THE USE OF GEOGRAPHIC INFORMATION SYSTEMS AND REMOTE SENSING IN A STUDY OF THE PROTOHISTORY OF SOUTHEAST ASIA

BY

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Statement of Originality

The contents of this thesis are all my own work except where reference is made in the text to works by other people. This thesis has not been submitted for the award of any other degree or diploma in this nor any other Institution.

Signed: 

Date:
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Acknowledgements

I would like to thank my principal supervisor Professor Steven Riley for his support throughout the period of this research.

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I acknowledge the input of Dr Richard Thomas of the University of Western Sydney for his initial concepts for the thesis and his introduction to Viet Nam, its culture and its protohistory.

I also thank my late parents who left school early due to the Great Depression and who fought in the second World War, but who worked hard to ensure that my sister Barbara and I had an education.
Finally I thank my wife Sue for her support and understanding and for her preparedness to listen to numerous monologues on the histories of Cambodia and Viet Nam, for her encouragement to continue and for her editing.

Dedication

I dedicate this thesis to my late brother-in-law Dr Peter D. Meese, whose insatiable thirst for knowledge through reading and travel remains an inspiration to me. He is sorely missed by myself, his family and by his partner, Dr Darren Lockie.

To give an accurate description of what has never occurred is not merely the proper occupation of the historian, but the inalienable privilege of any man of parts or culture.

O. O’F. W. Wilde 1854 – 1900
Abstract

The proto-histories of Viet Nam, Cambodia, Laos and Thailand previously have been considered in isolation, and have been written predominantly by European researchers. In particular, the proto-history of Viet Nam was developed in the late 19th Century and was seldom questioned by researchers over the following 100 years despite a variety of anomalies that were created by variations in the philology and the concepts of a ‘science-based’ archaeology. Many European concepts, as well as European concepts of religions that emanated from the Indian subcontinent, were imposed on the histories of the Southeast Asian societies. These impositions were made despite the obvious integration of Brahmanic principles or religion and societal management into what those societies had developed for themselves over several thousand years.

This thesis shows that the history of the Hindu religions, adopted by at least the ruling classes in Southeast Asian countries, had been developed far earlier than previous researchers have acknowledged. Remnants of hundreds of edifices across the region date from about the second Century AD at the latest, yet there must have been some diffusion of the religions for many centuries before that. There has been far wider acceptance of the greatness of the civilisations associated with the era of the Egyptian pyramid builders than there has been acceptance of the greatness and influence of the civilisations in the region around India that developed and flourished earlier than, if not contemporaneously with, them. These
are evidenced by more than the well-known Harappan and Mohenjo-daro archaeological sites.

By taking a regional view, by considering the religion upon which the ‘Indianisation’ process rested, by using Geographic Information Systems and by not pre-judging possible outcomes, this thesis shows that the ‘Brahmanic’ temples of Southeast Asia were originally established to a pattern which represented the Brahmanic priests’ views of their place in both space and time, which in turn related to the greater astronomical cosmos as well as to their inner cosmos. Their views were based on a religion developed in the Indian region possibly as early as the 4th millennium BC, at a time when there was abundant water in the now-dry Sarasvati River. This river, upon which their lives depended, also reflected the regular annual passage of the Sun and the Moon and to a lesser extent the five visible planets through the regular fixed patterns of stars. This reflection helped to develop their religion and philosophy of life.

By using image analysis software and a spatial information system this thesis shows that the *Chiem Son* inscription, found on a rock in the river in the middle of Quang Nam province, Viet Nam, described a city-state covering the whole of the natural caldera comprising that province, with a connection over the mountain range to the region to the north. It is asserted that there was a link between the polity referred to as ‘Champa’ with Lin-I, a polity which extended from the northern boundary of Quang Nam province to the Hoanh-Son pass, near the 18th parallel of latitude North.
The Spatial Information System has also been used to overlay a possible regional ‘cosmos’ over the Southeast Asian region, firstly centred on Angkor Borei, now commonly referred to as the capital of Fu Nan, a polity which existed 2,000 years ago and which had trade dealings with European trading merchants as well as Chinese merchants. A later, smaller cosmos has been shown to cover the mainland, this being centred at Ba Doem, a temple complex a few kilometres east of Stung Treng in Cambodia. The radial lines from the centre of this cosmos are shown to link with the eastern corner of the above-mentioned city-state covering Quang Nam province. Similar constructs have been shown to exist in Greece, Africa, South America and elsewhere, yet this has not previously been applied to Southeast Asia.

