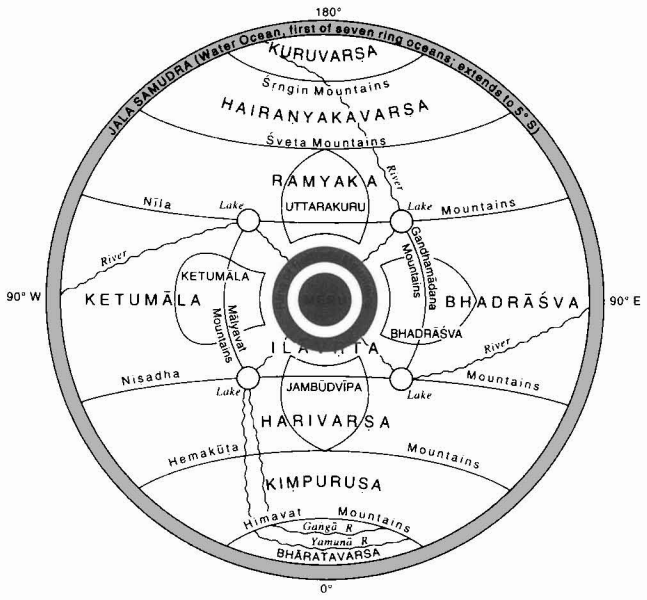


FIG. 16.18. ABSTRACT OF THE NORTHERN HEMISPHERE OF A COSMOGRAPHIC GLOBE. The northern hemisphere of the globe in figure 16.17 is represented here. It is shown in an azimuthal equal-area projection with Mount Meru centered on the northern pole. The depiction is my own freehand sketch, and the dimensions may vary slightly from those of the original. Since the Sanskrit text of the original has yet to be transliterated, the names of continents, mountain ranges, and rivers provided on this diagram are merely inferred, based on analogy to similarly positioned features in other known cosmographic maps, globes, and texts. Here the northern hemisphere appears essentially to be a conflation of the conceptions incorporated in the globes depicted in figure 16.14 and plate 26, which reflect in turn the early Brahmanic and later Puranic views represented in figures 16.1 and 16.3. Hence the dual indication of the names of the eastern and western continents Bhadrāśva and Ketumāla. No satisfactory explanation can be offered for the deviant shape of the inner of the two Ketumālas. The placement of Bhāratavarṣa (India) in the southern part of the hemisphere, centered on the Indian prime meridian, and the depiction therein of the Gaṅgā and Yamunā rivers are the globe's principal concessions to geographic reality.

shape.[89] Between the petal continents, four rivers run to circular lakes at the four corners of Ilāvṛta and then veer clockwise out of those lakes toward the equator, skirting the southern limits of the petal continents. Three of the rivers reach the equator at approximately 90°E, 180°, and 90°W, while the remaining river divides into what are presumably the Gaṅgā and the Yamunā, which flow across Harivarṣa and Kiṃpuruṣa to Bhāratavarṣa and then west to east across that continent without reaching the equator. Conspicuously missing on both globes are any features directly on the equator (e.g., Laṅkā at 0°, 0°).

On the whole, BM(B) presents a simpler picture in the northern hemisphere. While there is some indication of buttress mountain ranges on the four sides of Meru, the petal continents are absent, and beyond the lakes at the four corners of Ilāvṛta there are only two rivers that flow toward the equator, rather than the customary four—namely, those extended to Bhāratavarṣa and the near antipodal continent, which I have tentatively designated Kuruvarṣa on BM(A). Because the originally low relief on this globe has been further subdued by handling, interpreting its features is more difficult than for BM(A).

A final noteworthy difference between BM(A) and BM(B) is the etching on the former only of what I take to be eponymous trees (e.g., the *jambū* for Jambūdvīpa) in the petal continents, of fish and other sea creatures in the seven ring seas of the southern hemisphere, and in the Gaṅgā and Yamunā rivers.

CELESTIAL MAPPING

To speak of celestial mapping as a part of the cosmographical tradition of traditional Hindu culture is perhaps to extend the meaning of "mapping" beyond its customary limits. Nevertheless, attempts have been made, since ancient times, to present orderly graphic portrayals of portions of the heavens in painting, sculpture, and architecture. The relevant literature is extensive. It derives on the one hand from art historians and on the other from historians of astronomy, and I have studied and understood only a small portion of the total corpus and none of it from primary sources in Sanskrit and other Indian languages. Thus, in what follows I can do no more than to provide a brief sketch of a few of the means and forms by which attempts at celestial mapping, broadly conceived, have been carried out and to indicate something of the emergence on Indian soil of certain centers of observational astronomy that sought to arrive at more objective and accurate views of the heavens than those that sufficed for most religious purposes.

The development in India of anthropomorphic icons to represent heavenly bodies may be traced back to the time of the Kuṣāṇas (first century A.D.) in the case of Sūrya, the sun-god; to the mid-second century in the case of the planetary deities (*grahas*), including the sun and moon; and at least to the sixth and seventh centuries, respectively, in the cases of Rāhu and Ketu, the deities associated with eclipses. These "planetary deities," nine in all, were designated by the Sanskrit term *navagrahas* and were customarily portrayed in a fixed order, beginning with the seven that in turn exercised their lordship over the days of the week (sun, moon, Mars, Mercury, Jupiter, Venus, and Saturn) and ending with Rāhu and Ketu. They so appear in innumerable sculptures (espe-

89. Given the late date of the BM(A) globe (middle to late nineteenth century), it is conceivable that the great impact of the West on India through the British colonial presence led the globe maker to postulate that Ketumāla was qualitatively quite different from the other three petal continents.

cially on the lintels over the portals of temples), in paintings, and in other forms. Although their early manifestations would hardly be described as maps, we do find in later cosmographies, some of which are described below, the maintenance of both the icons and the order established in ancient times.[90]

Iconographic portrayals of astronomical phenomena were not confined to the *navagrahas*. "In some interesting paintings of the schools of Rajasthan and of Deccan we can see personifications of the lunar days (*tithi*), of the hours of good auspices (*muhūrta*), of the days of the week (*dina*, *vāra*), of the months (*māsa*), of the years (*varṣa*), of the stars (*nakṣatra*), of the signs of the zodiac (*rāśi*), etc. These are based on iconographic texts often reproduced in the same pictures."[91] Plate 27 provides a characteristic example of the way *nakṣatras* (groups of stars near the plane of the ecliptic separating various lunar mansions) have been portrayed in Rajasthan in recent centuries.[92]

Not all symbols used to represent astronomical features in painted cosmographies were pictorial. As Tantric Hinduism developed, its use of essentially geometric astronomical (and astrological) charting came to be quite important. This esoteric tradition has given rise to numerous rather varied and often complex astronomical drawings, many of which have recently found their way into semipopular art books. I have not found it possible to study the original sources, which are never cited in the works I have seen. Nor have I been able to translate the abundant text or interpret the mathematical formulas that characteristically accompany the published drawings. Thus I leave to future scholarship the necessary analysis and explication of this large and intriguing corpus.[93]

I referred above to a pair of huge cosmographic paintings in Mīnākṣī temple in the south Indian city of Madurai, both recent (1963 and 1966) replacements for accidentally destroyed works that were originally executed in 1568. One of this pair, entitled *Bhūgolam* (the earth) has already been described. The other (fig. 16.19), several meters to the left of it and of the same size (about 4.25 × 4.25 m), is designated *Khagolam* (the celestial dome). Although I am unable to interpret this painting with confidence, I suggest that much of it could correspond fairly well to the following summation, by Pingree, of a portion of the cosmological sections of various Puranas.

> Above the earth's surface and parallel to its base are a series of wheels the centers of which lie on the vertical axis of Meru, at the tip of which is located the North Polestar, Dhruva. The wheels, bearing the celestial bodies, are rotated by Brahma by means of bonds made of wind. The order of the celestial bodies varies; the earliest seems to be sun, moon, nakṣatras, and Saptarṣis (Ursa Major). Some *Purāṇas* place the grahas (planets) between the moon and the nakṣatras; in others, interpolated verses add Mercury, Venus, Mars, Jupiter, and Saturn (in that order) between the nakṣatras and the Saptarṣis.[94]

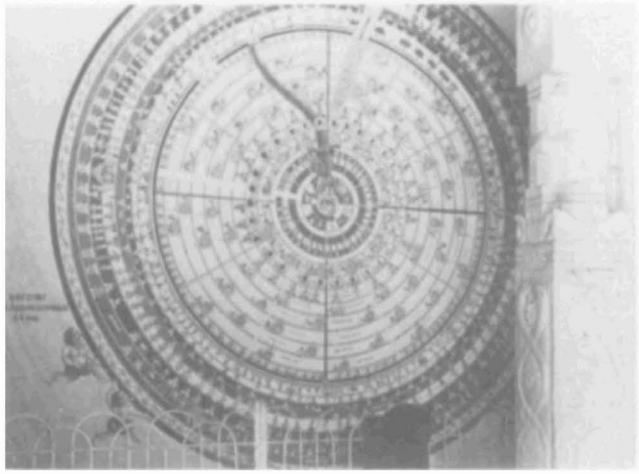


FIG. 16.19. *KHAGOLAM* (THE CELESTIAL DOME). This oil painting on canvas is in the waiting hall of Mīnākṣī temple, Madurai, Tamil Nadu. It is a repainting (1966) of an original dated 1568. This diagram is believed to represent, among other things, the twelve zodiacal months; the paths of the sun, moon, and five known planets; and presumably the ties of the celestial deities Rāhu and Ketu to other heavenly bodies.
Size of the original: approx. 4 × 4.5 m. Photograph by Joseph E. Schwartzberg.

Which of the many concentric circles shown in figure 16.19 represent the orbits (wheels) noted in the previous

90. Among studies that deal with the development of astronomical iconography, we may cite the following: Stephen Allen Markel, "Heavenly Bodies and Divine Images: The Origin and Early Development of Representation of the Nine Planets," *Annals of the Southeast Conference of the Association for Asian Studies*, vol. 9, twenty-seventh annual meeting at the University of Tennessee, Chattanooga, 15–17 January 1987, 128–33, esp. 129; idem, "The Origin and Early Development of the Nine Planetary Deities (*Navagraha*)" (Ph.D. diss., University of Michigan, 1989); Neven, *Peintures des Indes*, 19–21 (note 59); David Pingree, "Representation of the Planets in Indian Astrology," *Indo-Iranian Journal* 8 (1964–65): 249–67, esp. 249–50; Calambur Śivaramamurti, "Geographical and Chronological Factors in Indian Iconography," *Ancient India: Bulletin of the Archaeological Survey of India*, no. 6 (January 1950): 21–63, esp. 29–35; and idem, "Astronomy and Astrology: India" (note 18).

91. Śivaramamurti, "Astronomy and Astrology: India," 76 (note 18).

92. Similar views are presented in Ajit Mookerjee and Madhu Khanna, *The Tantric Way: Art, Science, Ritual* (London: Thames and Hudson, 1977), pl. 6 (102) and caption on 100, and Neven, *Peintures des Indes*, 21 (note 59).

93. Examples of the types of illustrations I am referring to here may be seen in the following works: Mookerjee and Khanna, *Tantric Way*, 99 (note 92); Mookerjee, *Tantra Art* (note 54); idem, *Tantra Asana* (note 60).

94. David Pingree, "A History of Mathematical Astronomy in India," in *Dictionary of Scientific Biography*, 16 vols., ed. Charles Coulston Gillispie (New York: Charles Scribner's Sons, 1970–80), 15:533–633, esp. 554.

description is uncertain. But it seems safe to assume that the male and female figures seated in the center of the painting represent the sun and the moon, respectively, and that the wheels for the planets occupy the relatively light space between the more central and more peripheral groups of concentric rings. Radiating outward from the center of the diagram are twelve spokes that may be described as like hour divisions of a clock. Presumably these are the divisions between the twelve zodiacal months. The spokes vary in color. Those at 1, 2, 4, 8, 10, and 11 o'clock are yellow, those at 5 and 7 o'clock white, and those at 3, 9, and 12 o'clock purple, blue, and red. Distributed over much of the painting are arabic numerals (in their Western form), which very likely indicate (as on Jain cosmographies to be discussed below) the dimensions of various portions of the cosmos or their distance from its central axis.

The snakelike figure extending upward from the center and somewhat to the left to just beyond the outermost planetary ring I take to be Rāhu, the causer of eclipses. Its open jaws appear about to swallow up the sun and the moon. Also extending upward from the center, through the light field of nine encompassing rings and slightly to the right, is a thick band that looks like a river, which perhaps represents Ketu. Rāhu's tail is tethered by seven (count not certain) fine lines (not discernible on the photograph), connected to various wheels (*grahas*?). All but one of these lines terminate in the upper half of the painting. One might suppose they are somehow associated with the "celestial bodies . . . rotated by . . . bonds made of wind" cited in the quotation from Pingree, but their tie to Rāhu, rather than Brahma, argues against such a conjecture. A final feature of note in this exceedingly complex cosmography is a gold pavilion at the very top of the wheel, possibly the abode from which Brahma observes his creation and regulates the mechanics of the entire cosmos. Despite marked differences in their appearance, I suggest a fairly close correspondence between many of the conceptions embodied in the diagram just described and in the upper, astronomical portion of the south Indian cosmography depicted in figure 16.10 and described above.

Not only are Indian temples repositories for astronomical paintings and sculpture, but in some instances the temple itself may be regarded as an astronomical artifact. Although a number of so-called astronomical temples are known to exist in India, which in various ways provide architectural reflections of a portion of the heavens, regrettably their analysis is beyond the scope of this study.[95]

None of the astronomical works I have discussed to this point has required, so far as I can discern, the use of carefully calibrated, scientific instruments or extended accurate measurements of celestial phenomena. Nevertheless, such instruments had been in use in India, mainly by Muslims, for centuries before the creation of most of the Hindu artifacts to which I have drawn attention. Despite opposition from some Brahman astronomers, however, Hindus did ultimately begin to construct and utilize astrolabes and celestial globes to some extent; but those instruments differed from their Islamic counterparts in little more than script and nomenclature.[96] This matter has been discussed above in considerable detail in the chapter on Islamic celestial mapping, and therefore there is no need to recapitulate the story here. I do not mean to suggest, of course, that astronomical instruments were of no concern to Indians before the advent of the Muslims, but they were of relatively little importance and their nature is not well known despite references to them in numerous surviving texts.[97] Space precludes discussing them further.

The earliest-known reference to an Indian observatory relates to one that apparently existed in what is now Kerala about A.D. 860. Its existence is implied by a commentary by Śaṅkaranārāyaṇa on a text known as the *Laghubhāskarīyavivaraṇa*. I quote the translation in full:

> (To the King): Oh Ravivarmadeva, now deign to tell us quickly, reading off from the armillary sphere installed (at the observatory) in Mahodayapura, duly fitted with all the relevant circles and with the Sign (-degree-minute) markings, the time of the rising point of the ecliptic (*lagna*) when the Sun is at 10° in the Sign of Capricorn, and also when the Sun is at the end of the Sign Libra, which I have noted.

95. Descriptions of astronomical temples may be found in Śivaramamurti, "Astronomy and Astrology: India" (note 18), and in Giuseppe Tucci, "A Visit to an 'Astronomical' Temple in India," *Journal of the Royal Asiatic Society of Great Britain and Ireland*, 1929, 247–58.

96. As Blanpied has observed, "The establishment of a truly Indian school of observational astronomy would . . . have had to involve Brahman astronomers who were recognized as such by the Hindus themselves. Although these Pandits made use of and interpreted the Islamic data which had infused into India, they were by tradition devoted to calculational rather than observational astronomy." He then cites al-Bīrūnī, who observed in the twelfth century that the Brahmans "cherish, of course, the most inveterate aversion towards all Muslims. This is the reason, too, why Hindu sciences have retired far away from those parts of the country conquered by us, and have fled to places which our hand cannot yet reach, to Kashmīr, Benares, and other places." William A. Blanpied, "The Astronomical Program of Raja Sawai Jai Singh II and Its Historical Context," *Japanese Studies in the History of Science*, no. 13 (1974): 87–126, quotations on 116, text and n. 97; the quotation of al-Bīrūnī is from *Alberuni's India*, 1:22 (note 25).

97. Scores of excerpts from such texts relating to instruments are quoted in the original language, together with translations, in B. V. Subbarayappa and K. V. Sarma, comps., *Indian Astronomy: A Source-Book (Based Primarily on Sanskrit Texts)* (Bombay: Nehru Centre, 1985), 74–80 (armillary spheres), 81–85 (observatories), and 86–99 (instruments). These excerpts range from two to thirty-six lines, and most, except for those on observatories, appear in verse form. Relatively few exceed ten lines.

Then again—

> Oh, Ravi, deign to tell us immediately, reading off from the armillary sphere, by means of the reverse *vilagna* method, the time for offering the daily oblations, when the Sun, shrouded under thick clouds, is 10° in the Sign Leo and also when it is the middle (i.e. 15°) in the Sign Sagittarius.[98]

But this quotation, if taken as proof that an observatory did indeed exist, may be no more than the exception that proves the rule in regard to observational astronomy; for we know of no additional Indian citation of a Hindu observatory until 1866, when, in his work *Mānamandira*, Bapudeva refers to the observatory constructed in Varanasi, approximately a century and a half earlier, by the celebrated polymath Raja Sawai Jai Singh II, whose astronomical achievements we shall now consider.[99]

Numerous studies have been written about Sawai Jai Singh (1686–1743) and his diversified scientific endeavors. For details about the physical characteristics of the four of his five observatories that have survived into the twentieth century, Kaye, despite being somewhat dated, remains an indispensable source, as is Blanpied's admirable critical historiographic analysis.[100] Given these and other works, many of them illustrated, it will not be necessary to touch on more than a few highlights to establish Jai Singh's place in the history of celestial mapping in South Asia.

