

13. ASTRONOMICAL STUDIES OF VIJAYANAGARA I. THE SACRED HILLS

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INTRODUCTION

During the 1991 field season we initiated a series of investigations of the archaeoastronomy of Vijayanagara. Our postulate in this study is that at a certain level of organization the city manifests planning which incorporated astronomical directions, symbolism, and cycles with local geography and myth. Our studies include the orientations of temples and palaces, the role of the hills and other major geographic features in the organization of the city, and references in epigraphic and other historical material to astronomical events such as solstices, equinoxes, zenith sun, and eclipses.

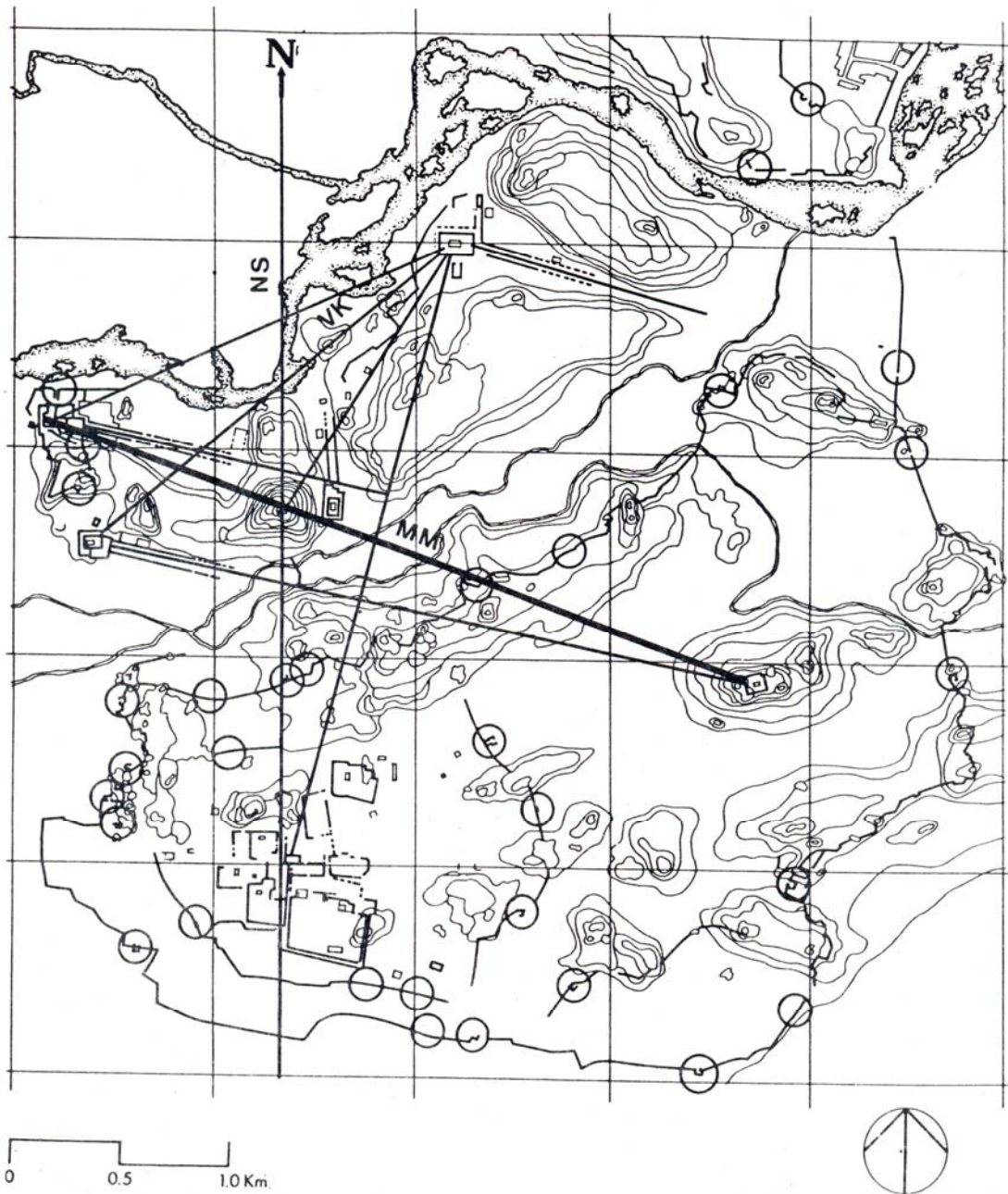
Local geography, of course, provides the physical substrate for the organization of space in a city, and hills, especially if they are invested with mythic or sacred meaning, may function as pivotal nodes and centres of symmetry. In this paper we consider four major hills within or near the city, Matanga, Malyavanta, Anjenadri, and Hemakuta, each of which has played a particular role in the history and mythology of Vijayanagara. Each of these hills has influenced the spatial organization of certain sections of the city, serving as an attractive centre for its area of symbolic influence. In addition our investigations reveal a high degree of connectivity among the hills and suggest a complex, geometrical plan which established the placement of the major structures of the city.

SACRED HILLS

A. Matanga hill

1. Summit: While the founding of Vijayanagara is historically credited to the first kings Harihara I and Bukkaraya I, the origin myths of the city identify the sage Vidyaranya as its founder. According to the *Rayavacakamu*¹ Vijayanagara was founded close to Matanga hill because of the symbolic protection promised by the sage Matanga to Sugriva. On the mountain the natural predatory order was reversed, and all who dwelled upon it were protected from their enemies.