This thesis demonstrates the need for a reconsideration of the proto-history of Southeast Asia, in particular that of Viet Nam, to better reflect the basis on which the ‘Indianisation’ process was adopted by the indigenous peoples and to better collate the data from the various parts of the central to south Vietnamese coast before providing an alternative meta-narrative to that which has been accepted for over 100 years by much of the archaeological community.
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Abbreviations

AD       Anno Domini (since the birth of Christ)
BC       Before Christ
BCE      Before the Christian Era
BEFEO    Bulletin de l’École Français d’Extrême Orient
BIL      Band Interleaved by Line (raster image format)
BP       Before Present
BSQ      Band Sequential (raster image format)
c or ca  Circa (about, in time)
Ç        Çaka (Hindu era starting in 78 AD)
C$^{14}$  Carbon 14 – used for dating through knowledge of its decay rates
CHCPI    Centre d’Histoire et Civilisations de la Peninsule Indochine
CSVN     Central to southern Viet Nam
DCOW     Digital Chart of the World, managed by Penn State University,
         available from http://www.maproom.psu.edu/dcw/
EDM      Electronic Distance Meter (now built-in to Total Stations)
EFEO     École Français d’Extrême Orient
GCP      Ground control point
GIS      Geographic Information System
IAU      International Astronomical unit
km       Kilometres
RMS      Root Mean Square (error analysis method)
RS       Remote Sensing
SIS      Spatial Information System (new name for GIS)
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<tr>
<td>SPOT</td>
<td>Système Probatoire d’Observation de la Terre (French satellite imagery)</td>
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<tr>
<td>TM</td>
<td>Thematic mapper (satellite imagery product by Landsat, USA)</td>
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<td>UTM</td>
<td>Universal Transverse Mercator (map projection)</td>
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Chapter 1: Introduction

This thesis has 5 objectives:

1. To utilise a Geographic Information System (GIS) to map the known sites of Brahmanic temples across Cambodia and Viet Nam, predominantly based on the maps and lists of Lunet de Lajonquière (1902) and of the summaries by George Coedès and Henri Parmentier (1923 and 1927).

2. To review the proto-history of Southeast Asia in a spatial context utilising GIS and Remote Sensing in covering large areas to enable an analysis from a regional perspective.

3. To demonstrate why the *Chiem Son* Inscription in Quang Nam province of Viet Nam should be re-analysed in view of a regional perspective, rather than a local perspective.

4. To show that the spread of the Brahmanic religions across much of Southeast Asia probably began earlier than most European researchers have accepted over the past 150 years, and was based upon the knowledge of the sciences as expressed in the Vedic texts which originated centuries if not millennia before European researchers have previously accepted.

5. Various researchers have shown that many of the ancient structures of mankind, in a variety of countries on many continents, were constructed with alignments to positions of the sun, the moon, the major planets and/or the pole star, or using dimensions which reflect the days of a month or year (Snodgrass, 1985, 1990; Stevens, n.d.). This thesis attempts to show
that similar constructs can be applied to the early Brahmanic temples of southeast Asia.

This thesis thus reviews the proto-history as described by many European researchers, followed by an introduction to the Brahmanic literature upon which the religion of Southeast Asia was based – at least in the early centuries of the first millennium AD. This is followed by discussions of the histories of astronomy and arithmetic, particularly as the latter relates to the sciences of surveying and mapping. These histories demonstrate that there were appropriate philosophical and communication developments to enable the Southeast Asians to understand how the Vedic religion and its later teachings could best be utilised to develop the region into one or more powerful entities.

The thesis then utilises the technology of remote sensing to assist in the spatial analyses of the Indic temples of Southeast Asia. The thesis also discusses the development of the GIS of the temples using the maps and lists of the late 19th C and early 20th C explorers and historians of the region. These spatial analyses are introduced in more detail later in this Introduction.

**Justification for the thesis**

The protohistory of Southeast Asia has been largely written by European missionaries, historians and archaeologists since the 17th Century AD. There are several aspects about the presentations of this protohistory that are questionable in the methods of scientific reporting in the modern world, namely:
1. There are limited if any references to original sources of material in the meta-narrative style of reporting that was adopted. This gave many authors even into the mid-20th Century such as Cadière (1915), Maspero (1928), Claeys (1931), Mus (1934), Stern (1942), Boisselier (1963), Coedès (1966) and Higham (1989, 2002) a means to make bland statements about “possible” events that became accepted by later writers without argument.

2. The philologies of archaeology and historical recording have changed. Both require evidence from physical sources, with analyses which take into account findings from areas further afield than the locality of an archaeological ‘dig’ and in many cases which need to consider data from a wide range of professions or sciences, such as palaeoclimatology, sedimentology, photogrammetry - using airborne or satellite derived images in visible and other ranges of the electro-magnetic spectrum including radar – and carbon dating (Renfrew and Bahn, 1996).

3. The Euro-centric view of Greek supremacy in philosophical thought has dominated or even led the analyses of the development of the cultures of Southeast Asia (among others), even though the development of Greek philosophy can be traced no further back than the first half of the 6th C BC (Dreyer, 1906). This theme is developed further in Chapter 2 – Literature Review.
4. It is easy to impose modern concepts into the spatial dimensional analyses or to produce evidence for concepts that have no known relevance to Southeast Asia. The problems of analysis are made difficult by the writings of populist authors whose works have little theoretical basis and are couched in 18th Century essentialisms. For the European researchers, it was all too easy to see the history of a far-eastern region in terms of Greek astronomy or philosophy, in which they were schooled, which argued that sudden changes in a civilisation were caused by invasion and eradication of all of the local population.

This thesis reviews the evidence, including some Vedic or Brahmanic aspects of cosmology and time, and attempts to use the modern technology to find underlying spatial patterns that are evidence of the influence of Vedic or Brahmanic culture.