Nominally a vassal of the Mughal emperor, and governor at times of the Mughal provinces of Agra and Malwa, Jai Singh was in effect a powerful and independent monarch in his own right. His mathematical and scientific bent became evident at a very early age, and his lifelong quest for knowledge, especially in astronomy and mathematics, was not constrained by barriers of culture. "Thus, although [he] was a Hindu who . . . subscribed publicly to Hindu cosmology, his emphasis on observational rather than on calculational astronomy, as well as a number of textual references, suggest that his observational program was influenced more by Islamic than by Hindu astronomy."[101]

Over the period from about 1722 to 1739, drawing upon his considerable influence and wealth, he supervised the construction and staffing of observatories at the Mughal capital of Delhi; his own new capital, Jaipur; Varanasi; Ujjain; and Mathura. The precise dates of construction of none of these are known, but there seems little doubt that the so-called Jantar Mantar (a corruption of yantra and mantra) in Delhi was first and Jaipur second. Of the five, that of Mathura is a total ruin and the one at Ujjain is in serious disrepair. The remaining three have undergone varying degrees of restoration. Jai Singh modeled his observatories largely on the one constructed in Samarkand in 1428 by his great Timurid predecessor Ulugh Beg, but the instruments installed in them, mainly masonry constructions, were hardly limited to those used in the fifteenth century. In fact, some of the most accurate and ingenious of the instruments were of Jai Singh's own design.[102] The massive scale of many of Jai Singh's instruments is attributable to his conviction that small instruments could not possibly yield satisfactory accuracy. In the preface to his *Zīj-i Muḥammad Shāhī* (New tables of Muḥammad Shāh [named for the then ruling Mughal emperor; hereafter referred to as the *Zīj*]), Jai Singh expresses himself (writing in the third person) on this and related points as follows:

> But finding that brass instruments did not come up to the ideas which he had formed of accuracy, because of the smallness of their size, the want of division into minutes, the shaking and wearing of their axes, the displacement of the centres of the circles, and the shifting of the planes of the instruments: he [Jai Singh] concluded that the reason why the determinations of the ancients, such as HIPPARCHUS and PTOLEMY proved inaccurate, must have been of this kind; therefore he constructed in . . . *Shāh-Jehanabad* [Delhi], which is the seat of empire and prosperity, instruments

98. Subbarayappa and Sarma, *Indian Astronomy*, 81 (note 97).

99. Subbarayappa and Sarma, *Indian Astronomy*, 81–85 (note 97). Blanpied, citing Dharampal, notes that various European travelers, allegedly including Jean-Baptiste Tavernier, who died in 1689, three years after Jai Singh's birth, were of the opinion that the Varanasi observatory predated that monarch. It has been variously attributed, though without proof, to Jai Singh's grandfather, who reigned from 1590 to 1614 and built in Varanasi the Man Mandir, on whose roof the observatory is situated; to 1680 (Tavernier); to the reign of the Mughal emperor Akbar (1556–1605); and to an even earlier but unspecified date. Blanpied also cites Gurjar's conjecture that "Jai Singh added his masonry instruments to what had been a small, conventional observatory established by one of his ancestors, perhaps by Man Singh himself" (Blanpied, "Astronomical Program," 96 [note 96]). See also Dharampal, *Indian Science and Technology in the Eighteenth Century: Some Contemporary European Accounts* (Delhi: Impex India, 1971), 1–91, including some reproductions of engravings indicating how the Varanasi observatory appeared to eighteenth-century European observers; and Laxman Vasudeo Gurjar, *Ancient Indian Mathematics and Vedha* ([Pune: S. G. Vidwans, Ideal Book Service], 1947), 177–78.

100. George Rusby Kaye, *A Guide to the Old Observatories at Delhi; Jaipur; Ujjain; Benares* (Calcutta: Superintendent Government Printing, India, 1920). This small but well-illustrated volume is an abridgement of Kaye's *The Astronomical Observatories of Jai Singh* (Calcutta: Superintendent Government Printing, India, 1918; reprinted Varanasi: Indological Book House, 1973). See also Blanpied, "Astronomical Program" (note 96). I am indebted to Emilie Savage-Smith for calling my attention to the highly valuable latter reference. Also very useful for its numerous photographs, technical details, and comparative analyses among observatories by type of instrument—though not well written—is Prahlad Singh, *Stone Observatories in India: Erected by Maharaja Sawai Jai Singh of Jaipur (1686–1748 A.D.) at Delhi, Jaipur, Ujjain, Varanasi, Mathura* (Varanasi: Bharata Manisha, 1978).

101. Blanpied, "Astronomical Program," 109 (note 96).

102. This account is compiled from particulars given in the sources cited in note 100.

> of his own invention, such as *Jey-pergás* [Light of Jai, a hemispheric dial, to be explained below] and *Ram-junter* [a circular instrument for measuring altitudes and azimuths] and *Semrat-junter* [Emperor of Instruments, an equinoctial sundial, Jai Singh's chief instrument], the semi-diameter of which is of eighteen cubits, and one minute on it is a barley-corn and a half; of stone and lime, of perfect stability, with attention to the rules of geometry, and adjustment to the meridian, and to the latitude of the place, and with care in the measuring and fixing of them: so that the inaccuracies, from the shaking of the circles, and the wearing of their axes, and displacement of their centres, and the inequality of the minutes, might be corrected.
>
> Thus, an accurate method of constructing an observatory was established; and the difference which had existed between the computed and observed places of the fixed stars and planets, by means of observing their mean motions and aberrations with such instruments, was removed.[103]

A point of this account that warrants particular note is that Jai Singh was most concerned with providing stability for his instruments. It is therefore hardly surprising that in four of his five observatories he had the ground leveled and carefully prepared for the instruments to be placed there. Only Varanasi, where the observatory was built on the roof of a palace built by Jai Singh's grandfather, Man Singh, was an exception. Although this proves nothing, it does lend circumstantial support to Gurjar's conjecture (cited in note 99) that this relatively small observatory was simply added onto another of even more modest proportions that was already in existence there.

Since the Jaipur observatory contains a wider array of extant instruments than any of the others, I provide in figure 16.20 a copy of the plan of it. Space precludes discussing these instruments in more detail, but a simple inventory will convey the sense of their diversity and of the uses they were put to. I list them below in the order in which they are discussed by Kaye.

1. Saṁraṭ Yantra, the largest instrument ever constructed by Jai Singh. It is an equinoctial dial consisting of a triangular gnomon, oriented along the local meridian, its hypotenuse is parallel to the earth's surface, with two attached quadrants. It measures nearly 90 feet high and 147 feet long, and its quadrants have radii of 49 feet, 10 inches. Though it is graduated to read to seconds, "this is impossible in practice, owing to the ill-defined shadow (due to the size of the penumbra)."[104]

2. Ṣaṣṭāṁśa Yantra, a sextant with a convex arc of 60° and 28 feet, 4 inches in radius. Two pairs of such arcs are built into the masonry at the eastern and western ends of the Saṁraṭ Yantra.

3. Rāśivalaya Yantra, an ecliptic instrument consisting of a collection of twelve dials on a platform, one for each sign of the zodiac, each of the same design as the Saṁraṭ Yantra, but with quadrants in the plane of the ecliptic when that sign is on the horizon and not on the plane of the equator.

4. Jai Prakāśa, a pair of hemispheric dials, 17 feet, 10 inches in diameter (fig. 16.21); their use will be explained in some detail below.

5. Kapāli, a smaller pair of hemispheric dials, 11 feet, 4 inches in diameter, one with the plane of its upper edge representing the horizon, the other with that plane representing the solstitial colure. This instrument is found only in Jaipur.

6. Rāma Yantra, a cylindrical astrolabe employing an orthographic projection with a pillar at its center and a floor and walls graduated for altitude and azimuth observations. The four such instruments at Jaipur (not all of which appear on Kaye's plan) were actually built long after Jai Singh's death, but according to the same general specifications as larger instruments of the same type that he had constructed in Delhi. The larger of two pairs have diameters of 23 feet, 11 inches.

7. Digaṁśa Yantra, a simple azimuth instrument consisting of a pillar and two surrounding circular walls, a lower inner wall of the same height as the pillar (about 4 feet), on which an observer can walk, and an outer wall twice the height of the former over which the observer with a movable sighting string can look. In effect, this is a circular protractor.

8. Nārī Valaya Yantra, a masonry cylinder about 10 feet in diameter with a horizontal axis in the plane of the meridian and parallel dial faces in the plane of the equator. The dials are graduated into *ghaṭi*s (one-sixtieth of a day, i.e., twenty-four minutes) and *pala*s (one-sixtieth of a *ghaṭi*).

9. Dakṣiṇāvṛtti Yantra, a simple mural instrument used for taking meridian altitudes. On its east face are two intersecting quadrants 20 feet in radius and on the west a semicircle of 19 feet, 10 inches.

10. Yantra Rāja, two large, fixed metal single-disk astrolabes, 7 feet in diameter, one made of about sixty sheets of iron riveted together, the other of brass. It is likely that Jai Singh brought these from Delhi to Jaipur.

11. Unnatāṁśa Yantra, a graduated brass circle, 17 feet,

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103. Excerpt from the translation of the entire preface by William Hunter, "Some Account of the Astronomical Labours of Jayasinha, Rajah of Ambhere, or Jayanagar," *Asiatick Researches; or, Transactions of the Society Instituted in Bengal*, vol. 5, 4th ed. (1807): 177–211, esp. 184–85; also cited by Kaye, *Old Observatories*, 14–15 (note 100).

104. Kaye, *Old Observatories*, 43 (note 100). This is only one of a number of instances in which Jai Singh's instruments appear to have been "overdesigned"; elsewhere they were "underdesigned." For particulars, see Blanpied, "Astronomical Program," 101 (note 96). The remainder of my inventory of the instruments in the Jaipur observatory is based mainly on Kaye, *Old Observatories*, 43–47, with reference back to some of the earlier descriptions on 26–38.

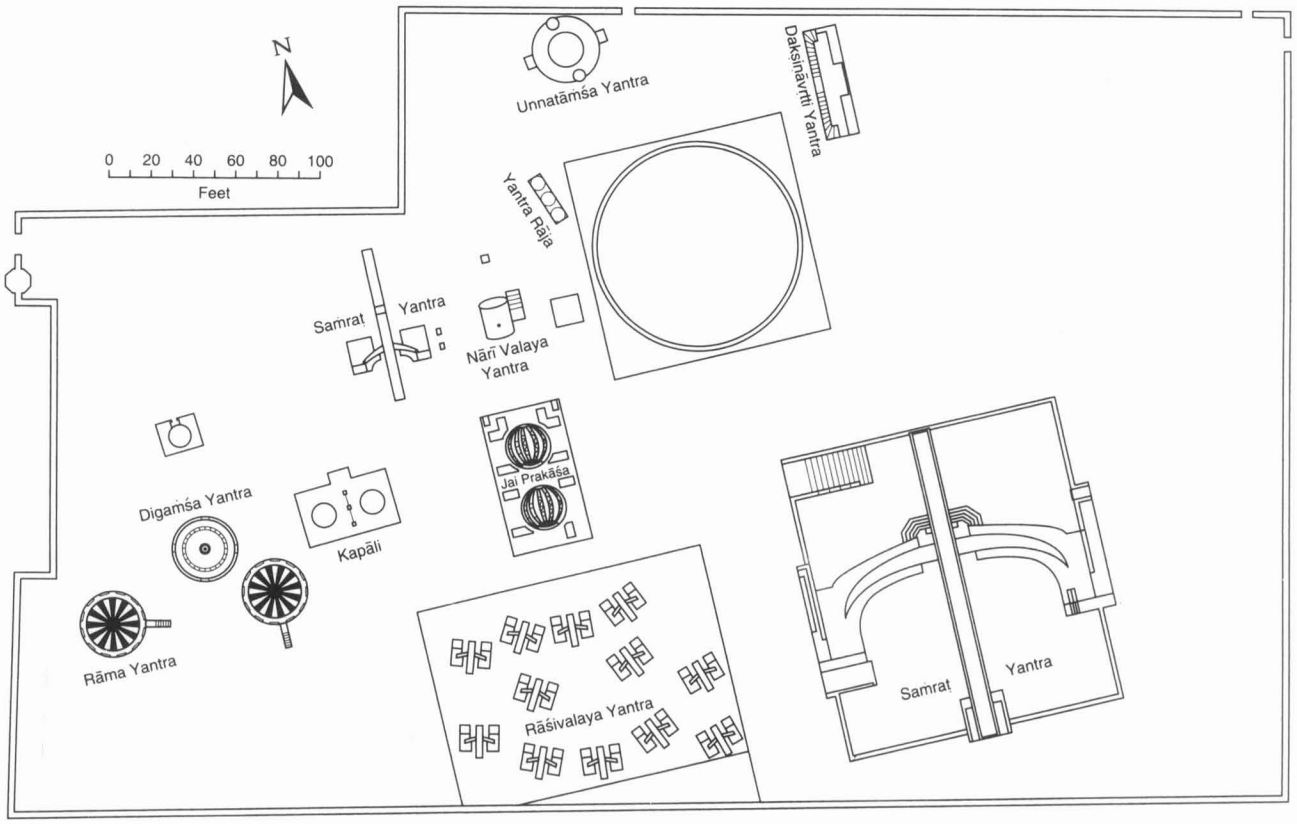

FIG. 16.20. PLAN OF JAIPUR OBSERVATORY. Built by Maharaja Sawai Jai Singh II of Jaipur between 1728 and 1739, this observatory, the largest of five he constructed, contained numerous massive fixed masonry astronomical instruments as well as other smaller mobile metal instruments. Most of the former survive and are shown in this diagram. After George Rusby Kaye, *The Astronomical Observatories of Jai Singh* (Calcutta: Superintendent Government Printing, India, 1918; reprinted Varanasi: Indological Book House, 1973), following p. 52.

6 inches in diameter, suspended so as to revolve about a vertical axis and used to measure altitude. This was possibly of Jai Singh's own design.

12. Chakra Yantra, an equatorial, of which there are two identical examples at Jaipur. Each consists of a metal disk, 6 feet in diameter, fixed so as to revolve about an axis parallel to that of the earth, with a separate graduated hour circle at the southern end of the axis and a pointer on the axis to indicate the hour angle, and with an index and a sighter on the main circle.

13. Krāntivṛtti Yantra, an instrument of rather limited accuracy used to measure celestial latitude and longitude, consisting of two brass circles, pivoted so that one moves in the equatorial plane and the other in the plane of the ecliptic. Though the one now at Jaipur is quite modern, masonry work still exists to support a much larger instrument of the same type, presumably from Jai Singh's time.

Among the instruments cited above, the Jai Prakāśa (figs. 16.21 and 16.22) "is perhaps the most ingenious and original of Jai Singh's inventions."[105] Hence I quote in full Blanpied's description of it:

> Each instrument consists of a pair of hemispherical bowls which, at the Delhi observatory, are about 4.2 meters in radius. The surfaces of these bowls are inscribed with the celestial coordinates and oriented such that the positions of celestial objects can be mapped directly onto them [fig. 16.22]. Two straight wires in the horizontal plane, one oriented north and south and one east and west, intersect at what would be the center of the complete sphere. In essence celestial bodies are mapped onto the concave hemisphere by an observer inside the bowl who sights them through the intersection point. For example, the straight line which passes through this point and is inclined at the latitude angle λ to the horizontal defines a line of sight to the north celestial pole. Therefore, the pole of the instrument is inscribed at the intersection of that line with the concrete surface. Likewise, the plane perpendicular to the aforementioned line which passes through the east-west wire is parallel to the earth's equator and would, if extended, intersect

105. Blanpied, "Astronomical Program," 98 (note 96).

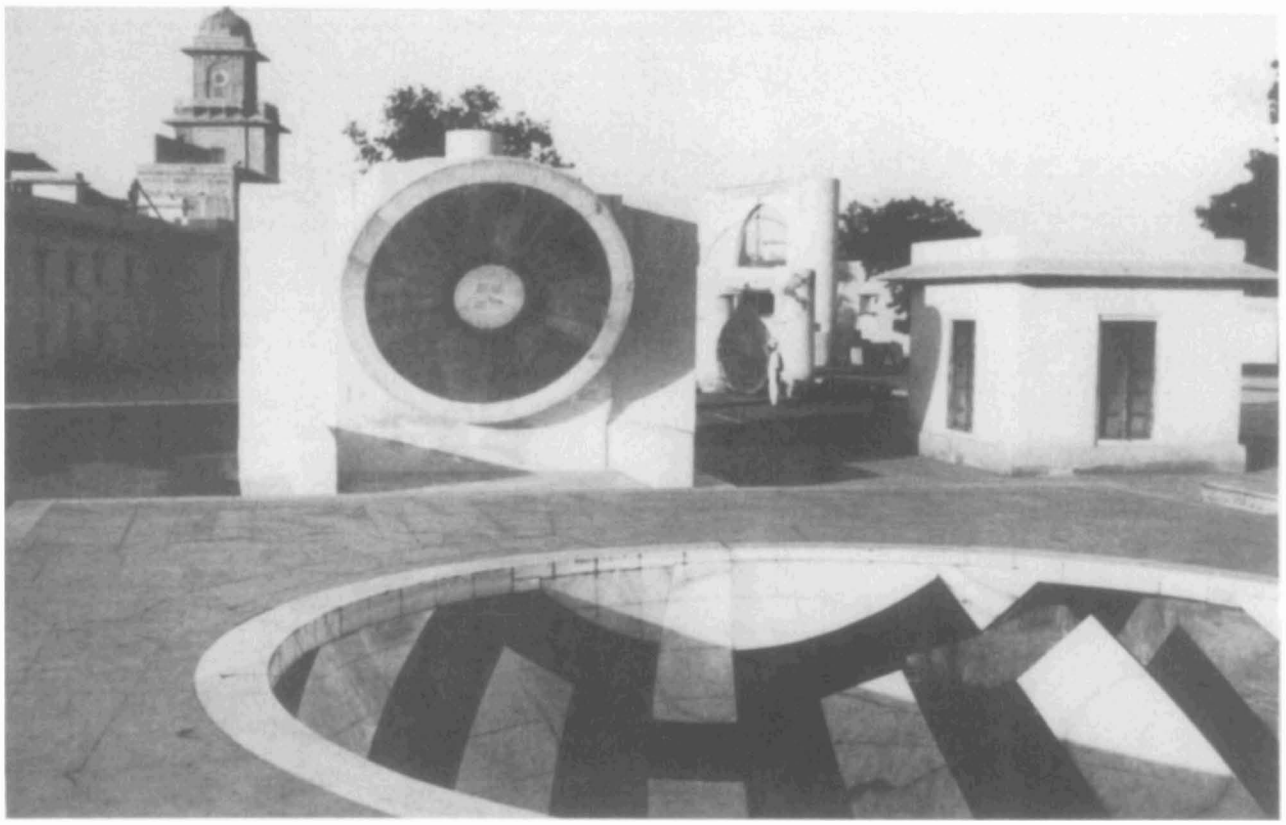

FIG. 16.21. JAI PRAKĀŚA (LIGHT OF VICTORY). This astronomical instrument, designed by Maharaja Sawai Jai Singh II and constructed by him at the Jantar Mantar observatory in Jaipur, was used to determine the stellar coordinates of celestial bodies. It comprises two sunken concave hemispheres onto whose complementary surfaces lines of sight from the observed bodies could be projected. Other instruments appear in the background.
Photograph courtesy of Robert Harding Picture Library, London.

the celestial equator. A great circle is inscribed on the masonry surface at its intersection with this plane, and defines the instrument's equator. Circles of celestial longitude and azimuth were inscribed on the instrument by following an analogous set of prescriptions.