Although Vijayanagara was not constructed on the mountain itself, Matanga was regarded as extending a symbolic blanket of protection over the surrounding landscape. Its ritual significance is demonstrated by three monumental staircases constructed of great slabs of granite, an apparent *pradakshina* path around its base starting from the eastern end of the car street of Virupaksha temple, and the north road connecting the royal centre with the base of the mountain. Within the mountain are two sets of caves. Since caves and mountains are such fundamental aspects of Hindu mythology and temple design, their presence reinforces the symbolic and historic significance of the hill. The higher cave follows a semi-circular route within the mountain starting in an east facing, carved doorway and ending at a distance of 65



53. Axes of Vijayanagara

metres in a small chamber containing a Shiva linga and a statue of Nandi. The larger and lower cave crosses the mountain from west to east starting with a carved image of Ganesha. According to a local tradition this lower cave was the one in which Matanga and Sugriva once lived.

On the summit of Matanga hill has been built the Virabhadra temple, dedicated to the fierce and militant form of Shiva who appears with four arms, holding a sword, shield, bow, and arrow and faces north. There are no inscriptions to date the construction of the temple, but the inner shrine of the temple is perhaps one of the earliest of the Vijayanagara period² (Fig. 20). The temple lacks the architectural sophistication and symmetry which characterize many of the Vijayanagara temples. Its somewhat haphazard and disjointed floorplan suggests several stages of construction and renders it difficult to establish definite axes. Our measurements of the columns in its eastern *mandapa* indicate an alignment to $359^{\circ} 47'$. Thus situated on the highest and most significant hill of the city, the shrine on its summit defers to no other point within the city and faces true north within $13'$.

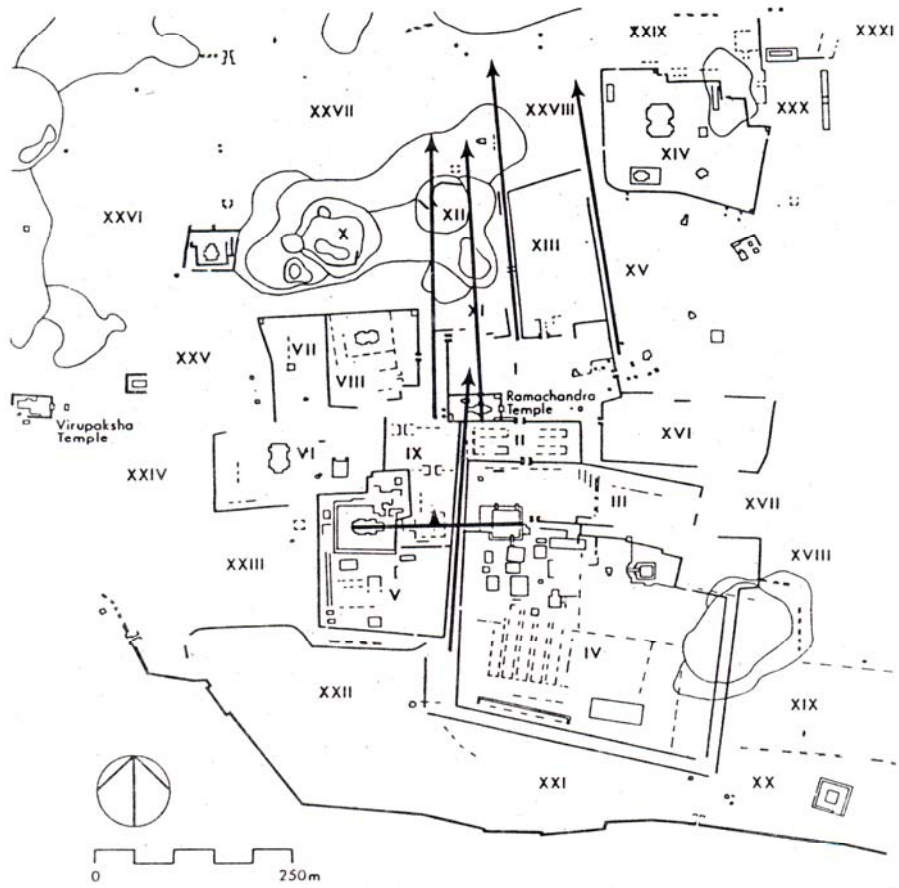
Two major axes of the city cross on the summit of Matanga hill (Fig. 53):

- NS: north-south axis which passes through Kodandarama temple on the north and through the large ceremonial gateway in enclosure IX of the Royal Centre;
- MM: an axis connecting Matanga and Malyavanta hills which aligns approximately with sunrise on the morning of Makara sankranti and

with Virupaksha temple.

2. North-south axis (NS): This axis divides the Royal Centre into two distinct sections that respectively manifest the public and private dualities of kingship (Fig. 54). Palaces are primarily in the western half, while the 100 column audience hall, the Mahanavami Dibba, the elephant stables and other structures associated with military activity lie to the east. The north-south line which crosses the tower of the Virabhadra temple on Matanga hill passes through the centre of one of the major gateways of the royal centre (Fig. 54). As viewed from the centre of that gateway the prominent *sikhara* of the Virabhadra temple lies less than $2'$ east of true north and, thus, directly above Matanga hill lies the fixed pole of the heavens. Since the unaided human eye can not resolve angles smaller than approximately $1.5'$, the accuracy of alignment is remarkable. Due to the effect of precession of the earth's axis of rotation, in A.D. 1500 Polaris was 3.8° from the true north pole, and hence the extraordinarily precise alignment of the ceremonial gateway and Virabhadra temple was achieved by methods other than simply sighting on the pole star.