The European historians of the late 19th – early 20th Century saw the rise and fall of civilisations in general in a “biological life cycle” context (Thomas, n.d.) of birth, development, maturity, decadence and death, seeming to forget or rather overlook that:

- Human development has been continual and world-wide for over 70,000 years, as evidenced by the ages of human remains found in Australia, Africa and Europe as well as in Indonesia;
- Civilisations have more often been overthrown by more powerful neighbours rather than actually undergoing this cycle. For example, Egypt, Babylon and Crete in the 2nd millennium BC (Bibby, 1962);
• Neolithic sites such as Stonehenge have been shown to have been set out for astronomical purposes, at least as far back as the 2\textsuperscript{nd} Millennium BC (Bibby, 1962; Cornell, 1981);

• Egyptian pharaonic lineages, in particular, have been traced back some millennia BC (Petrie, nd);

• Middle Eastern cultures such as the Babylonians existed to a high level of development some millennia BC – certainly throughout the second millennium BC (Bibby, 1962), as evidenced by the remains of their major buildings (Spence, n.d.) as virtually reconstructed in Forte and Siliotti (1996);

• The Chinese culture and knowledge date back many millennia (Needham, 1951; Needham and Ling, 1959);

• In India the Harappan and Mohenjo-daro cultures (at least) had developed several millennia BC, with regularly set out townships and square buildings suggesting a knowledge and recognition of right-angled triangles, as well as a well-developed international trade (Bibby, 1962; Ratnagar, 1981).

This thesis, which began as a localised response to the challenge by Davidson (1979) that “our knowledge of Champa remains so fragmentary, vague and inaccurate that the whole subject must be re-worked”, has had to review work from a wide variety of modern and old sources by people from many countries. This has resulted in a study not just about ‘Champa’ - referring mainly to that part of Viet Nam from the present-day province of Quang Tri in the north around Hué.
Figure 1.1: Map of current Provinces of Viet Nam covering ‘Champa’ region
(Source: http://encyclopedia.thefreedictionary.com/Provinces+of+Vietnam)

to the southern province of Ninh Thuan (Thomas, nd) (Figure 1.1) - but about the regional proto-history of most of Southeast Asia – Viet Nam, Cambodia and parts of Laos, Myanmar and Malaysia.

 Terminology

Although India is a modern phenomenon, in that it was not known as a single country at the time being discussed in this thesis (ca. 2,500 BP to 1,500 BP), the author has accepted the use of the term ‘Indianisation’ to describe or refer to the fact that there was some cultural influence by people from the sub-continent now known as India and also incorporating Bangladesh, Sri Lanka, Nepal, Pakistan, Afghanistan and Bhutan. Similarly, the terms ‘Indic’ or ‘Brahmanic’ have been adopted to describe the temple styles which are distinct from the styles throughout
Myanmar which are temples for the worship of Buddha rather than for the Hindu religion (Snodgrass, 1985).

**The European Colonisation of Southeast Asia**

Following the closure of China to most external traders in the late 1420s, during the reigns of Hung-hsi and Hsüan-te, the European traders were forced to find a way to sail to India, the Spice Islands of Indonesia and to Southeast Asia for their exotic products (Twitchett and Fairbank, 1978). Until then the Spice trade had used routes across the Bay of Bengal to India, then either by sea through the Palk Strait to the Arabian Sea or overland to what is now Goa on the west coast of India. Traders would then have taken the goods through the Middle East by the Arabian and Red Seas, or even through the Gulf of Oman and the Persian Gulf, following and extending routes taken by traders between India and the Middle East since the Harappan civilisation of the northern Indian region several millennia BC as described and detailed in Bibby (1962) and Ratnagar (1981).

By the 17th Century AD Roman Catholic missionaries were operating in Southeast Asia, learning the languages and translating the Christian texts from Latin into those local languages and learning about the local history from the natives (Rhodes, *ca.* 1650a (Tr. 1966), *ca.* 1650b (Tr. 1999)). After the English had colonised India, the French sought to do the same in Southeast Asia (Honey, 1982 in Truong-Vinh-Ky (1881) translation). As a part of this process Étienne Aymonier was sent by the French Institut des Belles-Lettres to map Cambodia in the late 1870s to early 1880s. These maps, included in Appendix 4, only show a
few archaeological sites (Aymonier, 1895). Aymonier was sent to continue this mapping in Viet Nam in 1883, where he had limited success due to Vietnamese resistance to the French colonisation and the spread of Catholicism. This period is detailed by P.J. Honey in the introduction to his translation of Truong-Vinh-Ky’s report of his travel to Tonking in 1876 (Truong-Vinh-Ky, 1881). Later, Lunet de Lajonquière mapped the Malay peninsula and Cambodia, showing the positions of hundreds of archaeological sites (de Lajonquière, 1902).