In practice, nighttime measurements seem to have been made by fixing one end of a taut string to the intersection of two horizontal wires. The observer stood at the bottom of the concave bowl and moved about until by fixing the free end of the string he could sight the particular star or planet along it. The intersection of the string and the coordinates inscribed on the hemisphere then gave the celestial coordinates of the planet or star. In order to facilitate such measurements, passages with stairways were cut into the hemispherical bowls. These enabled the observer to move around easily and to stand at a lower level than the graduated surface. For this reason each *Jai Prakash* consists of two complementary hemispheres. Positions of the access passages on one are positions of gradations on the other, and vice versa.

Daytime measurements could be made simply and directly with the *Jai Prakash*. Since the parallel rays of the sun are equivalent to lines of sight, the shadow cast upon the concave hemisphere by the intersection of the two horizontal wires falls upon the inscribed lines defining its celestial coordinates. Additional circles of zodiacal signs were inscribed on the surface in such a way that the particular circle on which the shadow of the intersection point falls determines the sign which is then on the meridian.[106]

The impressive scale of some of the instruments of Jai Singh described above is evident in figure 16.23, which shows a portion of the Jaipur observatory complex popularly known as the Jantar Mantar.

That the accuracy of the data obtained from Jai Singh's observatories far surpassed that of any of his Indian predecessors' cannot be doubted. The Samrat Yantra, for example, "could be used by a skilled observer to read solar time to a precision of 15 seconds, . . . [and] also should have been capable of yielding the solar altitude to within 2 minutes of arc . . . [and] the *Jai Prakash* and

106. Blanpied, "Astronomical Program," 98–100 (note 96).

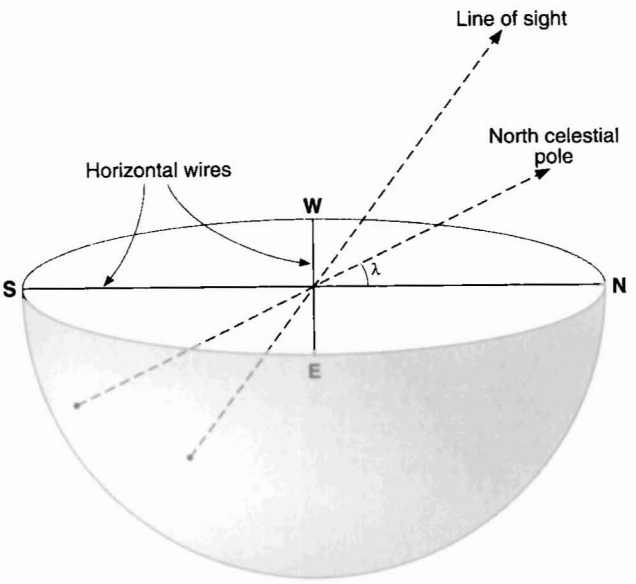

FIG. 16.22. SCHEMATIC DIAGRAM OF THE JAI PRAKĀŚA. This diagram shows how the Jai Prakāśa were used to fix the position of the North Pole and the stellar coordinates of an observed heavenly body.
After William A. Blanpied, "The Astronomical Program of Raja Sawai Jai Singh II and Its Historical Context," *Japanese Studies in the History of Science*, no. 13 (1974): 87–126, esp. fig. 2 (p. 99).

the *Ram Yantra* seem also to have been capable of precisions of about this order."[107] How the data yielded by these and other instruments compared with the data of contemporaneous European astronomy is debatable, however. Before Mercier's recent translation of the Persian tables forming the body of Jai Singh's *Zīj*, evidently compiled over about 1730–38, commentators on the subject based their judgments mainly on the observations made by various European assessments of the instruments employed and on Jai Singh's criticisms of the findings of the astronomical tables of Philippe de La Hire, transmitted to him in 1730 by the Portuguese Jesuit missionary Emmanuel de Figuerda. Jai Singh professed, for example, to have found an error of half a degree in La Hire's assignment of the place of the moon, and for this and other reasons he implied in the preface to the *Zīj* that he had nothing to learn from the astronomy of Europe. Nevertheless, he remained in contact with European missionary and lay astronomers, either by correspondence or by direct discussion with those resident in Jaipur, especially the French Jesuits Claude Boudier and Pierre Pons, who journeyed all the way from Chandernagore in 1734 at the raja's invitation.[108] Since Mercier's study of the *Zīj* is the most thorough and recent available, it is in order that I quote here, virtually in its entirety, the abstract of that work:

> The [tables of the] *Zīj-i-Muḥammed Shāhi* . . . are usually represented as embodying the observational work done at the observatories of Delhi and Jaipur, under the direction of Jai Singh and [his chief astronomer] Jagannātha. In this paper these Persian tables are analysed thoroughly, and their various components are identified with earlier sources. In fact no new observational results are to be found apart from a new determination of the obliquity. Instead, the tables of the Sun, Moon, and Planets are all identical with those of La Hire (1727), apart from a mere change of meridian from Paris to Delhi. There are worked examples for the time of a solar eclipse of A.D. 1734 May 3, which was total in central India. The tables and text of Book II on basic spherical astronomy are taken without alteration from the *Zīj* of Ulugh Beg, except that those functions which depend on the obliquity have been recalculated. The star table is taken from Ulugh Beg. The long geographical table includes those of Ulugh Beg and La Hire, as well as some 240 sites (many in India) from unidentified sources.
>
> The *vṛttaṣaṣṭāṃśa* of Delhi and Jaipur is a sextant totally enclosed by walls in which the Sun's image is formed as in a camera obscura. It is certainly the only instrument in those observatories susceptible of real accuracy, and it was used in determining the obliquity and the latitude. A number of accounts of its design and use are given, including those of Jagannātha and the Jesuits.[109]

Assuming that Mercier's conclusions are correct, we must ask ourselves when and how Jai Singh decided, despite the claims he made for the accuracy of his own instruments, to copy so many not only of the findings of La Hire, but also of those made in the fifteenth century by Ulugh Beg. One possible explanation is that the preface to the *Zīj* was written before a sufficient body of data had been amassed to establish the tables included there, and in the anticipation that those data would embody a degree of accuracy that they failed to realize. The instruments employed may well have been capable of achieving the sought-for level of accuracy, but the observers using them may have been deficient in their concern for careful measurement, thereby confounding Jai Singh's hopes and expectations. I know of no written source that might throw additional light on this line of speculation.

A related issue is Jai Singh's failure to make use of the telescope, of which he almost certainly had knowledge. "Perhaps," suggests Blanpied,

107. Blanpied, "Astronomical Program," 101 (note 96).

108. Blanpied, "Astronomical Program," 99 and 117–24 (note 96), and Raymond Mercier, "The Astronomical Tables of Rajah Jai Singh Sawā'i," *Indian Journal of History of Science* 19 (1984): 143–71, esp. 143–45 and 159–63.

109. Mercier, "Astronomical Tables," 143 (note 108).

FIG. 16.23. JAIPUR OBSERVATORY. This photograph, taken from atop the Saṁraṭ Yantra within the Jaipur observatory built by Jai Singh, shows several of its giant masonry instruments. The Saṁraṭ Yantra, a triangular gnomon, has a height of nearly 90 feet, above the ground and a base of 147 feet. The corresponding instrument at Delhi is substantially smaller (60 feet, 4 inches high). The two complementary concave hemispheres of the Jai Prakāśa (17 feet, 10 inches in diameter) appear in the middle ground, and beyond it are the Nārī Valaya Yantra and a smaller Saṁraṭ Yantra. The measurements cited are taken from George Rusby Kaye, *Astronomical Observatories of Jai Singh* (Calcutta: Superintendent Government Printing, India, 1918; reprinted Varanasi: Indological Book House, 1973). Photograph courtesy of Robert Harding Picture Library, London.

> one of the Jesuit missions to Jaipur did convince him that the new European observational techniques had already made even the grandest naked eye instruments obsolete, and convinced him of that fact after seven years of labor with his great instruments at Delhi, instruments erected a bare five kilometers from the throne of the Moghul emperor who had allegedly commissioned them. In that case the most intrepid of scholars might well have become discouraged with the observational program he had devised.[110]

One may also wonder why there is no mention in the *Zīj* of the dynamics of planetary motion and why Jai Singh seemingly displayed little or no interest in the Copernican heliocentric conception of the solar system, though he appears to have been informed of it. One intriguing possibility is that Jai Singh may also have learned from the Jesuits of the havoc being caused in Europe by the Copernican revolution and that he may therefore have decided to suppress the idea in India even though he may have been personally convinced of the correctness of Copernican views in regard to heliocentricity and the elliptical orbits of the planets.[111]

What, we may ask in conclusion, were Jai Singh's underlying motives in carrying out his ambitious astronomical program? Apart from the intellectual curiosity for which he was justifiably acclaimed, one primary object, one can argue, "was to provide solar data on which to base a reformed calendar" to replace the centuries-old Hindu sidereal calendar based on the *Sūrya-siddhānta*.[112] This is in keeping with the fact that Jai Singh lavished much greater care on the task of improving the Saṁraṭ Yantra, which was primarily used for solar observations, than he devoted to his other instruments.[113]

110. Blanpied, "Astronomical Program," 123 (note 96).

111. A. Rahman, *Maharaja Sawai Jai Singh II and Indian Renaissance* (New Delhi: Navrang, 1987), 75–76.

112. Blanpied, "Astronomical Program," 102 (note 96).

113. Blanpied, "Astronomical Program," 101 (note 96).

One can only speculate on the course Indian astronomy might have taken had the intrusion of European power been delayed by one or more generations. Although Jai Singh failed to achieve all his ambitious astronomical goals and seems not to have even attempted to establish a new school of astronomy, his astronomical tables, whatever their ultimate sources may have been, were used in northern India throughout the eighteenth century and were then considered among the best available.[114] And the grandeur of his astronomical conceptions, whatever the shortcomings in their realization, command admiration and set him apart from his less scientifically minded Indian contemporaries.

Cosmographies: The Jain Tradition

Of the three ancient Indian religious traditions, that of the Jains appears to have had the greatest and most continuous preoccupation with cosmographical questions. To this day it is said, "Every [Jain] monk knows by heart, from the time of his noviciate, the verses of the *saṃgrahaṇīs* [cosmographic texts]. He knows how to draw representations of them, and can sometimes even make models of them. He can also comment upon them in detail, following a long-established tradition."[115] Even to the laity the subject remains one of "absorbing interest," and allegedly "cosmographic diagrams appear in all Jain temples."[116] The purpose of preparing cosmographies was essentially didactic. "All in all, the representation of the world which the Jains have elaborated permits them to show, in a condensed way, which would have a greater impact upon the mind of a believer, the myriads of destinies through which one will transmigrate in the course of innumerable aeons."[117] The same would, of course, also have been true of cosmographies of Hindu and Buddhist conception, though their religious use—especially in Hinduism, where metaphysics was largely left to the Brahman elite—was less than in the case of the relatively well-educated and affluent Jains. There are, in fact, so many surviving examples of premodern Jain cosmographies, not only in India but in major museums and art galleries throughout the world, that an inventory of those I have seen or know of would be far from complete and serve little purpose.[118]

Most of the known Jain cosmographies derive from Rajasthan and Gujarat, the two Indian states with the largest proportions of Jains in their population. Most of the surviving works were painted in gouache on paper, mainly in pastel hues, as parts of illuminated *saṃgrahaṇī* manuscripts, the oldest thought to have been composed in the sixth or seventh century A.D. Of the extant illustrated recensions, however, none is said to be older than the fourteenth century. Additionally, there are many Jain cosmographies painted in gouache on cotton cloth, and surviving examples date at least as far back as the fifteenth century.[119] Perhaps the principal reason ancient Jain cosmographies are so much more plentiful than those of the Hindus is that they were carefully preserved both in monasteries and in the *bhaṇḍāra*s (libraries) that are characteristic adjuncts to Jain temples. There are no corresponding institutions in Hinduism.[120]

A third medium in which Jain cosmographies survive is stone, especially bas-reliefs in Jain temples and shrines, as in the case of the representation of Nandīśvaradvīpa in figure 15.1. Not surprisingly, given the durability of the medium, the oldest of all the known cosmographies are sculpted in stone. These works date as far back as A.D. 1199–1200.[121]

Figure 16.24 presents a fifteenth-century view of Manuṣyaloka, in which the central continent, Jambūdvīpa, corresponds—in content, if not in relative scale—to the simplified and idealized sketch of figure 16.5.[122] The circular mountain range midway across the ring continent of Puṣkaradvīpa, marking the limit of the world of man, is shown by the wavy outermost circle. Though the arrangement of land areas, mountains, rivers, lakes, and other features is essentially symmetrical, there are several places where rivers diverge like opposite spokes of a swastika, long a sacred symbol in Indian culture. Reproduction in black and white does not convey an idea of the colors, often vivid, that are characteristic of cosmographies of this sort.

Conventions vary from one work to another, but there are certain broad tendencies. For example, it is usual to show water in blue with visual reinforcement provided by fish and a basket-weave pattern suggesting waves. Mountains are typically portrayed in one or more distinctive colors of a more intense hue than that of the continents where they are situated (though that is not so for the mountains of Puṣkaradvīpa), Meru in gold or some other prominent color, and so forth. On this work there is substantial text identifying various portions of

114. Blanpied, "Astronomical Program," 107 (note 96).

115. Caillat and Kumar, *Jain Cosmology*, 16 (note 57).

116. Gombrich, "Ancient Indian Cosmology," 130 (note 1).

117. Caillat and Kumar, *Jain Cosmology*, 26 (note 57).

118. For a partial list of sources, see notes to appendixes 16.1 and 16.2.

119. Moti Chandra, *Jain Miniature Paintings from Western India* (Ahmadabad: Sarabhai Manilal Nawab, 1949), 52–53.

120. Stella Kramrisch, personal communication, 5 January 1983.

121. I have photographs of three other exquisite examples from the thirteenth century as well as of others of later origin. I hereby thank M. A. Dhaky, associate director for research of the Center for Art and Archaeology of the American Institute of Indian Studies in Varanasi, for calling these items to my attention and sending me photographs of them.

122. This painting is now at the Victoria and Albert Museum in London. Its reference number is Circ. 91-1970. I thank Betty Tyers for bringing it to my attention.