In the *Ajitagama*,³ a manual dealing with religious architecture, the technique for establishing geographic north using the gnomon is described in detail. The act of erecting a column and laying out cardinal directions was probably viewed as a ritual re-enactment of the creation of the world.⁴ The gnomon itself partakes of the symbolism of the *axis mundi*, and perhaps also the *yupa* and *stamba*. A day was chosen when the sun was without blemish (there were no naked eye sunspots) and the sun was north of the



54. Royal Centre. Alignments of the Ramachandra Temple, the north road, and a eastern wall to Matanga hill are indicated. The alignment of the passage leading to Ramachandra temple to Anjenadri hill is shown.

celestial equator (the sun has risen above the chaos of the southern ocean). The gnomon was set in a square area "as smooth as a mirror". The two points where the shadow of the gnomon crossed a circle with a radius equal to the height of the gnomon were marked, yielding an east-west line (Fig. 55).

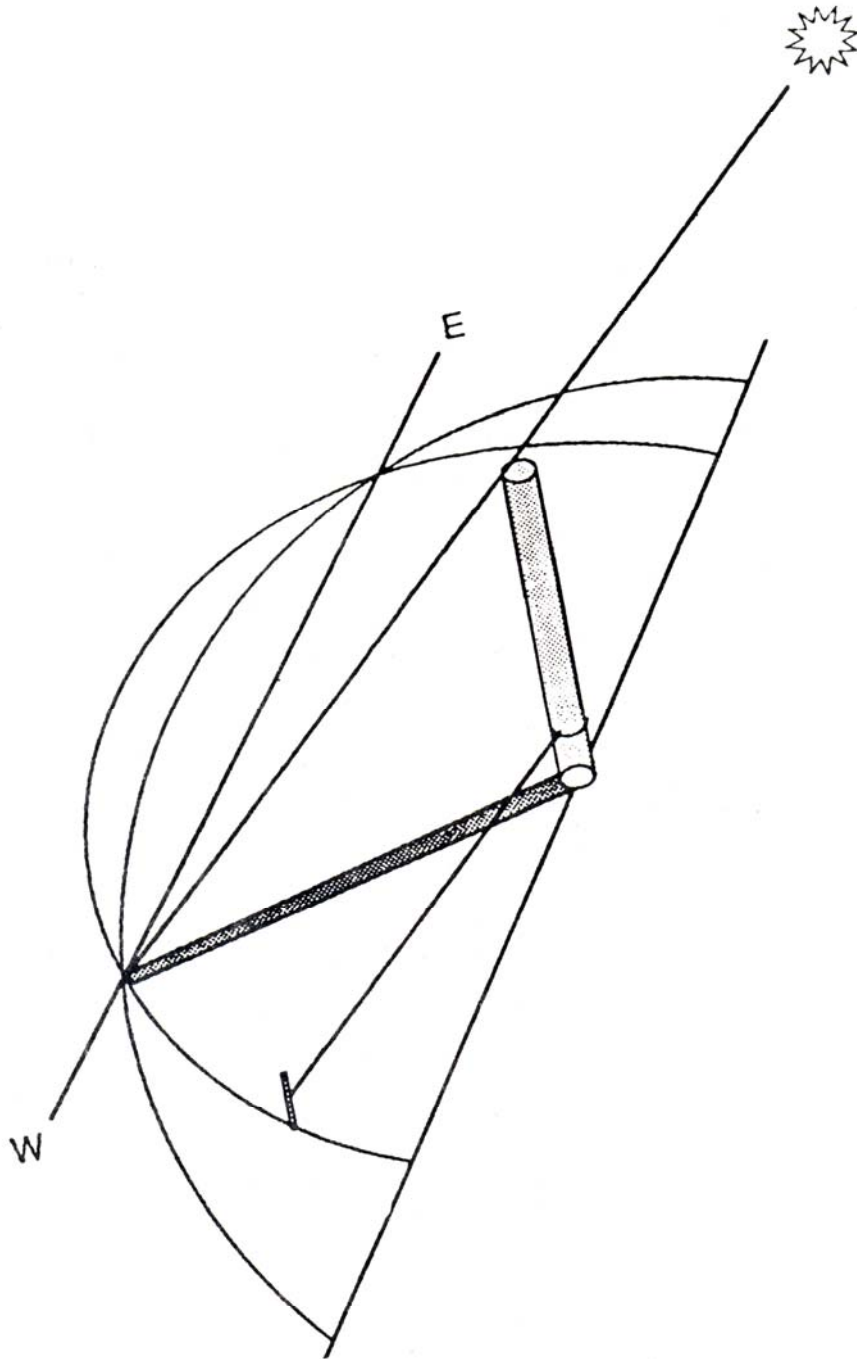
It was recognized as early as the 7th century A.D. that this method was inaccurate due to a very slight change in the position of the sun among the stars between morning and afternoon observations.⁵ By the 11th century elaborate mathematical formulae were available to provide the necessary corrections to the gnomon observations. By means of ritual measurement using the gnomon and ritual mathematics the position of north could be established with an accuracy limited only by the resolving power of the human eye.