**École Français d’Extrême Orient**

The École Français d’Extrême Orient (EFEO) was established in 1900 to undertake research into the archaeological sites of Southeast Asia and it provided support for those undertaking this research. It was based originally in Ho Chi Minh City and later in Ha Noi. This group organised for an architect, Henri Parmentier, to travel throughout the region, where he measured and described the temples. His work is detailed in Parmentier (1909, 1927). In addition, Parmentier and George Coedès published in 1923 lists of temples and other sites across Southeast Asia known to them (Coedès and Parmentier, 1923). Based on these early works and the then popular archaeological theory that civilisations followed a human-like development of birth, growth, maturity, decline and death, histories of the various peoples of Southeast Asia were developed, published and widely accepted (Barth, 1885; Bergaigne, 1885; Dutreuil de Rhins, 1889; Aymonier, 1895, 1901, 1903, 1904; Cadière, 1915; Coedès and Parmentier, 1923; Maspero, 1928; Claeys, 1931; Mus, 1934; Stern, 1942; Boisselier, 1963; Coedès, 1966, 1968; Chandler, 1983; Higham, 1989; Coedès, 1992; Higham, 2002).
The above life-cycle theory was applied also to the development of art in Viet Nam, in particular the bas-reliefs and sculptures found with the remains of the Brahmanic temples in the region referred to as ‘Champa’ (Stern, 1942; Guillon, 2001). However, these art histories presented many difficulties in trying to resolve the inscriptions on the temples with that historical theory, leading to Davidson’s comment of the need to re-work the analysis of ‘Champa’ (Davidson, 1979).

**Proto-history of Viet Nam**

The proto-history of northern Viet Nam has been well covered through studies of the Chinese chronicles and presented in texts such as Taylor (1983). This period of northern Viet Nam’s history was well documented, as for several centuries Chinese emperors had endeavoured to run this region as an outpost, although several attempts were made by the indigenous peoples to rid themselves of the yoke of the Chinese authority, eg in 137AD and in 192 AD (Leuba, 1915), to cite two of the early uprisings.

Although there are some references in the Chinese chronicles to the south-central part of Viet Nam, its proto-history has been mainly left to conjecture, based on limited references in the Chinese chronicles to the area and limited studies of the inscriptions on the Vedic temples. There is confusion from the interpretations of the Chinese Chronicles over the locations of places mentioned arising from confusion of the distances allegedly travelled by the Chinese to reach them. Although the Chinese were well travelled in the region, they probably did not realise that there were ocean currents that affected their sea travel. These unseen
currents obviously would lead to different estimates of distances travelled, depending upon whether one was sailing with them or against them.

As such, the proto-history of this part of the Southeast Asian region has only been seriously evaluated since the late 1970s, although some attempts were made as early as 1885 (Barth, 1885; Bergaigne, 1885). However the best early work was on the chronicling of the design, construction and layout of the Brahmanic temples (Parmentier’s work) along with the preparation of maps to aid further exploration (de Lajonquière’s work). Despite the obvious ‘Indianisation’ of the region, few works were written describing the Hindu / Śivaite / Vedic religion and its relationship to Southeast Asia, either as a whole or in part. Therefore no consideration has been given to the maps of the temples and other sites and how these temples might represent the relationship to the region of the Vedic religion and its cosmology. This thesis therefore endeavours to address the argument that there was an established relationship between the setting out of the early temples, the religion and the region of Southeast Asia, in which over 1,500 sites have been found, by entering them into a Geographic Information System (GIS) to aid the development of a spatial analysis.

There have been some recent papers such as those presented at the Workshop on New Scholarship on Champa in Singapore (August, 2004) which provide new data, such as the translations of previously unpublished inscriptions from southern Viet Nam (Schweyer, 2004) or reviews of early to mid 20thC. histories and theories (Southworth, 2004). Additionally, some innovative research appears to
have been presented at the 10th International conference of the European
Association of South-east Asian Archaeologists (London, September 2004), such
as Brown, R.L. – *Identification of the early Vishnaiva images of Southeast Asia* -, 
Cunin, O. – *Reassessment of the original number of the face towers in Angkor Thom* -, Guillon, E. – *New Cham archaeological discoveries north of Huê Viet Nam* -, Jacques, C. – *Moats and external walls of Khmer temples* -, Lefferts & 
Cort – *Water and Fire: Hindu cosmologies in Angkor and Bali* -, Mihailovs, V. – 
*The use of mithuna in the design of Dvaravati coins* -, Pou, S. – *Kalpana or ritual practice in ancient Cambodia* -, Prapandvidya, C. – *Shaivism in Thailand as recorded in inscriptions and documents from the 6th Century CE to the early Ayudhya period* - and Schweyer & O’Naghten – *Relationships between Khmer and Cam countries from 7th to 14th Centuries*, although the full text of these presentations have not been provided to this author.

Other than for Prapandvidya (2004) mentioned above, little has ever been presented on the Vedic religious aspect or origin of the temples in Southeast Asia. Those who have touched on this, albeit obliquely, are Ord (1996) - who looked at the topophilic view of these particular temples – and Llobera (2001) – who looked at the general concept of topographic prominence. Hall (1985) writes of the use of the temple complexes as “economic centers as well as institutions of political consolidation (which) is shown in the numerous inscriptions that record the assignment to temples of management rights to public granaries ..”. Whilst it is accepted by the author of this thesis that later temples were utilised in this manner, the contention is that in the early phase (ca. 100 BC to 500 AD) there
was a deliberate move to setting out the temples in a cosmological pattern. This would have been to demonstrate to the indigenous peoples that the Vedic religion could be applied as easily to their region as to its region of origin, those lands in the shadow of the Himalayas.