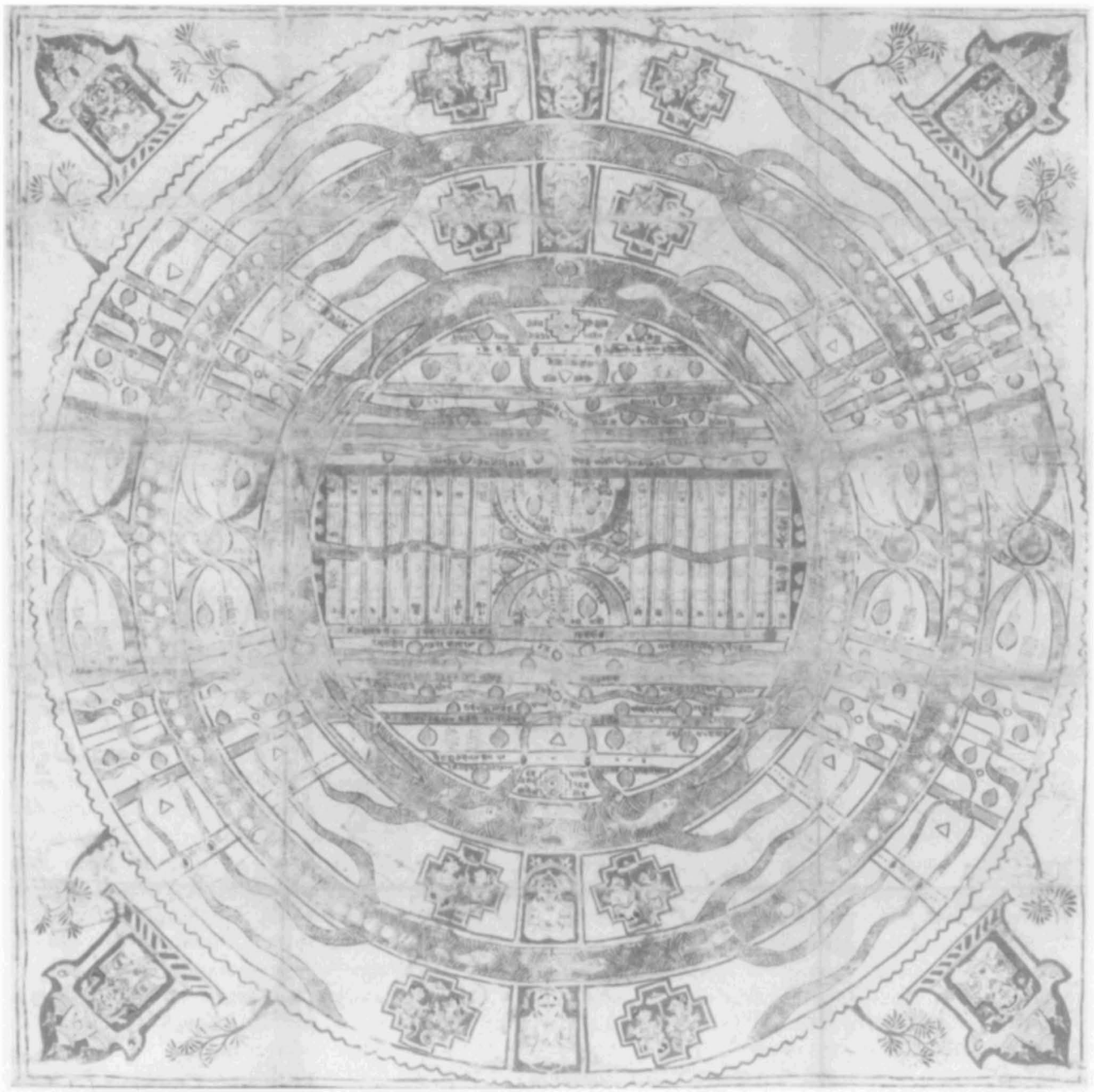

FIG. 16.24. MANUṢYALOKA (THE WORLD OF MAN) ACCORDING TO JAIN COSMOGRAPHICAL TEXTS. Depicted here are the so-called two and a half contintents (*adhai-dvīpa*) within which humans may be born. Jambūdvīpa, the central continent, is surrounded by the first ring ocean, Lavaṇa Samudra (Salt Sea); and successively Dhātakīkhaṇḍa, the first ring continent; Kālodhadi, the Black-Water Ocean; and the inner half of Puṣkaradvīpa, the next ring continent up to Mānuṣottara, the circular mountain range that limits the world of man. Various representations of Mānuṣottara are shown in figure 16.28 below. This artifact is gouache on cloth from western India, fifteenth century.
Size of the original: 54.5 × 54.5 cm. Courtesy of the Board of Trustees of the Victoria and Albert Museum, London (Circ. 91-1970, negative no. GB3636).

Jambūdvīpa but not of the one and one-half surrounding continents. Other representations have even more extensive text, sometimes identifying several hundred individual features. Still others have little text or no text at all.

In this view, as in most, the detail is greatest for the area of Mahāvideha, the region bounded north and south by transverse mountain ranges and extending in a broad east-west band across the center of Jambūdvīpa to the

Lavaṇa Samudra (Salt Sea) to the east and west. Within Mahāvideha, in addition to Mount Meru, are four "elephant-tusk mountains" (Vakṣāra) with tips close to Meru; the regions of Uttarakuru to the north and Devakuru to the south, bounded by the tusklike mountains; ten small lakes, five each in a north-south line; in each of the two *kuru*s, emblematic trees on either side of the chains of lakes (the *jambū* being placed in Uttarakuru); the great rivers Śītā and Śītodā, flowing east and west, respectively, from the two lakes closest to Meru; and thirty-two provinces, known as *vijaya*s, ranged about those two rivers, eight each to the north and south, each with its own central mountain range and bounding rivers.[123]

Another noteworthy area of Jambūdvīpa is Bhārata (India), the bow-shaped region at the continent's southern extremity. An east-west Vijayārdha mountain range crosses this region, and through it flow the rivers Gaṅgā to the southeast and Yamunā to the southwest. The central portion of Bhārata is Āryakhaṇḍa, the pure land of the Aryans, and around it on all sides is Mleccha, the land of impure peoples. Small though Bhārata appears here, it ought to occupy an even smaller area, since the *saṃgrahaṇī* texts state that it occupies only 1/190 the area of Jambūdvīpa.[124] That the area actually known firsthand to the Jain sages who composed the text should occupy so minuscule a portion of the total cosmos and, within Jambūdvīpa, so eccentric a location is wholly in keeping with the religious traditions of India.[125]

Further details about the nature of Jambūdvīpa are provided by figures 16.25, 16.26, and 16.27. Apart from its interesting detail, figure 16.25, which represents Uttarakuru, just north of Mount Meru, is noteworthy in several respects. First, its orientation, with south at the top, contrasts with the prevailing northern orientation of virtually all views of Jambūdvīpa as a whole. This change in orientation was probably intended to allow for a better composition, in portraying—within the tusklike Vakṣāra Mountains—the *jambū* tree, the wish-granting tree (*kalpavṛkṣa*), and the representative inhabitants of the region, who are here born in couples (*yugalikau*), whose desires can be met from the *kalpavṛkṣa* above them. Also noteworthy is the departure from symmetry. Note the mountains crowned by nine (left) and seven (right) sanctuaries. The meaning of the rectangle at the base of the mountain on the left is not known. At the top center one can see where the Śītā River begins its easterly course.[126]

Finally, this view, like so many others in South Asian cosmographies, combines the horizontal representation of features associated with most modern maps with variously oriented frontal perspectives in showing the figures, trees, and sanctuaries. Figures 16.26 and 16.27 relate to Mount Meru, which the Jains envisage as a series of three narrowing platforms, often portrayed as truncated cones, the highest (the *cūlikā*) surmounted by a great sanctuary.

FIG. 16.25. UTTARAKURU, THE REGION NORTH OF MOUNT MERU. Represented here is a very small part of Jambūdvīpa just to the north of Mount Meru, the small circle at the top of the map. The bar at the bottom represents the east-west Nīla (Blue) Mountains from which two arcs, the Vakṣāra (Elephant-Tusk) Mountains, project toward Meru. Midway between them flows the Śītā River through five lakes. Also shown are a couple (humans here being always born in pairs) beneath the wish-fulfilling *kalpavṛksa* tree, and to their left is the *jambū* tree, from which the continent's name is derived. This leaf from a manuscript (?) is gouache on paper, Rajasthani, from the eighteenth century.
Size of the original: not known. By permission of Ravi Kumar, Basel, Switzerland.

At the foot of the mountain and around each platform are terraces with parks full of trees and flowers, and their pictorial representation takes many forms. A view of the summit area of Meru from above is provided in figure 16.27. Two such contrasting perspectives on a single feature are common in the cosmographic art of the Jains.

Of the plethora of surviving Jain cosmographic diagrams, those relating primarily to Jambūdvīpa (with or without the additional one and a half continents included within the Manuṣyaloka) are without a doubt the most common. Despite substantial differences in the styles of painting, one is struck by the apparent consistency of not only the broad outlines, but also many of the lesser details that the works display. Cosmographies dating from the sixteenth century and later seem to be in no way affected by advances in non-Jain astronomy, either Indian or Western, or by the burgeoning of geographic knowledge.

123. Caillat and Kumar, *Jain Cosmology*, 148–49 and 156–57 (note 57). In this view, the placement of the eponymous *jambū* tree is in Uttarakuru, to the north of Meru, suggesting that the Jain cosmographers were trying—as in many other respects—to differentiate their cosmos from that of the Hindus, for whom Jambūdvīpa, the continent of the *jambū* tree, was either the southern continent (as in fig. 16.1) or the central continent.

124. Compare figure 16.5 with N. P. Saxena and Rama Jain, "Jain Thought regarding the Earth and Related Matters," *Geographical Observer* 5 (1969): 1–8, esp. 6.

125. Eck, "Rose-Apple Island" (note 26).

126. Caillat and Kumar, *Jain Cosmology*, 158–59 (note 57).

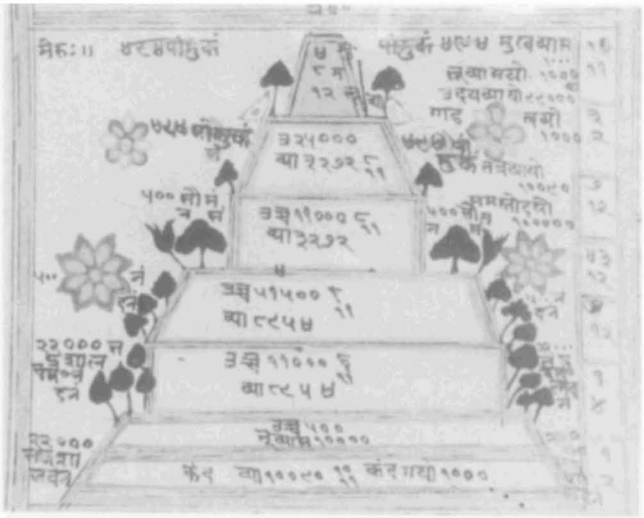

FIG. 16.26. PROFILE VIEW OF MOUNT MERU (JAIN CONCEPTION). This illustration is from a relatively recent recension of a thirteenth-century Sanskrit cosmological text, Candrasūri's *Trailokyadīpikā*. Written by one Indravarman in Jaipur in the year Samvat 1793 (A.D. 1850), the manuscript comprises eighty-six folios of eleven lines each in gouache and ink. Rising to a height of 100,000 *yojana*s, Mount Meru forms the *axis mundi* of the Jain universe (as it does also for Hindus and Buddhists). In Jain cosmography, Meru comprises three truncated cones, decreasing in diameter but increasing in their vertical dimension toward the summit. Though rarely drawn to scale, the dimensions are noted, as in this case, on many representations. Terraces at the foot of each level are marked by forests and gardens. Also present, though not shown in this view, are palaces and temples.
Size of the original: not known. By permission of the Bhandarkar Oriental Research Institute, Pune (acc. no. 603 of 1875–76, fol. 25b).

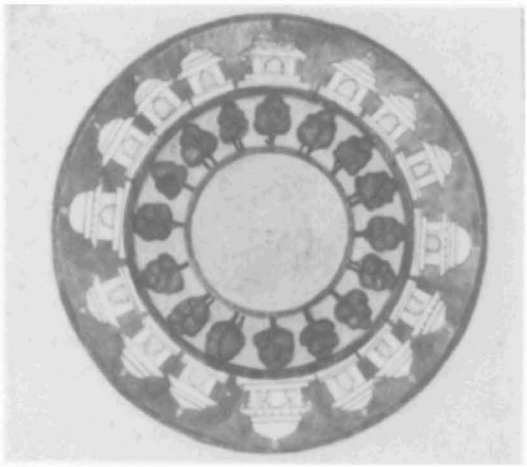

FIG. 16.27. OVERHEAD VIEW OF FLAT SUMMIT AREA OF MOUNT MERU (JAIN CONCEPTION). The medium, provenance, and date of this artifact are not known. Like the terraces leading toward the summit of Meru (compare fig. 16.26), the summit itself is a place of forest parks and palaces. This view provides a relatively rare top-down perspective.
Diameter of the original: 10.5 cm. By permission of the British Library, London (Add. MS. 26374, p. 18).

In that respect they differ substantially from the Hindu globes discussed above. In short, the hold of the canonical texts on the minds of Jains—or at least of those monks who were responsible for painting cosmographies—appears to be unbroken.[127] On the other hand, many cosmographies of the past century or so were created purely for commercial purposes, as objets d'art or as souvenirs to be sold to pilgrims and tourists, irrespective of their faith, who as a rule have only the dimmest notion of their content.

I carried out a statistical analysis on forty-four representations of Jambūdvīpa. Though I make no claim that the sample is representative, the results of the analysis may still be of interest. These are provided in appendix 16.1. This appendix indicates that the Jain Jambūdvīpa cosmographies originate overwhelmingly from Gujarat and Rajasthan; survive from at least as far back as the fifteenth century and are still being produced; and are painted on either cloth or paper in a wide range of sizes (the smaller ones generally being parts of manuscripts), typically in four to six colors. Most often they show two and a half continents, not infrequently only one, and only rarely two, virtually always centered on Mount Meru. Most representations are quite detailed, half showing more than a hundred separate components of the cosmos. Ancillary iconographic details commonly include numerous anthropomorphic figures, trees, and fish, the latter as a generic indicator of seas or, less commonly, rivers. Text too is often abundant, though about one-fourth of all representations contain no text at all. On about one-third of the sample numerical dimensional notations supplement the text. Conventional uses of color are also common, especially blue for the sea and rivers (with wave patterns reinforcing the symbolism); while various colors, especially yellow, red, green, and white, are used for mountains, frequently three or four colors on a single map. Finally, most cosmographies incorporate supplementary decorative detail—architectural, anthropomorphic, geometric, floral, and other plant and animal motifs—in the corners and in painted borders.

Figure 16.28, relating to a single feature of Jambūdvīpa, the mountain range at the outer limit of the Manuṣyaloka, indicates the variety among Jain cosmographies attributable to individual artistic license and the absence

127. An example of a modern Jain text, in Hindi, is Āryikā Jñānamatī's *Jaṃbūdvīpa* (Hastinapura, Meerut District, Uttar Pradesh, 1974). This work, by a Jain nun from Uttar Pradesh (not an important region for Jainism), is a straightforward exposition of the various parts of the Jain cosmos with twenty illustrations (including one in color on the book's cover) and numerous statistical details about the number and dimensions of the various regions, mountains, lakes, rivers, and trees that constitute the cosmos.

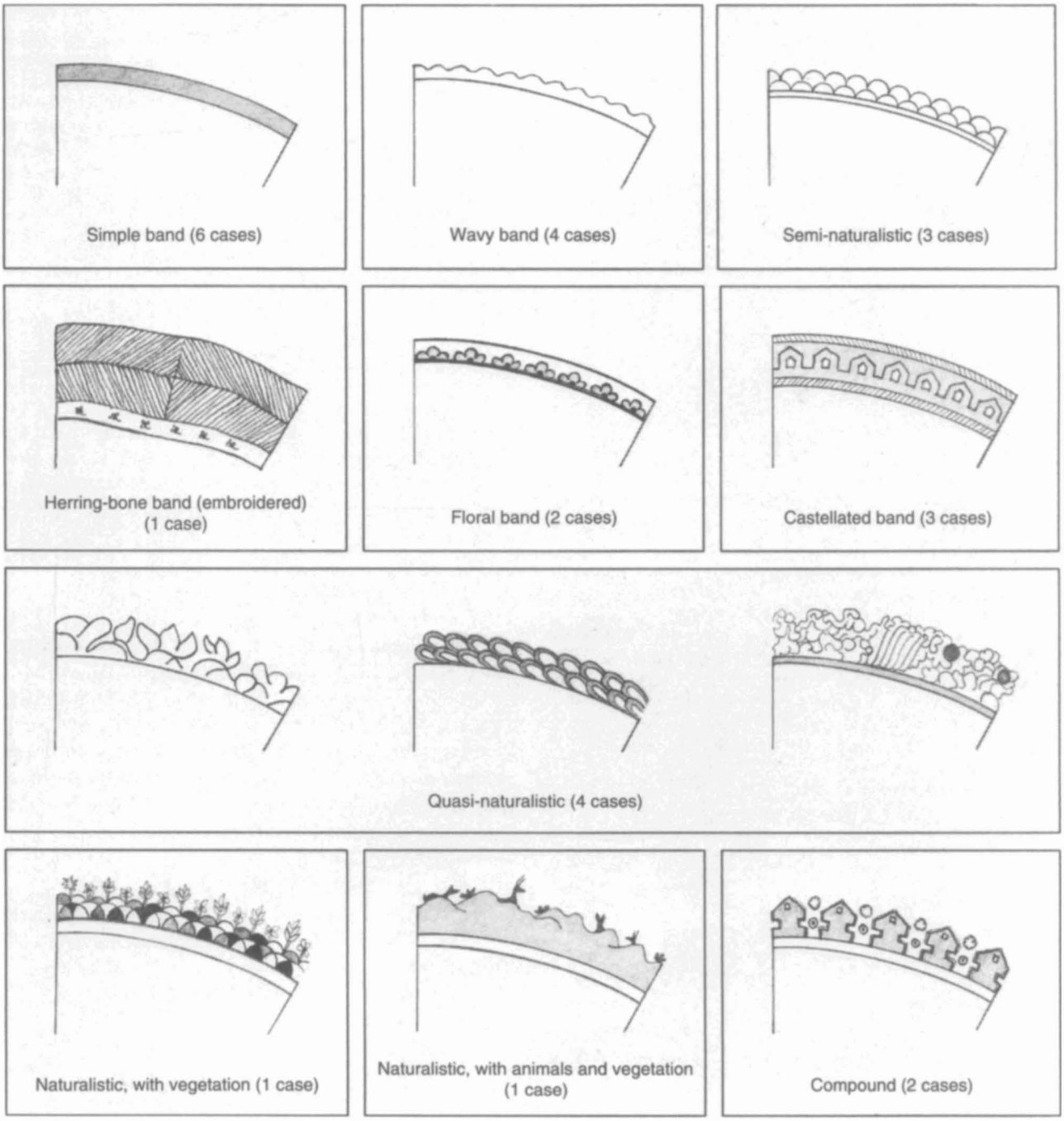

FIG. 16.28. VARYING METHODS OF DEPICTING THE MĀNUṢOTTARA MOUNTAIN RANGE MIDWAY ACROSS THE THIRD JAIN CONTINENT, PUṢKARADVĪPA. Mānuṣottara (Beyond Humankind) marks the limit of the *adhaidvīpa* (two and a half continents) comprising the Manuṣyaloka (World of Humans).
Designed by Joseph E. Schwartzberg from the cosmographies given in appendix 16.1.

of established cartographic canons. But the drawings remain faithful to the substance of the *saṃgrahaṇī* texts.