The motif of separation of space into eastern and western halves by the NS axis is further elaborated by the placement of the 100 column audience hall and the large palace in enclosure V (Fig. 54). The axis nearly precisely bisects the line connecting them. The centre of the major, east facing room of the palace lies 92.8 m to the west of the axis while the centre of the 100 column hall lies 89 m to the east. As viewed from a point midway between these two structures, the *sikhara* of Virabhadra lies 4' from true north.

3. Matanga-Malyavanta axis (MM): The most obvious manifestation of this axis is the location of Virupaksha temple (Fig. 53). As measured from the roof of Virabhadra temple just above the shrine the *gopuram* of the Prasanna Malyavanta temple has an azimuth of $111^{\circ} 35'$. Exactly opposite lies Virupaksha temple; its inner *gopuram* has an azimuth of

$291^{\circ} 36'$, only 1' from 180° away from Malyavanta. The line connecting these three temples today approximately intersects with the rising position of the sun on the morning of Makara sankranti when on Jan 14, the sun enters the constellation of Makaram. The first gleam of the rising sun occurs within a solar diameter of the *gopuram* of Prasanna Malyavanta temple as seen from Matanga hill. The festival of Pongal occurring on this date has numerous aspects and one is a celebration of the turning of the sun back on a northern path. The difference between the current date of Pongal and winter solstice is due to the precession of the equinoxes. In the 16th century, Makara sankranti occurred approximately 7 days earlier and sunrise would still have occurred within 2° of the line connecting the summits of Matanga and Malyavanta hills.

The MM-line serves as an axis of symmetry (Fig. 53) for Vithala and Ramachandra temples. Vithala lies 1.42 km to the northeast and Ramachandra lies 1.49 km to the southwest of the axis. These were the two pre-eminent temples in the city during the last 25 years of the empire. An inscription in the Virupaksha temple records the gift in 1513 of gold and silver articles as well as several villages to that temple by Krishnadevaraya, following the total solar eclipse of March 7, 1512.⁶ Associated with that eclipse, gifts were also made by the king to the Prasanna Virupaksha temple in the royal centre and to the Vaishnavite temples of Vithala and Ramachandra. The eclipse of 1512 marks a curious watershed as it was the occasion of the last royal gift inscribed in the Virupaksha temple and the first in Vithala. Gifts to the Vaishnavite temples grew, and during the final 25 years of the empire,



55. Method for determining geographic north using gnomon

Vithala became the most important temple in the city and the major recipient of royal gifts.

These gifts at the time of the eclipse may have been primarily associated with the military successes of Krishnadevaraya as he had just successfully completed his campaign against Udayigiri, a hill fortress under the king of Orissa.⁷ They may also had a more explicit astronomical-mythological meaning. As described in the *Mahabharata*, Vishnu beheaded the demon Rahu, who is responsible for solar and lunar eclipses. Vishnu's weapon was the Sudarshana-chakra, representing the disc of the sun and the wheel, signifying the motion and swiftness of the sun. Because of the mythic overpowering of Rahu by Vishnu the eclipse may have complemented or even reinforced the growing importance of Vaishnavism in the capital.

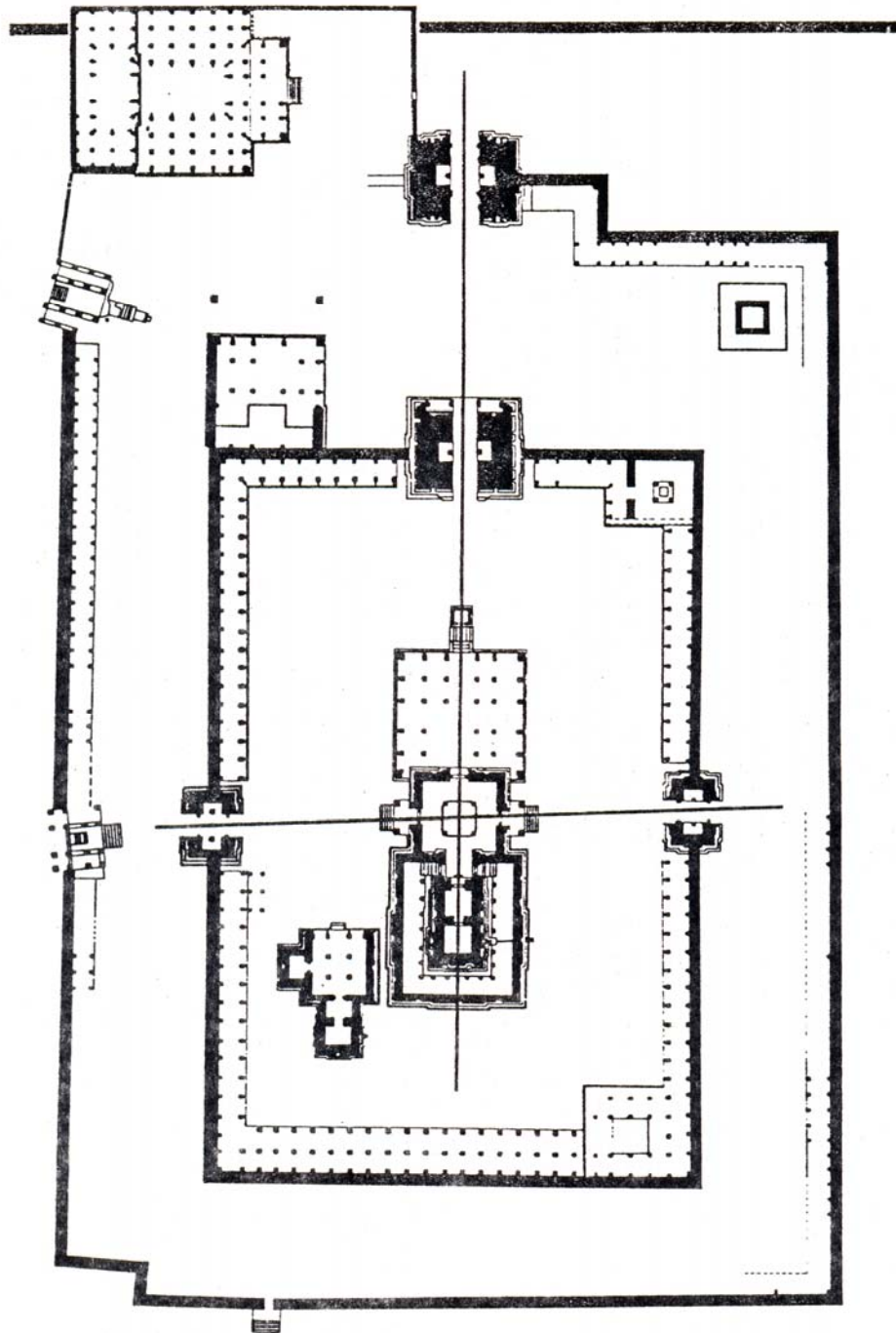
It may not be without symbolic significance that the line (VK) connecting Vithala and Krishna temples crosses Chakra-tirtha where there are three lingas carved in the rock next to the Tungabhadra river (Fig. 53). The two temples are symmetrically located on the VK line, each 1.08 km from Chakra-tirtha, where, according to local tradition, that Vishnu performed penances to Shiva, who in return gave him his Sudarshana-chakra. The VK line also serves as an axis of symmetry between Virupaksha temple and the summit of Matanga hill, which are respectively 17° 50' north and 17° 20' south of the line.