One of the underlying bases for the European versions of the proto-history of Southeast Asia and its ‘Indianisation’ has been that it only began with the earliest translated inscription on a stèle dating from the 2nd C AD – the Vo Canh inscription. However, in Aymonier (1901), which gives descriptions of dozens of sites including some translations of inscriptions, there is an inclusion of an excerpt from Moura (1883) – The Realm of Cambodia, Vol. II, p.6 – of a legend associated with Phnom Preah Vihear:

“The king of the Chams, in the year of the death of Buddha (543 BC) was shipwrecked at Dangrêk. This king settled at Kouk Telok.”

This legend should have given M. Aymonier the idea that ‘Brahmanic’ religions were spreading throughout Southeast Asia in the 6th C. BC, and not beginning in the 2nd C. AD. M. Aymonier must have given this some thought as he wrote a paragraph in response (translated from the French by this author):

“What is most certain, is that, many centuries later, in the era when historical Cambodia was flourishing, the influence of its literature, directly imported from India, meant that the Kambujas considered this chain like a miniature Himalayas which sheltered numerous hermitages and where many temples were built.”
Aymonier appears to have accepted that there was some earlier Brahmanic influence, but preferred to only write about the Christian-era Southeast Asia. When others began claiming that the Chams were only based along the Vietnamese coast, he should have brought to their attention Moura’s legend about a Cham king being in Cambodia, as this would have had a profound effect on the proto-histories that were written and accepted by the European researchers in the late 19th and early 20th Centuries.

The temple associated with Phnom Preah Vihear had six inscriptions, most dated in the 10th C with some dated to the early 8th C and one including lineage back to the late 8th–early 9th C (Aymonier, 1901). This major complex could well have dated back over 1,000 years from these extant inscriptions, yet no consideration of how this would have affected the proto-history of the region is apparent.

**This Thesis**

This thesis represents work undertaken as part of a general attempt to move the knowledge of ‘Champa’ beyond the limits set by the colonial research – that ‘Champa’ existed only along the coast of Viet Nam. Since the 1960s an increasingly impressive armoury of analytical tools has been developed for conducting archaeological research along with a plethora of new theoretical positions that describe how peoples lived in the past (Renfrew and Bahn, 1996). The late 1990s witnessed the arrival within archaeology of new generations of micro-computers, accompanied by new surveying equipment and techniques. These developments have gone hand-in-hand with new forms of imaging and analysis that have allowed the transference of geospatial technologies from...
mainstream science into archaeology, extending the possibilities for survey work beyond the constraints imposed by land-based survey techniques and even aerial photography that were the only methods available to the early researchers.

This thesis seeks to utilise some of the above-mentioned new technologies to extend analysis of the archaeology of Southeast Asia into the one dimension that the colonial research could not go – that of a regional coverage. Although French and English researchers did innovate in the use of aerial reconnaissance photographs for archaeological studies, eg. Moore (1988), they did not overcome the difficulties by which they were restrained with the early forms of the technology. In recent years the usefulness of satellite imaging has been demonstrated with Fletcher, R. (2000) showing from radar images that the road or canal network supporting the Angkor complex extended about 200 km around Angkor. Fletcher’s work demonstrates the existence of what could be described as ‘city-states’, at least towards the end of the first millennium AD. As shown in later chapters the builders of the temples were well aware of their spatial coordinates and indeed could have planned the temples with an aerial or a cosmological view in mind.

**The religious perspective**

This thesis presents a new look at the Brahmanic temples of Southeast Asia as a whole. A GIS has been utilised to map as accurately as possible many of the temples listed in the summary by Coedès and Parmentier (1923) and on the maps created by Lunet de Lajonquière (de Lajonquière, 1902). Using the capabilities of
the GIS to conduct a spatial analysis, this thesis offers a theory based on the cosmology of Brahmanism, one of the various Vedic religions which developed from the *Rg Veda*. The contention is that the early temples were spatially orientated as a religious symbol emphasising the relationship of Southeast Asia to the whole cosmos. Later temples became monuments to the ruling classes and high officials, as evidenced in various inscriptions that have so far been translated and published. Most of those that were translated by the early researchers such as Barth (1885) and Bergaigne (1885) were from the Sanskrit, omitting those in the languages local to Cambodia and particularly to south-central Viet Nam, with the latter only recently published (Schweyer, 2004).

The thesis uses three scales of spatial analysis: individual temple, ‘state’ and region. As shown later, in Brahmanic terms these scales relate to the identity of one’s self, one’s community and one’s territory to the cosmos, or to the order of the Universe. This order is reflected in various ways, including either as the four continents spread around the mythical Mount Meru or as the eight concentric circles representing the orbits of the visible heavenly bodies surrounded by the sphere of stars (Ashfaque, 1977). In attempting to prove that this deliberate layout of the temples was possible, several fields needed to be reviewed:

1. The age of development of the mathematical theories needed to support the surveying and mapping capabilities known to have existed long before what is now known (in the West at least) as Pythagoras’ theory, in the light of the modern histories of India and China;
2. The basic astronomical observations and theories which underpinned much of the Indic religious philosophies, utilising modern computer software to demonstrate that the phenomena actually occurred and must have been observed rather than calculated back at a later time;

3. Brahmanic rituals and representations of the universe (tantrism) need to be explained based on a revised age of the origin of the Vedas.