Even though the Jains appear never to have produced a globe, their representations of the cosmos are not confined to two dimensions or even to sculpted bas-reliefs. In the Digambara Jain temple in Ajmer, Rajasthan, one encounters a grand two-story atrium wherein are "gilt wooden representations of scenes from Jain mythology.... manufactured at Jaipur and installed in... 1896."[128] At least a portion of this imposing display is cosmographic, and it includes suspended gods sailing

128. B. N. Dhoundiyal, *Ajmer*, Rajasthan District Gazetteers, vol. 4 (Jaipur: Publication Branch, Government Central Press, 1966), 720.

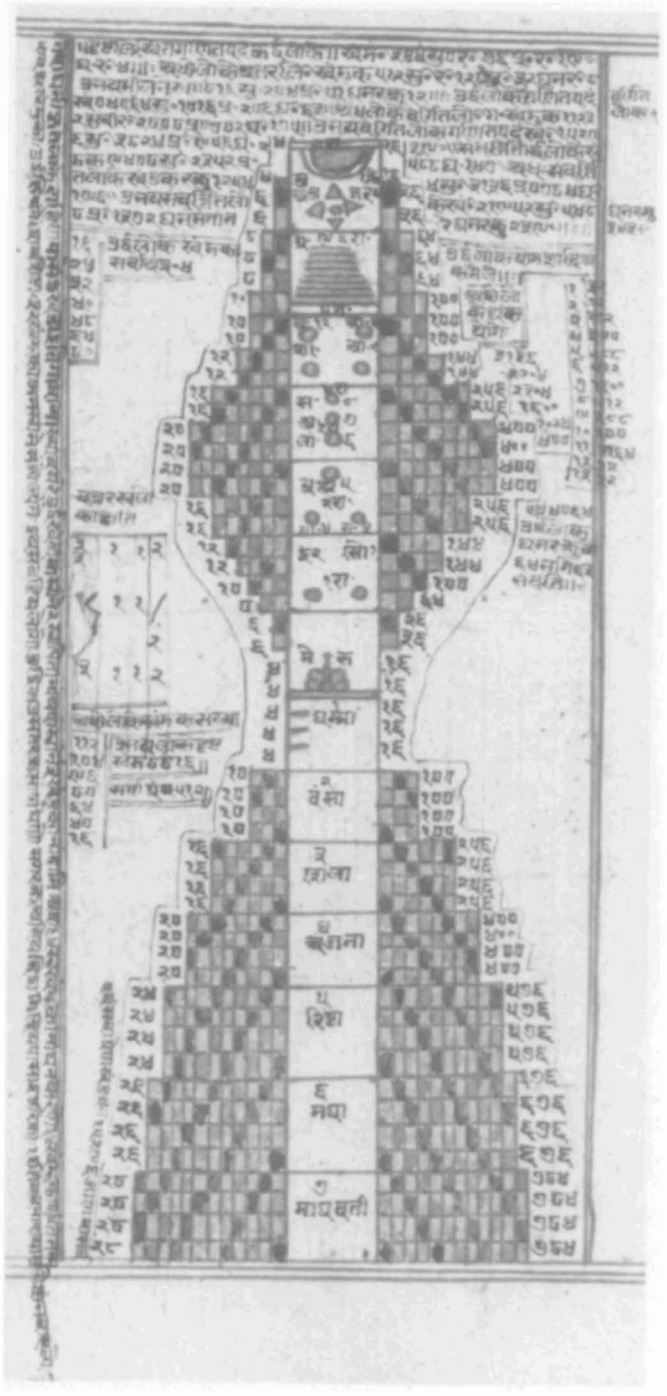

FIG. 16.29. THE LENGTH AND DIMENSIONS OF THE COSMIC MAN (LOKAPURUṢA). This diagram, gouache on paper, Gujarati, seventeenth century, shows greater concern for the actual dimensions of the cosmos than does the similar conception portrayed in plate 28. Those dimensions (expressed as numbers of *khaṇḍaka*s) are indicated by numbers at each successive level among the hells and heavens. Separating the two is the plane of Jambūdvīpa, here represented by a double line in the middle of the diagram, with Mount Meru rising just above it. The dome of perfection (*siddhi*), whose attainment brings an end to the cycle of rebirth, is shown at the top of the universe. Size of the original: not known. By permission of Ravi Kumar, Basel, Switzerland.

about in the skies in *vimans* (airships). Other parts include representations of the sacred cities of Ayodhyā and Prayāga (modern Allahabad) and of the Tribeni, the sacred confluence of the Gaṅgā, the Yamunā, and the mythic underground river Saraswati.[129]

As I have noted, the Jain universe is ordered along a vertical axis and is composed of a series of hells and heavens below and above the world of man. Plate 28 and figure 16.29 present two variations of the way our own universe—only one among many—is characteristically represented in Jain paintings. Plate 28, an anthropomorphic rendition, shows Jambūdvīpa and its immediately surrounding ocean as a disk at the waist, where it is rotated ninety degrees from its actual horizontal position (a not uncommon convention). Alongside the view in figure 16.29 are numbers giving the dimensions, including the depths from front to back, of the various portions of the universe in *khaṇḍaka*s, four of which constitute a *rajju*. The lowermost, "Thick Darkness Hell," for example, is 28 *khaṇḍaka*s along each side and 4 in height and comprises 3,136 cubic *khaṇḍaka*s out of a total for the whole of the lower world of 15,296 cubic *khaṇḍaka*s. But the concern with scale that we find in this figure and on many other paintings is by no means a general attribute of the extant representations of Jain cosmographies. (It appears to be even less of a concern in Hindu and Buddhist cosmographies.) On this subject, Caillat observes:

> The extreme minuteness with which the smallest details of this geography are analysed and depicted is certainly more striking than the indifference of the painters to the proportions of the various parts, however strictly they are stipulated by the texts. When, from Bharata (or Airāvata) to Videha, the widths of the lands and the mountains which border them are supposed to increase geometrically, i.e. from 1 to 2, from 2 to 4 . . . from 32 to 64, all the intermediate zones are invariably reduced in size in the illustrations, to the benefit of the north, south, and centre. . . .
>
> It is the same when one considers the oceans and continents which encircle Jambūdvīpa. In relation to the diameter of the latter, the width of Lavaṇasamudra is theoretically double, that of Dhātakīkhaṇḍa which surrounds that is quadruple, and so on. This does not stop them being represented, at the limits, by mere lines.[130]

Enough has been said in regard to our discussion to

129. Dhoundiyal, *Ajmer*, 721 (note 128).
130. Caillat and Kumar, *Jain Cosmology*, 32 (note 57).

this point to convey the flavor of Jain cosmographical thinking and its visual representation. Given the availability of numerous relevant published works, especially the magnificently illustrated *Jain Cosmology*, little purpose will be served here by providing comparable details for other portions of the Jain cosmos. Appendix 16.2, however, provides a statistical summation of some of the attributes of a small sample of Jain representations of our universe.

Appendix 16.2 tells a story not greatly different in many respects from that of appendix 16.1. The identifiable source areas for the cosmographies showing the three major components of the Jain universe are west Indian, either Rajasthan or Gujarat, and the dates of surviving works go back at least to the sixteenth and possibly to the fifteenth century. The paintings, typically in at least four colors, may be on either cloth or paper and vary greatly in size, even more so than representations of Jambūdvīpa alone. The discoid portion of the cosmos representing Jambūdvīpa is almost always rotated ninety degrees to a vertical position so that the viewer can discern its three major components, even though they are ordered vertically and joined by a central column. Within Jambūdvīpa the long axis of the central region of Videha is most frequently oriented east-west, but occasionally it is north-south. Much more often than not, an androgynous anthropomorphic figure is an icon for the entire universe. The diminishing widths of successively higher hells and the widening, then diminishing widths of successively higher heavens are generally signified by a step-like outline within which a checkered grid represents the specific number of *rajju*s for the height and width of each layer, frequently supplemented by dimensional notations. Supplementary text is often present, either on or adjacent to the central figure or, less commonly, nearby, though the total amount of text is typically less than in the Jambūdvīpa cosmographies analyzed in appendix 16.1. Anthropomorphic, geometric, and other illustrations ancillary to the central figure are common. Most of the works have borders, rendered in a variety of ways but on the whole fairly simply.

In concluding this discussion of Jain cosmography, I present and briefly comment on four additional paintings that reflect the remarkable diversity of the domains constituting the Jain universe. A complete exposition, regrettably, would be well beyond the realizable scope of this history. The first of the paintings to be considered is of Nandīśvaradvīpa, the eighth Jain continent (the seventh ring moving outward from Jambūdvīpa, and hence in the same horizontal plane in the middle of their vertically disposed universe). We next move upward to the heavens immediately above these several rings, but still within the same middle stratum, and I present two views of celestial bodies. Finally, we ascend to an even more ethereal realm to regard some of the many wonders to be found in the fifth of the seven heavenly strata above the plane of Jambūdvīpa. Views of the other heavenly realms and of the many components of the seven levels of hell lying below Jambūdvīpa, as well as of the various continents ranged around Jambūdvīpa itself, may be found in various sources indicated in the introductory section of this chapter.

The view of Nandīśvaradvīpa presented in figure 16.30 stands in marked contrast to the bas-relief of the same area shown in figure 15.1. One sees here, in reduced scale, the numbered inner continents that it encircles. The authors of many views, however, including figure 15.1, have either shown these inner continents at an exceedingly small scale or have not bothered to depict them at all and have sometimes inserted in their stead some icon, such as a representation of one of the major Jain *tīrthaṅkara*s (preceptors), of whom Mahāvīra, a contemporary of the Buddha, was the greatest. It is probably he who is represented in the center of figure 15.1.

To the Jains, Nandīśvaradvīpa is the continent where lesser deities (Siddhas) assemble for festivities. Figure 16.30 portrays, in each of the four cardinal directions, a mountain of antimony crowned by a sanctuary for the Siddhas and surrounded by four lakes (*nandā*s, of which there are sixteen in all) between which four pairs of mountains rise up. On these thirty-two mountains are palaces for the Siddhas' wives. Sixteen additional palaces or sanctuaries (four in each of the four secondary directions) bring the total to fifty-two. The plan of a set of four sanctuaries about one *nandā* appears in the right half of the diagram. These sanctuaries provide the principal iconographic element of figure 15.1.

Celestial mapping based on accurate observations of the heavens does not form a part of the Jain tradition. Representations of heavenly bodies and associated phenomena within the Jain cosmos, however, are abundant. Among these representations, for example, are simple paintings of the Jyotiṣas, the five types of gods of light, who are more or less analogous to the Hindu *navagraha*s. These deities—*sūrya*s (suns), *candra*s (moons), *graha*s (planets), *nakṣatra*s (asterisms), and *tārā*s (stars)—occupy successively higher levels within a horizontal band of immeasurable breadth above the various ring continents and oceans. Vertically, they are distributed within the relatively narrow range of from 110 to 900 *yojana*s above the highest point of the middle world. Those above Jambūdvīpa revolve about Mount Meru and, like others in the remainder of Manuṣyaloka (the world of man), are ceaselessly in motion, whereas those beyond the world of man are fixed in position and shine with uniform brightness sufficient to carry their light outward for 100,000 *yojana*s. The Jyotiṣas may be symbolically portrayed by the *vimāna*s, which are at once their chariots

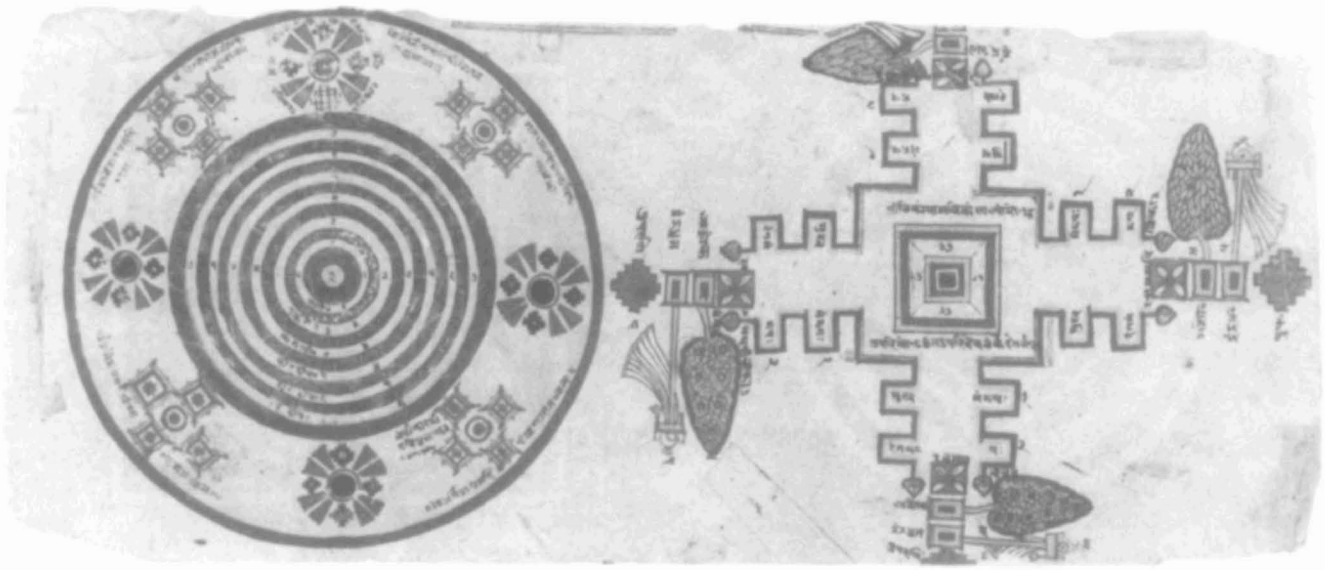

FIG. 16.30. NANDĪŚVARADVĪPA, THE EIGHTH JAIN CONTINENT. Six ring continents and seven ring oceans separate Nandīśvaradvīpa and the innermost continent of Jambūdvīpa. On this diagram, which is gouache on paper, Rajasthani, and dated to about the seventeenth century, the scale of all the features encompassed by Nandīśvaradvīpa is reduced (though not as greatly as in fig. 15.1) to provide more space for that continent. Nandīśvaradvīpa is marked by four mountains of antimony, each crowned by a sanctuary with lakes to its north, east, south, and west (right portion of diagram), and by thirty-two additional mountains arranged in four sets of eight mountains each (shown here as small triangles).
Size of the original: not known. By permission of Ravi Kumar, Basel, Switzerland.

and palaces. In some views these *vimāna*s are rendered by colored circles or semicircles (e.g., red for the sun, black for Rāhu) within surrounding circular fields; in others their characteristics are more explicitly depicted. In the vast cosmographic diorama in the three-story atrium of the principal Jain temple in Ajmer, the Jyotiṣas are rendered anthropomorphically, and they and their *vimāna*s are shown in great detail and in three dimensions.[131]

A peculiarity of Jain cosmology in respect to the heavenly bodies above Manuṣyaloka is the belief that they occur in pairs separated by 180° within their respective orbits. Figure 16.31 illustrates this point with reference to the paths of the sun and the moon. The diagram relates to the day of Capricorn (the winter solstice). Hence the areas of the diagram assigned to the moon, signifying night, are somewhat broader than those assigned to the sun, signifying day, and are divided into a larger number of parts (six versus four). The attendant belief is that the sun and the moon each take two days to make a complete revolution around the earth, illuminating its southern half on one of those days and its northern half on the other.[132]

The seeming superfluity of suns and moons illuminating Jambūdvīpa pales in comparison with those for Manuṣyaloka as a whole. The actual numbers are indicated on figure 16.32, where they are written on the four diagonal spokes. Over Jambūdvīpa the figure 1 appears on each spoke, in two cases each for the sun and the moon; in the surrounding ocean, Lavaṇa Samudra, the number 2 appears on each spoke; in Dhātakīkhaṇḍa, the first ring continent, the number 6; in Kāloda, the next ring, the number 21; and in the outermost ring, which represents half the continent of Puṣkaradvīpa (up to the previously discussed Mānuṣottara mountain range that forms the outer limit of the world of man), the number 36. Thus, the total number of suns illuminating Manuṣyaloka is 132, while at distances of 90° from each of those suns there is a corresponding moon.[133]

The forms Jain artists used in depicting portions of their cosmos are not always as regular as in figures 16.30, 16.31, and 16.32. Thus, we find in figure 16.33 an illustration of "eight black fields" (*kṛṣṇarājī*s) in the third layer of the fifth heaven of the Brahmaloka (universe), which the texts describe "as being triangular or square,

131. Caillat and Kumar, *Jain Cosmology*, 176 and 190 (note 57), for general details, and facing pages for illustrations; the note on the Jain temple in Ajmer is based on a visit I made in 1980.