The line connecting Vithala and Ramarchandra temples also runs approximately perpendicular to the car streets of the three major temples of the sacred centre, Vithala, Virupaksha, and Krishna. The car street of Vithala passes between hills to

the southeast and is aligned toward the rising point of Sirius, the brightest star in the night sky. The car street of Krishna has an azimuth of 101° 30' and is aligned with the summit of Malyavanta. The southern leg of the walled pathway in the royal centre leading to Ramachandra temple is a fourth feature that is perpendicular to the Vithala-Ramachandra line and parallels the car street of Krishna with an orientation of 101° 40'.

4. Rotation toward Matanga: The organization of the royal centre may have evolved as the kings shifted their allegiance toward Vaishnavite deities. The north-south axis dividing the royal centre may have originally reflected the mythic power of Matanga and his daughter, Pampa. Within the royal centre the Ramachandra temple, probably built by Devaraya I, A.D. 1406-1422⁸ appears to have served as the state chapel during the Vaishnavite kingships. The temple has been rotated by 1° 30' away from true cardinality to become aligned to Matanga hill which is framed in its northern gateway, 9' from the exact centre of the northern doorway (Fig. 54). Sacred topography has thus taken precedence over true cardinality.

A second example of rotation of a major temple away from cardinality occurs in Tiruvengalanatha which has the curious property of possessing an east-west axis which is close to cardinal with an azimuth of 90° 20' while its north-south axis is rotated to the east of north by 3° 10' (Fig. 56). Such an angle is within 4' of the direction to the Hanuman shrine on the summit of Anjenadri hill as seen from the summit of Matanga hill (3° 6') (Fig. 57). The major axis of Tiruvengalanatha temple thus appears to be the result of a nearly perfect geometric



Tiruvengalanatha Temple Complex

56. Tiruvengalanatha Temple showing EW and NS axes

translation eastward from the summit of Matanga hill to its present location.

The third example of the rotation of structures away from cardinality because of the influence of Matanga hill is suggested in the relationship between Virupaksha temple and the southern gateway of Hemakuta hill. The gateway has been rotated away from cardinality and local topography such that Matanga hill is centred in its opening at an azimuth of $94^{\circ} 25'$. The axis of Virupaksha temple has been rotated from cardinality by a similar angle, with an azimuth of $93^{\circ} 52'$. This orientation of Virupaksha temple also brings its axis close to perpendicularity with that of Tiruveṅgalanatha.

The line connecting Matanga hill and the southern gateway of Hemakuta hill (MH) also serves as an axis of symmetry between Virupaksha and Krishna temples (Fig. 57), which respectively lie $15^{\circ} 40'$ north and $15^{\circ} 30'$ south of the line.