These historical reviews are followed by:

- A presentation of the temples as mapped from data in Coedès and Parmentier (1923) and de Lajonquière (1902);
- The use of satellite imagery to help analyse in a visual sense a new interpretation of the historical inscription of *Chiem Son* in the Viet Nam province of Quang Nam, and
- A spatial analysis of the relationships of the early temples across the Southeast Asian region.

**Description of following chapters**

**Chapter 2, Literature Review**, provides a literature review which includes a brief pre-history of Southeast Asia, beginning with the development of bronze-age and iron-age sites throughout the region which indicate that the formation of what we would term complex societies was developing from about 2,000 BC and were not developing in isolation (Higham, 1989 & 2002).
The proto-history of Southeast Asia as presented by the French and other European scholars is reviewed also. The aim is to demonstrate how the mixing of science-based research with a world-view dominated by Euro-centric supremacy imposed on an entirely different culture has generated confusion and paradoxes in the Southeast Asian regional history for over a century, which began to be questioned by Davidson (1979) and which is only now being questioned elsewhere (eg. Vickery, 2004).

Chapter 3, Brahmanism, provides discussion of the Brahmanic rituals and practise which have been described interchangeably as manifestations of the passage of time and as linking the macrocosm of the universe to the microcosm of man. Eight concentric circles representing the passages of the star sphere, the sun, the moon and the visible planets are centred on the Earth. Similarly there are eight points (chakras) on the human body, centred on the navel, which represent the basic characteristics of human nature (Khanna, 1979).

This leads to a new view of the ‘Indianisation’ of Southeast Asia, showing the religious relationship between Cambodia and Viet Nam in particular. In a flat representation of this cosmological view the circles are divided into the four seasons or into twelve solar periods of time (Bailly, 1787). Early temples are shown to have been built along the lines of division of these periods, demonstrating the close relationship of the Indo-Chinese peninsula to the Brahmanic cosmology.
Chapter 4, Early Mathematics and Surveying and Mapping Techniques, aims to demonstrate that the development of the sciences for setting out buildings in a square grid pattern, primarily from Chinese and Indian perspectives, the latter through the Mohenjo-daro and Harappan cities, was existent well before the Europeans utilised and expressed it in the ways accepted today. Reference is also made to other histories of the period with such examples as the effectiveness of the Egyptians who built the great pyramids at Gizeh and the Babylonian era with their walled cities such as Nineveh, demonstrating that many groups had an appropriate mathematical knowledge, even if not expressed in the way we know it today.

A brief review of metrology is provided showing that there were from early times, such as in Harappa, standards of distance and weights being used (Berriman, 1953). Despite changes in standards of distance, it is demonstrated that surveying and mapping methods did not change for several millennia until the development and introduction of electronics in the second half of the 20th C., suggesting that the error-minimising practical methods and arithmetic computations were well-established long before modern times.

Further, writers such as Mus (1934), Snodgrass (1985) and Mannikka (1996) have shown that there is an extraordinary amount of mathematically significant numbers which can be found in the literature and which appear in the dimensions of Indic temples. Many researchers have overlooked the use of metrology to determine that the standards were adopted and used from the second millennium.
A Spatial study of Southeast Asia  Phil Ronaldson

BC. Berriman (1953) is a useful guide to the use of standards in distance, weights and measures for trade, showing that the skills and standards were known to Middle Eastern and Indian societies several millennia BC.

Chapter 5, Early Astronomy, shows that the knowledge of astronomy was developed to a high degree earlier than generally accepted by previous non-Indian researchers, in the second millennium BC in the Middle East at least. It is demonstrated that the knowledge of astronomy spread in all directions, although the Chinese developed similar but separate methodologies and explanations. Astronomy also developed separately around the various continents of the world, with surprisingly similar stories about the origins of the star formations. These are detailed in the book Astronomy across Cultures: A History of non-western Astronomy (Selin, 2000). Despite the vast separations of oceans and across several thousand years, American Indians aligned their tents the same way the Hindus aligned their temples (del Chamberlain, 2000). This is just one example detailed in Chapter Four of the similar derivations of constellations.

Astronomy is important in terms of the Hindu religion. Modern star-gazers might laugh at the relative imprecision of the Hindu and Babylonian observations, but these observers were quite satisfied with the accuracy of planets being within 30° of an astral constellation. In fact the calculations had far greater precision than is generally accepted, with detailed explanations of methods laid out in the Surya-Siddhanta (Burgess, 1935). Prior to the Hindus, Neolithic sites were set out according to alignments of either stars or of the Sun and/or the Moon, showing
that these heavenly bodies have been important to the development of cultures and rituals for millennia. These astronomical alignments are evidenced by the setting out of the pyramids at Gizeh, the stone circles of Stonehenge, and the stone alignments of Menec, Kermaria and Kerlescan in Brittany (Cornell, 1981; Stevens, n.d.).

This chapter demonstrates, through modern accepted computer software (*Starry Night™*), that the astral events that were recorded in early religious tracts such as the *Rg Veda* did actually occur and could have been observed and recorded in some way. This latter point is emphasised by the need for rigorous mathematics to accurately back-calculate astronomical events such as eclipses. By showing that astronomy had been well used several millennia BC it is demonstrated that it was probably used to assist in the orientation of the temples in Central and Southeast Asia. Mahadevanandra Giri (1947) details the many verses in the *Rg Veda* which provide names for constellations, names which are still used today.