132. Caillat and Kumar, *Jain Cosmology*, 186–89 (note 57), for explanation and relevant illustrations.

133. Caillat and Kumar, *Jain Cosmology*, 178–79 (note 57); the illustration on 179 shows a multiplicity of symbols representing suns and moons beyond Jambūdvīpa, rather than the actual numbers indicated on figure 16.31, but this multiplicity merely suggests the increase as one moves away from the central region.

FIG. 16.31. SUNS AND MOONS ON THE DAY OF CAPRICORN. This Jain cosmography postulates two suns and two moons revolving around Jambūdvīpa, each completing one revolution every forty-eight hours. In this diagram, referring to the time of the winter solstice, the two quadrants signifying night are divided into three parts and are slightly broader than those signifying day, which are divided into only two parts. The artifact is gouache on paper, Rajasthani, eighteenth century.
Size of the original: not known. By permission of Ravi Kumar, Basel, Switzerland.

FIG. 16.32. SUNS AND MOONS REVOLVING AROUND MANUṢYALOKA. Numerous paired moons and suns revolve around the central axis of the universe in increasing numbers over successive concentric oceans and continents outward from Jambūdvīpa. The numbers in each successive ring are here written on the map, with a total of sixty-six suns or sixty-six moons on each of the four spokes depicted. The artifact is gouache on paper, Rajasthani, eighteenth century.
Size of the original: not known. By permission of Ravi Kumar, Basel, Switzerland.

and very thin," and "made up of particles of watery matter full of vegetable fragments which . . . flow from the Aruṇavara ocean of the middle world right up to the dizzy heights of the Brahmaloka." Allegedly the "triangular figures must be orientated to the north and south, the hexagonal ones to the east and west. It is in these masses, where every living being is born several times in the course of transmigration, that gods . . . produce rain or thunder."[134]

134. Caillat and Kumar, *Jain Cosmology*, 96–97 (note 57).

FIG. 16.33. THE EIGHT BLACK FIELDS IN THE THIRD LAYER OF THE BRAHMALOKA. In the third of the four layers of the Brahmaloka, the fifth Jain heaven, lie the *kṛṣṇarājīs* (eight "black fields"). The artifact is gouache on paper, Rajasthani, eighteenth century.
Size of the original: not known. By permission of Ravi Kumar, Basel, Switzerland.

Indo-Islamic Cosmography

Chapter 3 above presents a number of ways Muslims have attempted to portray the cosmos. Many of these conceptions undoubtedly found their way to India, though few Indo-Islamic cosmographies—apart from the distinct realm of celestial mapping (treated in chap. 2)—are known to have survived. To the views previously provided I here add some comments on various works of Indo-Islamic provenance that incorporate cosmographic symbolism and that some art historians have considered either metaphors for portions of the cosmos—most frequently paradise—or in some cases as literal re-creations of paradise on earth. Since the literature on the subject is extensive and for the most part readily available, I do not feel it is necessary to provide photographic illustrations of the ideas in question, but I do cite some key sources that will enable readers to pursue the subject independently in much greater depth than is possible here. Additionally, I describe one distinctive Indo-Islamic cosmographic conception and offer a few remarks on Mughal patronage of astronomy.

The Islamic penetration of India commenced with the Arab conquest of Sind in A.D. 711–12. Thereafter, for more than a millennium, numerous Muslim dynasties ruled over large parts of the subcontinent. In most areas, however, Muslims formed a relatively small part of the total population. Given the duration of the Muslim presence and the strength of the indigenous culture, some conjoining of religious traditions was inevitable, and with it came the diffusion of cosmological concepts. Since I have not explored in depth the dissemination of cosmological ideas within and among the several faiths of India, the discussion of Indo-Islamic cosmography that follows is intended to do no more than mention a number of themes that, in my view, warrant further research.

As far as I am aware, the earliest important instance of an Indian ruler's adopting indigenous Indian artifacts as cosmological symbols dates from the reign of the powerful and ostensibly zealously anti-Hindu Tughluq monarch Fīrūz Shāh. In the year 1360 he went to immense pains to dismantle and transport to his fort in Delhi three colossal monolithic pillars of the great Mauryan emperor Aśoka. Although all three pillars were reerected there, only one, known as the Topra pillar, still stands at that site. All three appear to have been placed by Fīrūz

> in front of his own personal mosque and Holy of Holies. . . . It is significant that the [remaining] pillar stands in the same relationship to the Islamic shrine as the sacred *dhvaja* or pillar (sometimes called "flagstaff") to a Hindu temple; or as the *yupa* (so-called "sacrificial post," but in essence another form of sacred pillar) once stood in relationship to the Vedic altar or *vedi*. In each case, its position was at the

> eastern extremity, half inside the compound and half out: a reminder of an ambivalence of acceptance and rejection which seems to have existed in many "historical" religions in the attitude to the so-called "symbols" of the *axis mundi* in earlier cosmic religions. . . . It transpires that Firuz Shah knew far more about the cosmic symbolism of "Ashokan" pillars than most historians. For instance his official chronicler places it on record that the correct name of the Topra pillar was *Minara-ye Zarrin* [golden pillar, so-called because it was gilt] and that it had grown up from . . . the Pleiades.[135]

Two centuries after Fīrūz, the mighty Mughal emperor Akbar (r. 1556–1605) also attempted, unsuccessfully, to transport to his intended but never-completed capital, Fathpur Sīkrī, another of the giant columns of Aśoka. Akbar's wide-ranging religious interests, his heretical religious practices, including sun worship, and in the years following 1575 his attempt to establish a new eclectic religious movement (later to be called the Dīn-i-Ilāhī [Divine Faith]), which he hoped would unite all Indians, are well documented. "But far less is known," observes Irwin, "about his interest in pillar worship and, in particular, his interest in cosmogonic myth, of which his so-called 'sun-worship' should be seen as a secondary aspect."[136] Another pillar that particularly fascinated Akbar was the pre-Aśokan "bull pillar" at the sacred site of Allahabad (ancient Prayāga), at the confluence of the Gaṅgā, Yamunā, and mythical Sarasvatī rivers, which has been interpreted as the " 'Place of Creation'. . . the mystical spot at which Heaven and Earth were initially separated. . . . [hence] the Navel of the Earth . . . [and] Centre of the Universe."[137] Although Akbar did not attempt to transport this pillar to his capital, he did construct in the Diwān-i-Khāss, the hall of audience at Fathpur Sīkrī, the central throne pillar that epitomizes in spirit the symbolic role of the *axis mundi*. In this, in the design of his thrones, and in other respects, Akbar sought to project himself as occupying the mystic center of the universe. Not surprisingly, therefore, one reads on the gateway to the gardens where his tomb was built the words: "These are the gardens of Eden, enter them to live for ever."[138]

Gardens were often seen metaphorically in the Muslim world as a re-creation of Eden, widely regarded as the seventh and highest level of the Muslim paradise, or, more generally, of paradise as a whole. But for Akbar's grandson Shāh Jahān, gardens were arguably more than a mere metaphor. In an abundantly and meticulously documented article, Begley seeks to demonstrate that the monarch, in his overweening pride, saw himself as God's agent on earth and the symbolic center of the world, and that he regarded the gardens he had built, especially that of his most sublime architectural monument the Tāj Mahal, *literally* as re-creations—along with the Tāj itself—of paradise. Each sector of the garden, he argues, each waterway and fountain, each gate, each basic component of the mausoleum and of the related buildings has its precise analogue in the textual representations of paradise and of the throne of God that form an important part of the Islamic religious tradition; and the calligraphy of the Tāj complex, setting forth apposite suras of the Koran, reinforces that message.[139] The cosmographic symbolism of the Islamic garden—and incidentally of the "garden rugs" into which the plans of gardens are woven—has been the focus of considerable literature, much of which Begley cites.[140] In one particularly relevant essay, Schimmel observes that

> many a writer, beginning with [the fourteenth-century Sufi poet] Amīr Khosrau, could claim that India must be Paradise itself, the very place out of which Adam was expelled. In an attempt to restore this Paradise Lost once more on earth, the Mughal rulers build their gardens and palaces: not in vain does the audience hall [of Shāh Jahān's Red Fort palace] in Delhi bear the proud inscription:
>
> If there is a Paradise on earth,
> it is here, it is here, it is here.[141]

135. John Irwin, "Akbar and the Cosmic Pillar," in *Facets of Indian Art: A Symposium Held at the Victoria and Albert Museum on 26, 27, 28 April and 1 May 1982*, ed. Robert Skelton et al. (London: Victoria and Albert Museum, 1986), 47–50, quotation on 47–48. At least one Muslim ruler before Fīrūz Shāh also reerected a pre-Islamic pillar in Delhi; Qutb al-Dīn Aibek, founder of the Delhi Sultanate (r. 1206–11), placed a Gupta-period iron pillar inside the courtyard of Delhi's first mosque, but there is no evidence that he attached any cosmological significance to this act. See Catherine Asher, "Jehangir and the Reuse of Pillars," to be published in a commemorative volume by the Archaeological Survey of India, ed. M. C. Joshi, manuscript p. 8 and n. 30.

136. Irwin, "Cosmic Pillar," 48 and the references cited there (note 135).

137. Irwin, "Cosmic Pillar," 49 (note 135).

138. Wayne E. Begley, "The Myth of the Taj Mahal and a New Theory of Its Symbolic Meaning," *Art Bulletin* 61, no. 1 (1979): 7–37, esp. 12. Concerning the words above the entrance gateway, see Edmund W. Smith, *Akbar's Tomb, Sikandarah, near Agra* (Allahabad: F. Luker, 1909), esp. 35.

139. Begley, "Taj Mahal," passim (note 138).

140. Particularly important are Ṣoubḥī el-Ṣaleḥ, *La vie future selon le Coran*, Etudes Musulmanes 13 (Paris: Librairie Philosophique J. Vrin, 1971), an exegetical work examining the relevant portions not only of the Koran itself, but of the major commentaries on it in regard, inter alia, to the topography of paradise; Elisabeth B. MacDougall and Richard Ettinghausen, eds., *The Islamic Garden* (Washington, D.C.: Dumbarton Oaks Trustees for Harvard University, 1976), an anthology of papers presented at the Fourth Dumbarton Oaks Colloquium on the History of Landscape Architecture, 1974; and L. Gardet, "Djanna" (paradise, garden), in *The Encyclopaedia of Islam*, new ed. (Leiden: E. J. Brill, 1960-), 2:447–52.

141. Annemarie Schimmel, "The Celestial Garden in Islam," in *The Islamic Garden*, ed. Elisabeth B. MacDougall and Richard Ettinghausen (Washington, D.C.: Dumbarton Oaks Trustees for Harvard University, 1976), 11–39, quotation on 20.

In his study of the Tāj, Begley notes the existence of various Islamic graphic representations of the heavenly regions that support the correspondences he has pointed out. Although most of the plans are of Middle Eastern provenance, Begley reproduces one depiction of paradise from an early eighteenth-century Indian manuscript, at present in the Bodleian Library, Oxford.[142] How many other such works may once have existed in India cannot be determined; but we know that Jahāngīr, the father of Shāh Jahān, possessed a copy of an important manuscript containing a diagram of the Plain of Assembly, in which Begley sees a close "iconographic parallel to the Taj's allegorical conception."[143]

In the discussion of world maps in the chapter on South Asian geographical mapping below, I call attention to a substantial number of paintings in which Shāh Jahān is portrayed either standing upon or holding a globe. In itself this would have no more cosmographic significance than do comparable paintings of Queen Elizabeth. But it is in order to point out here, as does Begley, that this exalted representation of the Mughal emperor was entirely in keeping with Shāh Jahān's inflated self-perception as the "vice-regent of God on earth" and, to employ the epithets of certain Sufi cosmological doctrines, "the embodiment of the Divine Pen," the " 'Shadow' of God's essence," the "Perfect Man." Thus, as for Akbar, a part of his cosmological preoccupation was with the throne, the analogue of the Koranic Divine Throne, and it is not surprising that his no longer extant Peacock Throne in the Red Fort palace in Delhi (Shāhjahānābād) was thought to be one of the most splendid creations in the rich panoply of Mughal art.[144]

Jahāngīr, the royal link between Akbar and Shāh Jahān, also utilized cosmographic symbolism and "attempted to integrate astrology with the administration of his empire. He built a tent which was divided into the twelve constellations of the Zodiac, and dressed his servants in uniforms with the symbols of the planets. 'He fitted up seven houses of audience named after the seven planets, and no other business might be effected except that appropriate to the day of the planet.' "[145]

Astrology was but one among a number of points of convergence between Indo-Islamic and Hindu cosmological thought; mystical doctrines provided others. It is conceivable that the latter may help explain one highly distinctive and eclectic Indo-Islamic cosmographic conception that appears to blend ideas taken from Hindu, Muslim, and Zoroastrian thought.

Although no indisputably Indian representation of this conception is known, a rendition of it, probably by an Indian artist, appears in an album of maps and drawings commissioned by Colonel Jean Baptiste Joseph Gentil, a French military officer in the service of the nawab of Oudh (now in Uttar Pradesh) during 1763–75.[146] (See also below, pp. 427–29.) The text accompanying the drawing is certainly by a French writer, perhaps Gentil himself.

Among the more or less "Indian" ideas in the diagram are that the world is supported by animals, one above the other, in this case a bull supported by a fish (in contrast to the serpent and the tortoise in some Hindu views); the importance of the bull (Nandi, in Indian mythology), which is shown with twenty-four horns (though the text says 80,000 "distant from one another by 1,000 days of travel for a good walker"), and the characteristic Indian hump; mountains of jewels (rubies directly above the bull and emeralds at the highest level); and an angel astride the mountain of jewels, who seems to function like the Jain cosmic man. Held aloft by the angel are seven circular lands alternating with six circular seas, though they are placed one above the other rather than in concentric rings, as in Hindu and Jain cosmographies. Additional features, possibly of Indian origin, are a supplementary mountain (in addition to the customary seven) analogous to Meru, with trees and a palace at the highest level; the large numbers and distances postulated, though modest by Jain or even Hindu standards; and finally, the dominantly vertical orientation of the universe.[147]

I am unable to state what currency the ideas presented in this cosmography enjoyed among Indian Muslims; but a note referring to some apposite text on a coin depicted with it suggests they were given some credence in Gentil's day as far away as Kandahar (now in south-central

142. Begley, "Taj Mahal," 14 and fig. 12 (p. 17) (note 138). The manuscript in question also contains sixty-six other illustrations of several holy places in Arabia, as well as depictions of both paradise and hell. "The style . . . is folkish, and undoubtedly represents a popular and provincial variant of Mughal court painting" (p. 14, n. 38).

143. Begley, "Taj Mahal," 25, including fig. 28 (note 138). Begley's n. 72 states that this manuscript, according to an autograph note by Jahāngīr, was among Jahāngīr's "most treasured books."

144. Begley, "Taj Mahal," 27–35, passim (note 138).

145. As cited in Blanpied, "Astronomical Program," 112 (note 96); some of the information comes from Jahāngīr's memoirs. Jahāngīr, like some of his Muslim predecessors, also reerected several pre-Islamic pillars, placing them in his capital at Agra and in the fort at Allahabad; but as with Aibek, we lack evidence that the pillars were intended as cosmological symbols. See Asher, "Reuse of Pillars" (note 135).

146. This work is in the Indian Department of the Victoria and Albert Museum in London. Its reference number is 15.25 1980, no. 35. Gole notes that "Gentil employed three Indian artists for a period of ten years to supply him with the illustrations needed for [his] albums." The names of two of these artists indicate that they were Hindus, while the third artist remains anonymous; Susan Gole, ed., *Maps of Mughal India: Drawn by Colonel Jean-Baptiste-Joseph Gentil, Agent for the French Government to the Court of Shuja-ud-daula at Faizabad, in 1770* (New Delhi: Manohar, 1988), 7.

147. Bess Allen Donaldson, *The Wild Rue: A Study of Muhammadan Magic and Folklore in Iran* (London: Luzac, 1938), suggests the sources for some of the features noted: the bull on the fish in the sea (p. 122); the mountain of emeralds (p. 90); a stratified series of mountains below the earth (p. 90); and the earth as the uppermost plane surrounded by the mountain of Ḳáf (pp. 89–90).

Afghanistan), where king Ahmad of the Abdali (Durrānī) dynasty ordered such coins to be struck.[148] Whether similar visual records of Indo-Islamic cosmographies will come to light is problematic. The widespread Muslim abhorrence of graven images may militate against it, but that aversion was never as strong in India as in the Middle East. In any event, we are dealing here with an exceedingly eclectic and heterodox conception.

The chapter on Islamic celestial mapping noted the achievements of Indian workshops making astrolabes and celestial globes. There is no need to reiterate that account here. But let me note in passing the existence of Indo-Islamic astronomical observatories. Although to the best of my knowledge no remains or even descriptions of such workshops survive, there are a number of textual references to them. According to Blanpied, "By implication, the Preface to the *Ziz Muhammad Shahi* [ca. 1835] admits to the existence of at least minor patronage of observational astronomy by the Moghul Emperors during the three centuries which separate Ulugh Beg from Jai Singh."[149] Akbar's father, Humāyūn, allegedly "regarded himself as something of a mathematician and astronomer. . . . [and] had a small personal observatory . . . in Delhi. . . . Abdul Fazl, writing during the reign of Akbar, claims that shortly before his death Humayun was planning to construct a larger observatory and had already chosen a site and obtained the necessary apparatus for it."[150] Further, Blanpied reports that "it has been alleged that Shah Jehan seriously contemplated erecting an observatory at Jaunpur in the province of Oudh" but was prevented from doing so by the coup against him staged by his son Aurangzīb.[151] Though little seems to have come of any of these efforts, that the Mughals were kindly disposed toward observational astronomy was presumably a factor enabling Jai Singh, whom I have already discussed, to carry out his own ambitious astronomical program.