B. Malyavanta hill:

1. Zenith sun: During the rainy season Rama retired to Malyavanta hill while Hanuman went southward in search of Sita. Before its association with Rama, the mountain was a sacred and important Shaivite site, named after a sage who was a devotee of Shiva. On the summit to the west of the Prasanna Malyavanta temple there are 20 lingas and Nandis carved into the rock on either side of a crack which has an orientation of $74^{\circ} 35'$; the second crevice to the south of the temple has a similar orientation. In addition, the Prasanna Malyavanta and Lakshmi temples on the summit of Malyavanta hill have orientations of $72^{\circ} 12'$ and $72^{\circ} 30'$, respectively. Elsewhere in the

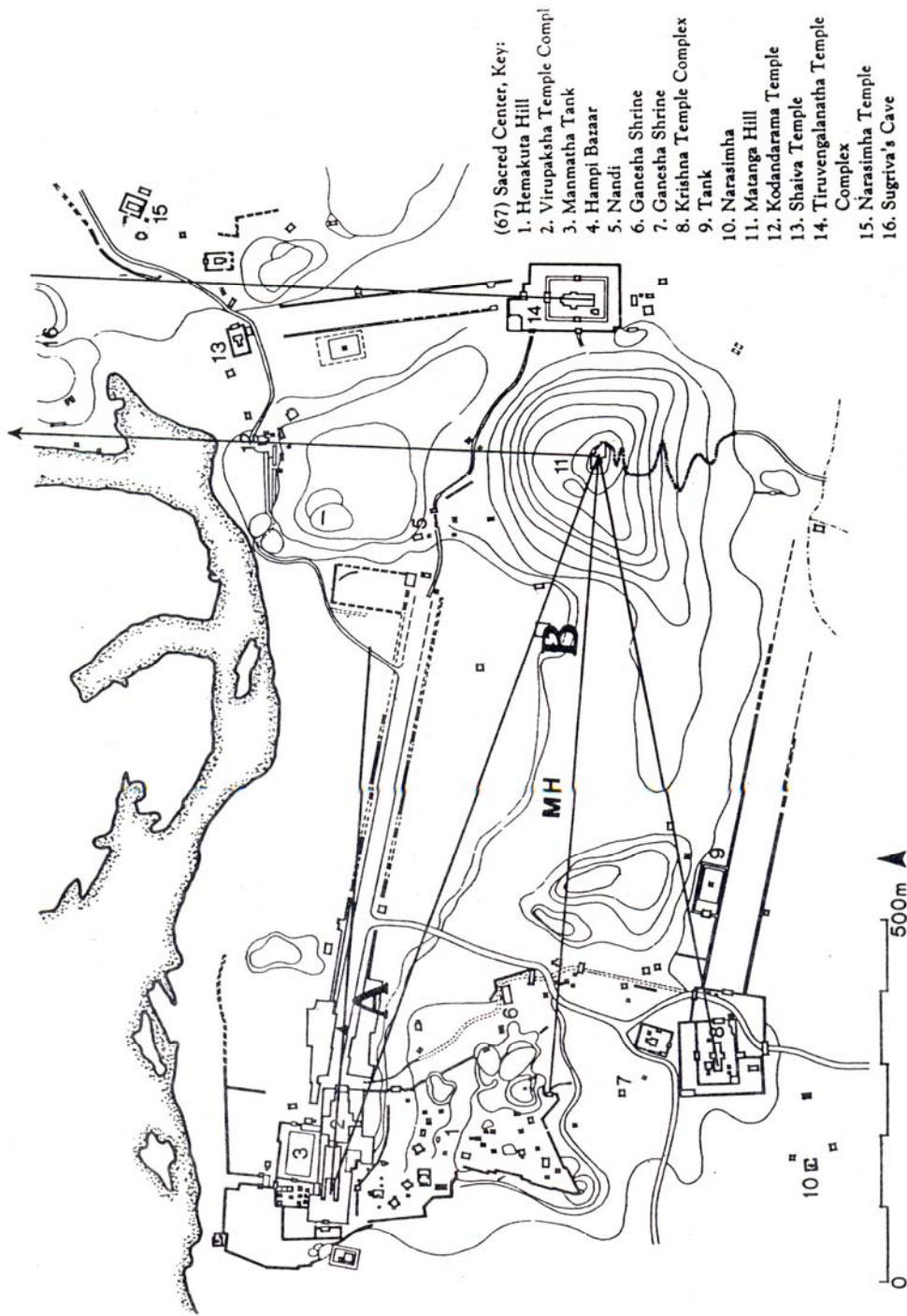
urban core we have identified a group of small temples and shrines which also have orientations of 72° - 76° . The mountain may have acquired additional symbolic relevance by its association with the sun on the day of the zenith sun, a highly important event in many societies which lie, like Vijayanagara, between the tropics of Cancer and Capricorn. The zenith sun is a visually dramatic phenomenon when vertical structures cast no shadows which occurs at the latitude of Vijayanagara near May 1 and July 26.

2. Summer solstice: As seen from the 100 column audience hall in the royal centre, the sun rises above Malyavanta hill at the time of summer solstice (Fig. 58). Stairways once provided access to the roof of the 100 column hall, and from that location the king may have held audiences and observed the rising points of the sun. The rainy season starts soon after summer solstice and ends before autumnal equinox, and hence the arrival to and departure from Malyavanta by Rama parallels the movement of the sun as viewed from the 100 column hall.

C. Anjenadri hill:

1. Rotation toward Anjenadri: The birthplace of Hanuman is identified with Anjenadri hill, 3.2 km to the north of Matanga hill across the Tungabhadra river. On its summit, a shrine opening to the east contains a rock carving of Hanuman. The perpendicular to its east-west axis crosses the Tungabhadra river at Chakra-tirtha. Nearby, the north facing Kodandarama temple has been rotated such that it faces the shrine of Hanuman on Anjenadri.