**Chapter 6, Data Analysis Part 1 – Remote Sensing and Quang Nam Province**, describes the use of Remote Sensing in the analysis of the city-state established in about the 5th C. AD over the current Province of Quang Nam in Viet Nam. Satellite Remote Sensing is used to demonstrate the extensive coverage of a region available from a single image or several mosaiced images. The Chapter explains the processes involved in relating one scene to another, merging neighbouring scenes and rectifying scenes of different spatial characteristics to other scenes. Finally, the annotation layer is used to demonstrate the interpretation
of the *Chiem Son* inscription using the imagery as a background aid to the interpretation. This is an example to show that the whole of Southeast Asia needs to be considered in any study of the proto-history, not just considered in their independent parts based on scattered archaeological findings, just as localised pottery shards need to be viewed in a three-dimensional context in the archaeological site analyses.

**Chapter 7, Data Analysis Part 2 – Mapping the Southeast Asian Indic sites**, develops a spatial analysis from temple level to the regional scale. Here is described the Geographic Information System (GIS) analysis that was developed from the lists and maps of almost 1,500 sites in Cambodia and Vietnam as published by such explorers and historians as Étienne Aymonier, Lunet de Lajonquière, George Coedès and Henri Parmentier, from 1895 to 1927.

The GIS is used to map over 700 of the almost 1,500 sites listed in the 1923 summary of Brahmanic temples across Viet Nam, Cambodia, Laos and Myanmar, including the Isthmus of Kra, these being the sites for which location details have been derivable. The value of this GIS technology is shown by the ability to make selections of temples based on their age, by the king referred to in the inscriptions or by other means depending on the database content. The analysis is limited in spatial accuracy to some extent by the accuracies of the surveys undertaken by the European explorers and their military personnel in the late 19th and early 20th centuries, by the transformations from one system of coordinates to another, by the limited number of significant figures used in the summary tables of
coordinates and by the inability of this author to gain access to the original records to check their accuracy against modern computations. However, sufficient spatial accuracy is maintained, considering the extent of Southeast Asia, to show the basic contention of the thesis that the early temples were set out in an established pattern relating Southeast Asia to the Vedic cosmology.

The GIS also has a ‘live’ component, with hotlinks from the overall map to bring up scanned images of such documents as the route maps of Aymonier from his 1895 publication of his journeys through Cambodia and Laos, as well as some images of the sculptures and temple layouts (Appendix 4 – CD).

**Chapter 8, Spatial Analysis of Indic sites** utilises the software package MapInfo Professional to show the potential regional cosmologies, one taken to be the earlier centred on Angkor Borei, the reputed capital of Fu Nan, with a second, smaller one centred on a temple complex known as *Ba Doem*, which has been translated to mean the “God of the Commencement (or Origin)” (Aymonier, 1901). This temple complex does not feature in previous analyses of the ‘Indianisation’ of the region. The Spatial Information System shows the inter-relationship between this little-known temple complex and the city-state covering Quang Nam province detailed in Chapter 6.
Chapter 9, Conclusion summarises the findings of the thesis. These include:

- Basic sciences – mathematics, metrology, surveying, mapping and astronomy - and religions date back several millennia, stemming from around the end of the last Ice Age;

- These sciences were not unique to India nor Europe but were widespread across the Middle East and Asia, probably through trade links;

- Modern scientific methods have been able to associate the teachings of the Hindu *Rg Veda* with the period soon after the end of the last Ice Age, thus adding a significant developmental period prior to adoption of it in Southeast Asia and elsewhere;

- The early Indic temples in Southeast Asia were established in a deliberate pattern by religious people to demonstrate to the local rulers the close link between the Southeast Asian ‘peninsula’, the Universal cosmology and one’s inner cosmology;

- Modern computer technology can be used for astronomical proofs, along with remotely-sensed image analyses and spatio-temporal analyses, to provide graphic explanations of regional proto-histories to support or to be supported by common archaeological methods such as local digs.

Summary of Introduction

1. Most of the current research in Southeast Asia is localised, possibly with the exception of recent and current work by Fletcher *et al.* in the region around Angkor Wat in Cambodia, although this is still limited to about a 100 kilometres radius.
2. The previously constructed proto-histories of much of Southeast Asia, and particularly of central to south Viet Nam, did not consider the arrangements of the Brahmanic temples in a regional cosmological sense.

3. This Introduction points out the need to consider this region as a whole, as well as the development of scientific knowledge in mathematics, surveying, mapping and astronomy from the Chinese and Indian perspectives, in order to appreciate that there might well have been a spatial element in the arrangement of early temples across Southeast Asia.