Microcosmic Analogues of the Cosmos

Just as the Brahman, or universal spirit, infuses all things, so too, for many ritual purposes, an infinitesimal portion of the human domain is taken to represent the whole of the cosmos. Such symbology, of course, is not exclusively associated with religions of Indian origin, but what makes it noteworthy is that, when religious practitioners carry out rituals embodying cosmic symbols, those symbols are often drawn on a prepared field according to well-defined formulas with clear conventions as to how the cosmos is to be spatially differentiated and at what scale various portions of the cosmos are to be laid out. In these respects and possibly in others, the performance of certain rituals and the building of particular types of edifices incorporates an essentially cartographic process.

As noted above, the earliest Aryan sacrifices involved building altars or *vedi*s, some of which were remarkably large and elaborate structures. *Vedi*s, however, are by their nature ephemeral artifacts. One may still stumble on *vedi*s or their archaeological remains in traveling about India, but sacrifices today are much less important than they were in Vedic times, and their physical appurtenances are therefore commensurately rarer. I am aware of no *vedi*s preserved in, or specially built for, a museum or preserved in situ in their completed state for postsacrificial viewing. Rather, dismantling the *vedi* is often a part of the ritual process.

At a much more modest scale, certain folk sacrifices also entail cosmic or terrestrial symbolism, or both. One such example involves a festival known as the Govardhan Puja, in which adherents to the cult of Krishna make offerings to Mount Govardhan in the region of Braj, not far south of Delhi, where Krishna spent his youth. A legend in the *Bhāgavata Purāṇa* relates how Krishna persuaded the cowherds of Braj to give up their worship of the Vedic god Indra and worship Mount Govardhan instead. In his wrath, the angry Indra caused seven days and seven nights of rain to visit the region of Braj. But Krishna protected the cowherds by raising Govardhan on his little finger, letting them and their cattle find shelter beneath it. Today Krishna's devotees, in several parts of India, fashion mounds of cow dung into the form of Mount Govardhan, which they then worship. Into the dung they insert trees fashioned from stems of grass with tufts of cotton or rag on top, and around the mountain they place little men and cattle fashioned from balls of dung. Thus, in effect, a three-dimensional terrain model finds a place in a religious ritual.[152]

Like the preparation of *vedi*s, the construction of Hindu temples has since ancient times been regulated by an elaborate set of instructions covering every aspect of the work. The various scriptures containing these instructions—commented on briefly above—date from at least the first century B.C. These texts, as I noted, relate also to building in general and include chapters on building houses and on planning, laying out, and building villages and towns.[153] In her classic work *The Hindu Temple*,

148. I thank Iraj Bashiri of the University of Minnesota, Minneapolis, for translating the Persian text on the coin and for directing me to Donaldson, *Wild Rue* (note 147), and Monique Schwartzberg for help in translating the French text.

149. Blanpied, "Astronomical Program," 111 (note 96).

150. Blanpied, "Astronomical Program," 112 and the references cited there (note 96).

151. Blanpied, "Astronomical Program," 114 and the references cited there (note 96).

152. Deryck O. Lodrick, "*Gopashtami* and *Govardhan Puja*: Two Krishna Festivals of India," *Journal of Cultural Geography* 7, no. 2 (1987): 101–16, esp. 107–12.

153. A list of important texts is provided by Prabhakar V. Begde in

Stella Kramrisch sets forth and explains in great detail the rules for temple building. These rules include drawing on ground leveled for the temple a plan called the *vāstupuruṣamaṇḍala*, which is regarded as a "forecast" of the temple, "the fundament from which the building arises," and "the place for the meeting and marriage of heaven and earth, where the whole world is present in terms of measure, and is accessible to man."[154] Thus temple construction, like that of *vedi*s, required the preparation of an ephemeral one-to-one scale map. It seems not unlikely, however, that many smaller-scale plans would also have been prepared, at least for large and complex temples, with which India abounds. At least one such example (fig. 15.11) has survived, as we have seen, and several palm-leaf copies of exceedingly detailed, illustrated seventeenth-century copies of medieval architectural manuscripts (e.g., fig. 15.12) have also recently come to light. The latter illustrations, however, are not cosmographic in the same sense as is the *vāstupuruṣamaṇḍala*, and they are discussed below.

What is true of Hindu temples is, with appropriate modifications, also true of Buddhist stupas, whose cosmographic symbolism is in fact more explicit and easier to discern than is that of most temples. Although Buddhism became virtually extinct in India proper by about the thirteenth century and most Buddhist monuments have as a consequence fallen into ruin, dozens of massive masonry stupas have, in varying degrees, withstood the ravages of time;[155] and a few, such as the Great Stupa at Sanchi, initially constructed in the third century B.C. and greatly enlarged in the following century, are very well preserved or restored. Additionally, there are many other large stupas on or near the periphery of India, in the Himalayas and Sri Lanka, as well as in trans-Himalayan Tibet and Southeast Asia. Because of the particular association of stupas with Lamaistic (Tibetan) and Theravada (Southeast Asian) Buddhism, I shall defer my discussion of their cosmographic significance.[156]

Of cosmography in Jain architecture I shall here say nothing, since it appears not to have been a major focus for scholarly attention. Jain temples and shrines tend to be quite ornate, but in general their styles over the centuries and from one region to another have not varied significantly from those of the Hindus.

In city planning and secular architecture, Indian builders were, at least in theory, to be guided by theoretical texts that incorporated cosmographic and astrological principles. A number of these, collectively known as *vāstuvidyā*, were allegedly authored by Ṛṣis (mythical sages) and gods. In fact, the texts "appear to be collective works, built up of successive stratifications, of accretions, elaborations and modifications [over] the course of many centuries."[157] As with temples, builders were enjoined by these texts to draw mystic diagrams (yantras) on the ground as a forecast, in effect, of what was to emerge there (see also below, pp. 466–72).[158]

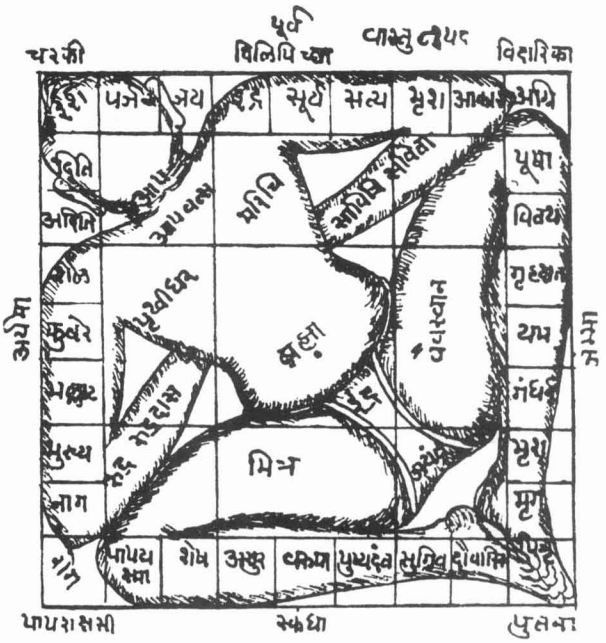

FIG. 16.34. *VĀSTUPURUṢAMAṆḌALA* (THE MANDALA OF THE COSMIC MAN). This drawing, from an old Indian manual of architecture (title, date, and provenance unspecified), shows one of thirty-two ways this mandala may be drawn (cf. fig. 15.13). By drawing the requisite horizontal and vertical lines on the ground before commencing construction, the architect summons forth from the earth the spirit of the cosmos (i.e., Brahma) personified by the cosmic man in the diagram.
Size of the original: not known. From Andreas Volwahsen, *Living Architecture: Indian* (London: Macdonald, 1969), 44.

Even in domestic architecture, there were associated cosmographic rituals. When constructing a house, one had to take into account at the outset the position within the ground of the *vāstupuruṣamaṇḍala*, the cosmic man, embodying the supreme principle or Brahman. This mandala, inherent in the earth itself, was marked on the ground before building could commence (fig. 16.34).[159]

Ancient and Mediaeval Town-Planning in India (New Delhi: Sagar Publications, 1978), 233–34.

154. Stella Kramrisch, *The Hindu Temple*, 2 vols. (Calcutta: University of Calcutta, 1946; reprinted Delhi: Motilal Banarsidass, 1976), 1:7.

155. Originally, stupas were earthen tumuli and hence not very durable (Basham, *Wonder That Was India*, 351 [note 15]).

156. See the discussion that will appear in the *History of Cartography*, volume 2, book 2.

157. Rāmacandra Kaulācāra, *Śilpa Prakāśa: Medieval Orissan Sanskrit Text on Temple Architecture*, trans. and annotated Alice Boner and Sadāśiva Rath Śarmā (Leiden: E. J. Brill, 1966), xiii.

158. Binode Behari Dutt, *Town Planning in Ancient India* (Delhi: New Asian Publishers, 1977), 142–43.

159. Andreas Volwahsen, *Living Architecture: Indian* (London: Macdonald, 1969), 43–46; and Brenda E. F. Beck, "The Symbolic Merger

Numerous household rituals entail similar considerations. The decorations that Indian women draw with rice paste in the courtyards of their homes, for example, typically contain cosmic elements, especially those designs known as *vrata alpana*, which are made in connection with sacred vows in exchange for some gift from the gods.[160] Similarly, patched shawls, coverlets, and wrapping cloths, made from cast-off pieces of fabric, are embroidered with motifs that portray portions of the cosmos.[161]

A widely held belief is that "in specialized Hindu rituals the individual joins with and even becomes identical to the cosmos itself. . . . [U]nder certain conditions the individual body and the universe are thought to actually merge."[162] Perhaps nowhere is this more apparent than in the practice of certain forms of yoga and in Tantrism, a long-lived, highly eroticized religious cult within Hinduism and also, in somewhat different form, within Tibetan and Himalayan Buddhism. Tantric art is particularly rich in illustrations fraught with cosmological symbolism. In both yoga and Tantrism, the practitioner engages in meditation, often aided by concentrating on an exterior mandala in Buddhism or yantra in Hinduism, mandalas generally being relatively complex and yantras relatively simple.[163] Both yantras and mandalas serve, to use a term coined by the renowned Tibetologist Giuseppe Tucci, as "psychocosmograms."[164] As such, they further the process by which one's self becomes a microcosm that fuses and becomes one with the enveloping macrocosm. One's spine then becomes the Meru or *axis mundi* of both. Arrayed along the spine are various centers of psychic energy that one summons up, in the practice of yoga, in moving toward the supremely illuminated *samādhi* state. These energy centers may be viewed as the psychophysiological analogues of the heavens that the soul traverses on its path to ultimate liberation—moksa in Hinduism or nirvana in Buddhism—whereby one is freed from the painful cycle of rebirth and made one with the infinite.

In regard to Tantric religious observances, Lannoy puts forward a similar concept:

> The idea that the human body is a microcosm . . . is essential to Tantric art, and it is expressed ritualistically in a number of ways. Both Tantric sexual rites and images related to this ritual are metaphors for the fire sacrifice, while the body of the woman is a homology of the Vedic altar. The ritual partner becomes a mystical terrain to be explored like the streets and sanctuaries of a holy city by a pilgrim. The Tantric poet Sahāra even discovers a sacred geography in his own body:
>
> I have walked with pilgrims, wandered round holy places.
> Nothing seems more sacred than my own body.
> Here flow the sacred Jamuna and the mother Ganges,
> Here are Prayaga and Benares, here the Sun and Moon.[165]

The mutability of space, time, and matter is related to the Hindu concept of *māyā*, of which Lannoy has this to say:

> Obviously the term *māyā*, which covers the whole of phenomenal existence, has been interpreted in many different ways. Since it is temporality it must be sacramentalized, or melt into Great Time, the cyclical cosmic rhythm. Since *māyā* is a collective hallucination veiling transcendental Reality, Absolute Truth can be grasped by various spiritual exercises (*sādhana*) through which one wakes to full consciousness. . . .
>
> The influence of this concept of *māyā* is of incalculable importance to patterns of thinking today. It is positive in the sense that it expresses India's sense of the transience of life, of mutability, and that this provides solace to those who can look forward to nothing but suffering. It is negative in the sense that the brute

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of Body, Space and Cosmos in Hindu Tamil Nadu," *Contributions to Indian Sociology*, n.s., 10 (1976): 213–43, esp. 213–14 and 226–28. Other examples of *vāstupuruṣamaṇḍala*s, taken from a Nepali book of iconographic drawings dated about 1800, are illustrated and briefly discussed in Pal, *Art of Nepal*, 174–76 (note 65). A fascinating, well-illustrated analysis of the way the *vāstupuruṣamaṇḍala* and certain related cosmological conceptions figure not only in the construction but also in the subsequent organization and use of a number of actual houses in the southwest Indian state of Kerala is provided by Melinda A. Moore, "The Kerala House as a Hindu Cosmos," in *India through Hindu Categories*, ed. McKim Marriott (New Delhi: Sage Publications, 1990), 169–202.

160. Stella Kramrisch, *Unknown India: Ritual Art in Tribe and Village* (Philadelphia: Philadelphia Museum of Art, 1968), 65–66; and Sudhansu Kumar Ray, *The Ritual Art of the Bratas of Bengal* (Calcutta: Firma K. L. Mukhopadhyay, 1961), 42. Both works are well illustrated; regrettably, however, there is no illustration to support Ray's statement (p. 44): "In Rajasthan, *alpanas* are still drawn to depict cities protected by walls and cultivated lands with irrigation channels indicated by water-marks."

161. Kramrisch, *Unknown India*, 66–67 (note 160); and Stella Kramrisch, "Kanthā," *Journal of the Indian Society of Oriental Art* 7 (1939): 141–67.

162. Beck, "Symbolic Merger," 214 (note 159).

163. Numerous texts on Indian art and religion contain illustrations of yantras. A particularly rich collection with explanations of the purposes to be served by a large variety of yantras is S. K. Ramachandra Rao, *Tantra Mantra Yantra: The Tantra Psychology* (New Delhi: Arnold-Heinemann, 1979).

164. Giuseppe Tucci, *The Theory and Practice of the Maṇḍala: With Special Reference to the Modern Psychology of the Subconscious*, trans. Alan Houghton Brodrick (New York: Samuel Weiser, 1970; first published by Rider, 1969), 25. S. K. Ramachandra Rao states: "Mandala has been variously translated by experts as 'cosmogram,' 'cosmogenic model,' 'map of the soul,' 'cosmic plan,' 'symbol of Kosmos,' and 'layout of the psyche' "; see his *Tantra Mantra Yantra*, 26 (note 163).

165. Richard Lannoy, *The Speaking Tree: A Study of Indian Culture and Society* (London: Oxford University Press, 1971), 28.

> facts of life are, in the final analysis, either illusory or of secondary importance and that nothing one does can alter them for the better. While *māyā* is therefore a consolation in the face of sorrow because it implies that life need never be taken too seriously, it also serves as a rationale for apathy.[166]

Conceivably, Lannoy overstates his case, though he is hardly alone in holding the views just expressed. But to the extent that he is correct and that people's worldview is informed by the belief in *māyā*, making maps would seem a pursuit of trivial importance.

The all-important Indian concern with the process of reincarnation finds graphic expression even in play. Over much of South Asia and the adjoining realms of Lamaistic and Mahayana Buddhism, one encounters board games incorporating tracks that players follow in pursuit of moksa or nirvana. Such tracks constitute, in effect, fantasy route maps for the soul and are in relation to conventional route maps what many cosmographies are to maps of the world.[167] Although the physical format of the games varies from one region to another, most entail a series of levels leading to successively more exalted states, the highest level being moksa, nirvana, union with Shiva, or something comparable. The rules also specify circumstances that lead to dramatic rises and falls in the level of the player's (soul's) existence. The English parlor game snakes and ladders is derived from an Indian prototype of this kind.[168]

Cosmography and Mental Maps

A topic that has not yet been adequately explored is the nature of South Asian mental maps—that is, the ways South Asians envisage the spatial attributes of their immediate world and the larger areas encompassing them. To what extent, one wonders, does the preexistence of culturally conditioned and richly detailed mental maps among significant sections of a population render making tangible maps a superfluous exercise? Did such a factor greatly inhibit the making of tangible maps in the past, when the hold of religion on people's minds was even greater than it is today? Given the Indian capacity to see the large in the small (and vice versa), what need was there to map the former? Writing of Varanasi, Diana Eck observes:

> As a microcosm, Kāśī is said to contain all the *tīrthas* of India's sacred geography within her borders. Thus, in the city of Kāśī there are temples, tanks, lakes, and rivulets which represent the symbolic presence of such places as Kedārnāth and Badrīnāth in the Himālayas, Kāñcī and Rāmeśvaram in the Tamil south, Purī in the east, Dvārakā in the west, the old cities of Mathurā, Ayodhyā, and Ujjain, the Narmadā and Godāvarī rivers, the Vindhya and Himālaya mountains.
>
> In Kāśī, the whole of the sacred world is gathered together into one place.[169]

In 1975–76, a Sri Lankan Tamil anthropologist, E. Valentine Daniel, performed a series of experiments in the Indian state of Tamil Nadu in which he asked two sets of informants from the village of Kalappūr (a pseudonym) to draw for him a map of either the *kirāmam*, signifying the clearly defined revenue village (group 1), or the *ūr*, the village conceived as a space the villagers identified with (group 2). Even though the answers to prior questioning of the villagers had shown Daniel that the villagers believed the two areas were equivalent, the maps made in response to his experiment were notably different. The group 1 respondents all began by drawing boundary lines around the village that attempted, within the limits of their ability, to replicate what one would have found on a cadastral map of the village. The group 2 respondents

> began not with the periphery of the village but at its center, with the noting of the important places, such as the temple, the priest's house, the crossroads, and so on. Only then did attention shift to the periphery. All the respondents took great care to mark the shrines of the sentinel deities, the points at which roads or the village stream enters the village, and the haunted tamarind trees that dot the edge of the village.[170]

Some of the group 2 informants did draw a boundary line around the *ūr*, connecting the outermost of the points of the types just noted, but many did not. In any case, the sets of maps the two groups produced were notably different.