One of the more anomalous orientations in the royal centre is that of the corridor leading



to the southern gateway of the Ramachandra temple (Fig. 54), perhaps used by the king for entry into the royal chapel. The "king's path" has been rotated to the east by $1^{\circ} 30'$ to align with the *sikhara* of the Hanuman temple on Anjenadri hill some 4.8 km to the north. Standing in the exact centre of the avenue at its southern end, the *sikharas* of Ramachandra and Anjenadri temples appear separated by only 7'. The alignment of these two structures provides a glimpse into the associated ritual as the king approaching from the south would be able to view the distant birthplace of Hanuman superimposed upon the Ramachandra temple. The decision to align the path away from both true north and from Matanga hill, reaffirms the great importance of *Ramayana* symbolism to the later Vijayanagara kings. It is noteworthy that the Ramachandra temple lies on the intersection alignments to Matanga and Anjenadri hills and Vithala.

2. Kotilinga tirtha: Precisely placed between Matanga and Anjenadri hills is an important Shaivite shrine, Kotilinga-tirtha, consisting of a *mandala* of over 1000 Shiva lingas carved into the bedrock on the bank of the Tungabhadra river; in addition there is a drawing of Hanuman facing Anjenadri. As seen from Kotilinga-tirtha, the *sikharas* of the temples of these two hills are within 2' of 180° apart.

D. Hemakuta hill:

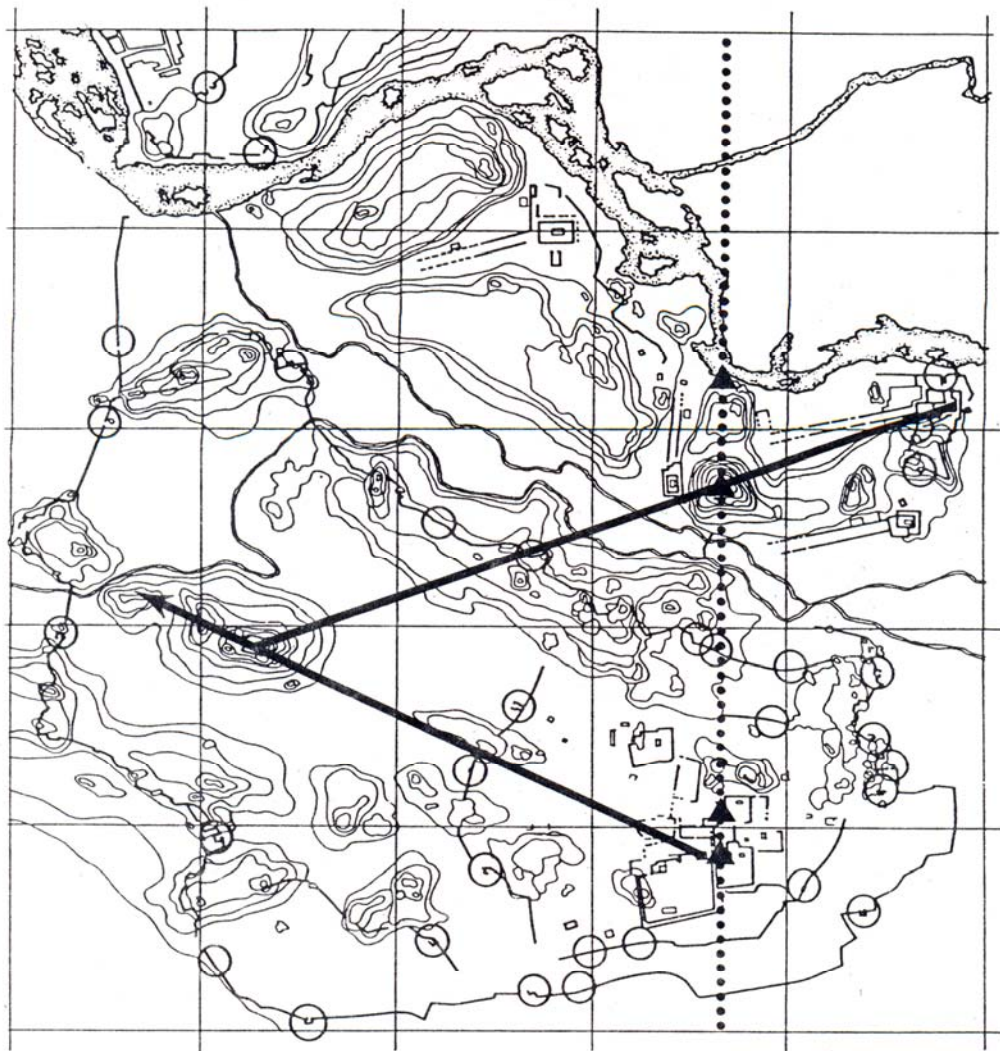
With some 17 temples and 12 shrines built upon it, no other area of the city has as high a density of monuments as the granite dome of Hemakuta hill. Like Matanga hill, it also has an extensive cave system near its summit. For centuries before the founding of the city the area between Hemakuta hill and the

Tungabhadra river had been an important Shaivite pilgrimage destination associated with Virupaksha. But even earlier the most important deity in the area was the goddess, Pampa, and the area was known as Pampatirtha as early as 689 A.D.⁹ Hemakuta is connected to other hills and structures in the city through the MH, MM, and VK axes (Figs. 53 & 57).