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166. Lannoy, *Speaking Tree*, 287–88 (note 165).

167. An example of such a game will be provided in the *History of Cartography*, volume 2, book 2, in the discussion of Greater Tibet.

168. F. E. Pargiter, "An Indian Game: Heaven or Hell," *Journal of the Royal Asiatic Society*, 1916, 539–42, with foldout illustration facing 539.

169. Diana L. Eck, *Darśan: Seeing the Divine Image in India* (Chambersburg, Pa.: Anima Books, 1981), 54. The theme is developed at much greater length in Diana L. Eck, *Banāras: City of Light* (New York: Alfred A. Knopf, 1982). In this latter work, Eck notes the existence in Varanasi of "a modern temple called Bhārat Mātā, 'Mother India,' containing no ordinary image in its sanctum, but rather a large relief map of India, with its mountains, rivers, and sacred *tīrthas* carefully marked. It is a popular temple with today's pilgrims, who circumambulate the whole map and then climb to the second-floor balcony for the *darshana* [sanctifying view] of the whole" (pp. 38–39). See also Rana P. B. Singh, "The Socio-cultural Space of Varanasi," *AARP (Art and Archaeology Research Papers)* 17 (*Ritual Space in India: Studies in Architectural Anthropology*, ed. Jan Pieper) (1980): 41–46. What has been described for Varanasi also holds true in varying degrees for numerous other sacred cities of India; Singh provides a partial list on p. 45.

170. E. Valentine Daniel, *Fluid Signs: Being a Person the Tamil Way* (Berkeley: University of California Press, 1984), 72–79, esp. 74. I have described here only a portion of Daniel's experiments with maps.

The conclusion Daniel drew from this experiment is that the *ūr* "does not have, in Tamil cultural terms, a clearly delineated boundary line, as does the kirāmam, and that in the correct drawing of an ūr map, the ūr ellai [limit] is depicted most accurately by the shrines and intersecting roads that mark the vulnerable points along the village frontier." He adds that "the discovery that an ūr, the culturally more significant and indigenous concept of territory, does not have a boundary sheds a new beam of light on the continuing explorations into the issue of regionalism in India."[171] Daniel explicitly concurs with the view of a fellow anthropologist (and historian), Bernard S. Cohn, "that a region may find its defining feature in a 'symbol pool.' "[172] If so, the absence of regional boundaries, either political or of another nature, on traditional Indian maps is all the more understandable. One should of course not generalize from a single village in the Dravidian state of Tamil Nadu to the whole of India, and much less to other countries of South Asia, and one should recognize that experiments conducted in the latter part of the twentieth century cannot provide infallible guides to the worldview of Indians in the precolonial period. Nevertheless, further studies along the lines demonstrated by Daniel are called for if we are to deepen our understanding of how Indians mentally map their world and, by extension, of how the content of many traditional maps was determined.[173]

171. Daniel, *Fluid Signs*, 78 (note 170).

172. Daniel, *Fluid Signs*, 78 (note 170). The work Daniel cites is Bernard S. Cohn, "Regions Subjective and Objective: Their Relation to the Study of Modern Indian History and Society," in *Regions and Regionalism in South Asian Studies: An Exploratory Study*, ed. Robert I. Crane, papers presented at a symposium held at Duke University, 7–9 April 1966, Monograph and Occasional Papers Series, Monograph 5 (Durham, N.C.: Duke University Program in Comparative Studies on Southern Asia, 1967), 5–37; the idea of the symbol pool is developed on 22–25.

173. The scope of this work prevents my embarking on a discussion of an additional topic that is closely associated with the idea of mental maps, namely, the organization of space, especially urban space and sacred space, to conform with the mental maps of South Asians or, to put it differently, to create within the real world the homologue of a culturally shaped mental map. An interesting series of papers that explores this topic, among others, is Niels Gutschow and Thomas Sieverts, eds., *Stadt und Ritual: Beiträge eines internationalen Symposions zur Stadtbaugeschichte Süd- u. Ostasiens*; *Urban Space and Ritual: Proceedings of an International Symposium on Urban History of South and East Asia*, Beiträge und Studienmaterialen der Fachgruppe Stadt 11 (Darmstadt: Technische Hochschule, 1977). Of the eighteen papers in this volume, nine relate to South Asia and a tenth to the predominantly Hindu culture area of Bali.

APPENDIX 16.1 A STATISTICAL SUMMARY OF ATTRIBUTES OF FORTY-FOUR JAIN COSMOGRAPHIES CENTERED ON JAMBŪDVĪPA

Attribute	Findings
Provenance	Gujarat, 17; Rajasthan, 16; other "western India," 1; eastern India, 2; unspecified, 8
Date (century)	15th, 2; 16th, 7; 17th, 6; 17th or 18th, 2; 18th, 14; 18th or 19th, 1; 19th, 5; 20th, 2; unspecified, 4
Medium	Gouache, 25; gouache and ink, 5; ink, 1; silk embroidery, 1; unspecified, 12
Material	Cloth, 20 (including all 15th- and 16th-century examples); paper, 15; unspecified, 9
Height	Average (of 18), 71.8 cm; maximum, 160 cm; minimum, 11 cm; unspecified, 26
Width	Average (of 18), 71.9 cm; maximum, 162.5 cm; minimum, 9 cm
Number of colors[a]	Average (of 26), 4.5; 7, 1; 6, 6; 5, 11; 4, 6; 3, 1; 2, 0; 1, 1; unspecified, 18
Orientation	Videha region (see fig. 16.5) horizontal, 44; Videha region vertical, 3
Number of continents	2½, 27; 2, 2; 1, 14; unclear, 1
Degree of detail	More than 100 features depicted, 22; 50–100 features, 19; fewer than 50 features, 3
Centeredness	Centered on Mount Meru, 43; unclear, 1 (frayed in center)
Depiction of anthropomorphic figures[b]	16 or more figures, 13; 8 figures, 3; 4 or 2 figures, 3; without figures, 21
Depiction of trees	16 or more trees, 18; 8–15 trees, 4; 4 trees, 2; 2 trees, 2; number of trees unclear, 1; without trees, 17
Text	More than 100 words, 20; 50–100 words, 5; fewer than 50 words, 8; no text, 11
Dimensional notations	Numerical notations given for dimensions of features depicted, 14; no such notations, 25; unclear (largely because of scale of photo), 5
Symbols for sea[c]	3 or more symbols used, 8; 2 symbols used, 13; 1 symbol used, 18; no symbol used, 4; sea not depicted, 1; waves, 30; fish, 25; other, 13
Color of sea	Blue only, 20; blue and red, 1; other, 2; unclear, 20 (mainly on black-and-white photographs), 20; sea not depicted, 1
Symbols for rivers	2 symbols (waves and fish), 3; waves only (not counting color), 18; symbols indistinct, questionable, or missing, 23
Color of rivers	Blue, 19; other, 3; unclear, 22 (mainly on black-and-white photographs)
Color of mountains[d]	4 colors, 13; 3 colors, 8; 2 colors, 2; unclear, 21 (but almost all these black-and-white photos appear to have more than one shade for mountains); yellow, 20; red, 20; green, 18; white, 13; brown, 2; blue, 1
Corner detail	Text, 18 (text only, 8); architectural details, 15 (architectural details only, 2); anthropomorphic figures, 11 (figures only, 1); geometric designs, 5; trees, 2; other vegetation and/or animals, 7; flags, 1; solid colors, 2; no detail, 7; unclear, 1
Borders	Double line, 13; single line, 3; colored band, 15; floral design, 2; fringe, 1; no border, 13; unclear, 1 (border features are not mutually exclusive)

Sources: Collette Caillat and Ravi Kumar, *The Jain Cosmology*, trans. R. Norman (Basel: Ravi Kumar, 1981), photos on frontispiece and pp. 107, 119–23, 127 (two depictions), 141, 143, and 144; Moti Chandra, *Jain Miniature Paintings from Western India* (Ahmadabad: Sarabhai Manilal Nawab, 1949), fig. 189; Saryu Doshi, *Masterpieces of Jain Painting* (Bombay: Marg Publications, 1985), 14; Toby Falk and Mildred Archer, *Indian Miniatures in the India Office Library* (London: Sotheby Parke Bernet, 1981), 544; O. C. Gangoly, *Critical Catalogue of Miniature Paintings in the Baroda Museum* (Baroda: Government Press, 1961), pl. XIX; John Irwin and Margaret Hall, *Indian Embroideries*, Historic Textiles of India at the Calico Museum, vol. 2 (Ahmadabad: S. R. Bastikar on behalf of Calico Museum of Textiles, 1973), pl. 30; Willibald Kirfel, *Die Kosmographie der Inder nach Quellen dargestellt* (Bonn: Kurt Schroeder, 1920; reprinted Hildesheim: Georg Olms, 1967; Darmstadt: Wissenschaftliche Buchgesellschaft, 1967), pls. 5 and 6; Ajit Mookerjee, *Tantra Art: Its Philosophy and Physics* (New Delhi: Ravi Kumar, 1966), fig. 25; idem, *Tantra Asana: A Way to Self-Realization* (New York: George Wittenborn; Basel: Ravi Kumar, 1971), pl. 20; Ajit Mookerjee and Madhu Khanna, *The Tantric Way: Art, Science, Ritual* (London: Thames and Hudson, 1977), 19 and 70;

Armand Neven, *Le Jainisme: Religion et culture de l'Inde: Art et iconographie* (Brussels: Association Art Indien, 1976), figs. 117 and 120; idem, *Peintures des Indes: Mythologies et légendes* (Brussels: Crédit Communal de Belgique, 1976), 17; Francesco L. Pullé, *La cartografia antica dell'India,* Studi Italiani di Filologia Indo-Iranica, Anno IV, vol. 4 (Florence: Tipografia G. Carnesecchi e Figli, 1901), 33–34; Philip Rawson, *Tantra: The Indian Cult of Ecstasy* (London: Thames and Hudson, 1973), fig. 60; Joseph E. Schwartzberg, personal collection; Umakant P. Shah, ed., *Treasures of Jaina Bhaṇḍāras* (Ahmadabad: L. D. Institute of Indology, 1978), fig. 159; Chandramani Singh, "Early 18th-Century Painted City Maps on Cloth," in *Facets of Indian Art: A Symposium Held at the Victoria and Albert Museum on 26, 27, 28 April and 1 May 1982,* ed. Robert Skelton et al. (London: Victoria and Albert Museum, 1986), 186; Sugiura Keohei, ed., *Ajia no kosumosu mandara* [The Asian cosmos], catalog of exhibition, "Ajia no Ucheukan Ten," held at Rafeore Myeujiamu in November and December 1982 (Tokyo: Kodansha, 1982), figs. 4/19–4/22 (six depictions); Kay Talwar and Kalyan Krishna, *Indian Pigment Paintings on Cloth,* Historic Textiles of India at the Calico Museum, vol. 3 (Ahmadabad: B. U. Balsari on behalf of Calico Museum of Textiles, 1979), pls. 92–95; *Le Tantrisme dans l'art et la pensée* (Brussels: Palais des Beaux-Arts, 1974), 5 and 21; London, British Library, Add. MS. 26, 374, OR 2116C, and OR 13476; and London, Victoria and Albert Museum, photo, negative no. GB3636.

a. In counting colors, each of the three primary and three secondary colors was considered irrespective of hue, and brown, black, and white (if painted) were also considered colors.

b. Anthropomorphic figures could be either deities or human beings; identifications frequently could not be made.

c. "Other" symbols in the sea included animals (e.g., turtles), anthropomorphic figures, geometric designs, and dots.

d. For the symbols used to depict the Mānuṣottara Mountains, midway across the third Jain continent, see figure 16.28.

APPENDIX 16.2 A STATISTICAL SUMMARY OF ATTRIBUTES OF TWENTY-FOUR COSMOGRAPHIES DEPICTING THE THREE MAJOR COMPONENTS OF THE JAIN UNIVERSE

Attribute	Findings
Provenance	Rajasthan, 11, Gujarat, 6; other "west Indian," 2; unspecified, 5
Date (century)	15th or 16th, 1; 16th, 3; 17th, 3; 17th or 18th, 2; 18th, 7; 19th, 2; 20th, 3; unspecified, 3
Medium	Gouache, 11; gouache and ink, 7; ink, 1; unspecified, 5
Material	Cloth, 10; paper, 9; unspecified, 5
Height	Average (of 15), 107.7 cm; maximum, 420 cm; minimum, 25 cm; unspecified, 9
Width	Average (of 15), 52.7 cm; maximum, 106 cm; minimum, 10 cm; unspecified, 9
Number of colors[a]	Average (of 11), 5,1; 7, 2; 6, 1; 5, 4; 4, 4; unspecified, 13
Representation of Jambūdvīpa	Rotated 90°, so that horizontal plane appears vertical, 19; shown as horizontal disk, 2; not shown, 3
Orientation of Videha[b]	Horizontal, 11; vertical, 6; ambiguous, 2; not shown, 5
Central column	Present in all three major levels, 20; present in part, 3; not present, 1
Illustration of anthropomorphic figures[c]	12 (figures in central column only, 5); geometric designs, 11 (designs only, 3); other illustrations, 4; text in column, 5; unclear elements, 3; not applicable, 1
Width of hells	Diminishing as in an ascending stair pattern (⌐⌐), 17; diminishing by a uniform slope (/), 6; uniform (|), 1
Width of heavens	Widening, then diminishing, in a stair pattern (⊏⊐), 17; widening, then diminishing, by a uniform slope (<), 5; uniform (|), 2
Checkered grid	Present in hells and heavens, 17; absent, 7
Text on or adjacent to central figure	More than 100 words, 4; 50–100 words, 1; fewer than 50 words, 7; no text, 12
Text in nearby field[d]	More than 100 words, 3; 50–100 words, 5; fewer than 50 words, 3; no text, 13
Dimensions on or adjacent to central figure	Present, 15; absent, 9
Dimensions in nearby field	Present, 9; absent (includes cases with no nearby field), 15
Universe shown as anthropomorphic figure	Explicit, 15; not explicit, 9
Ancillary illustration in nearby field	Present, 3; absent, 21
Borders	Double or triple line, 9; single line, 3; colored band, 6; floral design, 5; geometric design, 3; no border, 6 (border features noted are not mutually exclusive)

Sources: Collette Caillat and Ravi Kumar, *The Jain Cosmology*, trans. R. Norman (Basel: Ravi Kumar, 1981), 51, 53, 55, and 57; *In the Image of Man: The Indian Perception of the Universe through 2000 Years of Painting and Sculpture*, catalog of exhibit, Hayward Gallery, London,

25 March–13 June 1982 (New York: Alpine Fine Arts Collection, 1982), 126; Willibald Kirfel, *Die Kosmographie der Inder nach Quellen dargestellt* (Bonn: Kurt Schroeder, 1920; reprinted Hildesheim: Georg Olms, 1967; Darmstadt: Wissenschaftliche Buchgesellschaft, 1967), pl. 4; Ajit Mookerjee, *Tantra Art: Its Philosophy and Physics* (New Delhi: Ravi Kumar, 1966), figs. 20, 71, and 77; Ajit Mookerjee and Madhu Khanna, *The Tantric Way: Art, Science, Ritual* (London: Thames and Hudson, 1977), 71; Armand Neven, *Le Jainisme: Religion et culture de l'Inde: Art et iconographie* (Brussels: Association Art Indien, 1976), figs. 110 and 116; idem, *Peintures des Indes: Mythologies et légendes* (Brussels: Crédit Communal de Belgique, 1976), 14; Philip Rawson, *The Art of Tantra*, rev. ed. (New York: Oxford University Press, 1978), fig. 131; idem, *Tantra: The Indian Cult of Ecstasy* (London: Thames and Hudson, 1973), fig. 77; Joseph E. Schwartzberg, personal collection; Umakant P. Shah, ed., *Treasures of Jaina Bhaṇḍāras* (Ahmadabad: L. D. Institute of Indology, 1978), fig. 93; Sugiura Keohei, ed., *Ajia no kosumosu mandara* [The Asian cosmos], catalog of exhibition, "Ajia no Ucheukan Ten," held at Rafeore Myeujiamu in November and December 1982 (Tokyo: Kodansha, 1982), figs. 4/5–4/7; *Le Tantrisme dans l'art et la pensée* (Brussels: Palais des Beaux-Arts, 1974), 21, 25, 30, and 38.

a. In counting colors, each of the three primary and three secondary colors was considered, irrespective of hue, and brown, black, and white (if painted) were also considered as colors.

b. See "Orientation" in appendix 16.1.

c. The anthropomorphic figure is an androgynous cosmic being.

d. "Nearby field" signifies a part of the page or cloth that does not form an integral part of the illustration.