CONCLUSIONS

Our studies suggest that a complex geometry was employed to establish the locations of the major structures of Vijayanagara. Viewed in this light the city is not a collection of randomly sited structures scattered through an irregular landscape, but is a systematic whole with differentiated but interactive components.¹⁰ Fritz¹¹ has proposed that the capital city of Vijayanagara can be understood as a symbol of cosmic order, organized in a plan similar to the great capitals of the earliest urban societies. The model which Wheatley¹² has developed for these cosmic cities includes (1) the presence of a central monumental structure expressive of the *axis mundi*, (2) the alignment of roads, sections of the city, or major buildings to the cardinal directions, and (3) a connection between the city and mythological events.

Because its organization could not proceed independently of the dramatic and powerful local geography, the city presents an ambiguous centrality. The city is clearly not a simple *mandala* with one mountain or monumental structure in its exact centre. Nevertheless, Matanga hill dominates the symbolic landscape of the city, interwoven by geometry and myth into nearly every major feature of the city. As seen from the



58. Royal Centre showing direction of summer solstice

ceremonial gateway in enclosure IX the hill lies immediately beneath the axis of the cosmos. Radiating outward from the mountain are twelve or more lines which intersect and interact with significant features of the city (Fig. 59; Table 1). Not only do they cast a web of interconnecting symbolism, these radial lines may also represent the emergence and outward spread of order from

a point source similar to that expressed in the *vastupururshamandala* of the Hindu temple.¹³ According to the creation stories of Vijayanagara in *Rayavacakamu*,¹⁴ Matanga hill was indeed the source of the city. The radial lines seem also to be expressive of the symbolism of maintenance and protection which Matanga hill provided over the surrounding city.

TABLE 1

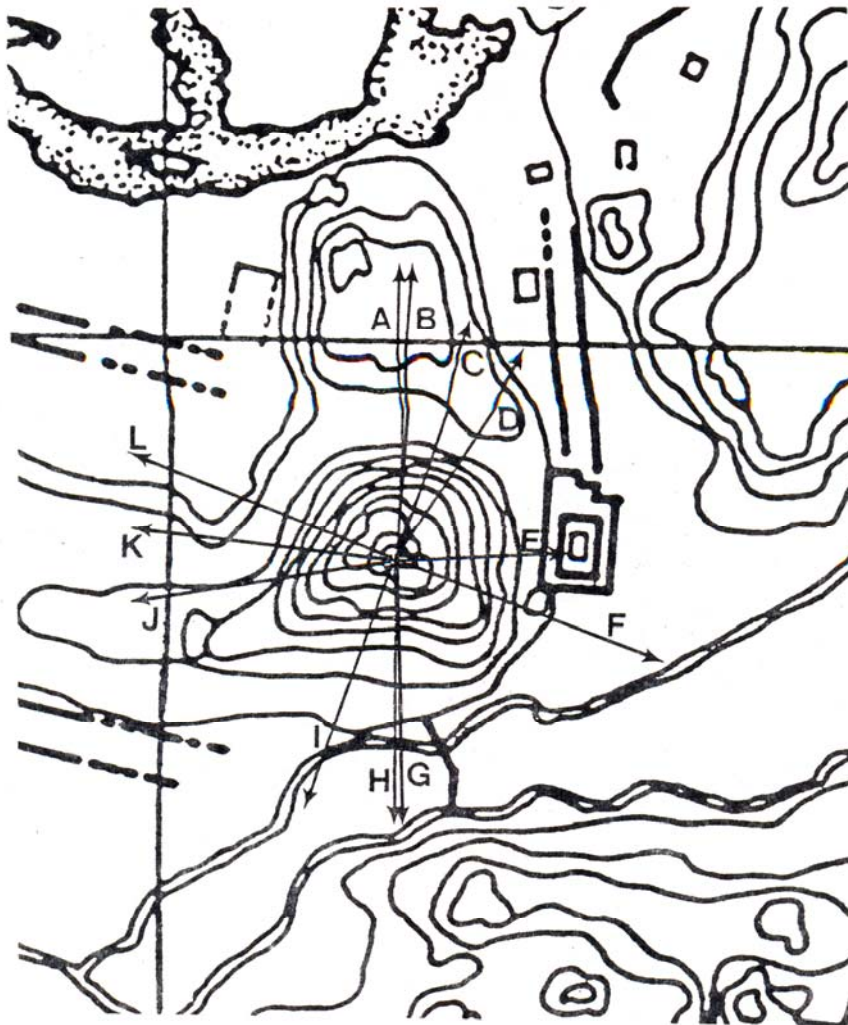
RADIAL LINES FROM MATANGA

Azimuth	Primary Aspect	Secondary Aspect
A 2° 2'	Chandrasekhara	Kodandarama
B 3° 6'	Anjenadri	Kotilinga
C 16° 50'	Sugriva's Cave	Opposite Prasanna Virupaksha
D 35° 31'	Vithala	Symmetry with Virupaksha across VK axis
E 87° 10'	Tiruvengalanatha	Rotation to Anjenadri
F 111° 35'	Malyavanta	Opposite Virupaksha Sunrise Makara Sankranti
G 178° 30'	Ramachandra	Rotation toward Matanga
H 180°	Enclosure IX	Ceremonial gateway 100 Column hall/Palace
I 196° 50'	Prasanna Virupaksha	Opposite Sugriva's cave
J 259° 30'	Krishna	Symmetry with Virupaksha across MH axis
K 274° 25'	Hemakuta	Rotation of gateway toward Matanga
L 291° 36'	Virupaksha	Opposite Malyavanta

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59. Radial lines from Mantangá hill

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