4. The subsequent chapters, summarised above, detail much of the knowledge of Southeast Asia, then review the development of the relevant sciences, including the use of modern sciences such as GIS and Remote Sensing and how these can aid researchers to understand the development of Brahmanic influences on Southeast Asian societies about 2,000 years ago.
Chapter 2: Literature Review

Introduction

This chapter provides a review of the literature relating to the proto-history of Southeast Asia, with particular reference to Viet Nam and Cambodia and smaller references to the Lao Peoples Democratic Republic, Thailand, Myanmar and Malaysia. The review provides:

- A brief introduction to the pre-history of the region, primarily from Higham (1989, 1996 and 2002), as a background to the study period under review;
- An introduction to the main names of polities used in the region across the first 1½ millennia AD;
- The background to the European colonisation and the establishment of the main research centre for the region, the French Ecole Francais d’Extreme Orient (EFEO) and its Bulletin (BEFEO);
- The early explorations by the French colonialists throughout the region, and the mapping of the region as well as the sites of the ruins;
- A review of the region’s history as presented by the colonial and later researchers.

From this literature review the reader should be able to understand that the proto-history of Southeast Asia, and in particular of Viet Nam, has previously been written without considering the pre-historic developments of prior societies throughout the region and especially the influence that the long-established Indic societies and religions had on the region.
Background

This chapter introduces a conglomeration of the histories of Viet Nam, Thailand and Cambodia as presented by the main researchers of the late 19th through to the late 20th Centuries: Aymonier, Barth, Bergaigne, Chandler, Chatterjee, Claeys, Coedès, de Lajonquière, Finot, Hall, Higham, Leclère, Leuba, Majumdar, Maspero, Mus, Parmentier, Rawson and Wolters. The method of presentation of most of these histories was as a meta-narrative, where a story was told without direct referencing as we know it today. In many cases, assumptions can only be made as to the origins of the data, and it is assumed that the factual data is primarily from Chinese records and secondly from translations of the Sanskritic inscriptions on stèles and temples throughout the region. The balance of the meta-narratives is supposition based on interpolation of the data which is in turn based upon the imposition of European models of civilisations - either the ‘life-cycle’ theory, wherein civilisations are born, develop, mature and decline, or of invasion theories, wherein most of the structure of a civilisation is destroyed by invaders.

The invasion theory is not generally accepted where the ‘Indianisation’ of Southeast Asia is concerned, as there is ample evidence that Indians have not taken over in a “mass migration following invasion”. ‘Indianisation’ was achieved more stealthily through the imposition and adoption of Hindu and Buddhist ways of life which, for reasons as yet undetermined, met with the needs of the indigenous rulers and was acceptable generally by the indigenous populations. Coedès (1968) makes good reference to this as described below.
The life-cycle of a civilisation often was adopted also as a means of classifying the remaining art from the proto-historic period – the statues, temple engravings and stèles (Stern, 1942; Boisselier, 1963; Guillon, 2001). It is known that this art history in particular has created anomalies in the proto-history of Southeast Asia and of Viet Nam in particular. However as more research and independent thought was undertaken, these views have required reconsideration.

To some extent this has occurred, but the Indic origins of the temple designs and of the religions which inspired the temples and their spatial relationships have rarely been considered in the publications, certainly not seriously, other than Snodgrass (1985 and 1990). This thesis is an attempt to bring a religious context into the regional perspective of the proto-history, but first there is a need to describe the general geography of the region as presented in the various European descriptions.

**Background to the early 20th Century meta-narrative**

The following work will refer to a variety of names peculiar to the Southeast Asian region. Some of them are considered to have been political entities, as they were mentioned in the Chinese annals as providers of annual gifts to the Emperor of the time, yet there are limited references to these entities within Brahmanic temple inscriptions. Despite these limited references some authors have placed much reliance on them in their versions of the proto-history and history.

- **An Nam or Annam** – the Chinese term for the Red River region of northern Viet Nam. Also referred to as Tonkin or Tonking, particularly by the French.
• **Lin-I or Lin-Yi** – the Chinese term for the break-away group south of An Nam, generally believed to have occupied the area around Hué in Viet Nam from the late 2nd C AD for an undefined period, but less than 500 years.

• **Champa** – usually refers to the coast of Viet Nam continuously south from Hué to Phan-Rang, with various capitals at various times, lasting until 1471.

• **Panduranga** – considered by many authors to be a part of Champa, with some considering it a separate entity, occupying the area around Phan-Rang in southern Viet Nam.

• **Fu-nan or Funan** – covers at least the southern coasts of Cambodia and Viet Nam, with a capital reputedly at Angkor Borei or Ba Phnom.

• **Chen-la or Zhen-la** – inland of Fu-nan, with many claiming it replaced Fu-nan. There are limited references to “Land” and “Water” Chen-las.

• **Kambuja** – replaced Chen-la and covering the general area now known as Cambodia.

Figure 2.1 depicts the approximate relative positions of the above entities.

**Pre-history**

Charles Higham, in his overviews of Southeast Asian archaeology (Higham, 1989, 1996, 2002), provides the most recent definitive works on the pre-history of Southeast Asia, producing evidence of bronze-age and iron-age sites throughout the region. In his 1996 version, Higham demonstrates that the use of bronze and iron were widespread by the 2nd millennium BC, compared with northern Europe’s use of bronze from the middle of the 2nd millennium BC (Bibby, 1962).
In contrast, Groslier (1962) states that the bronze age for Southeast Asia started in the 6th Century BC, without providing any evidence.

Prior to Higham, Taylor (1983) and Wheatley (1983) showed that rice cultivation and village settlements were being developed from about 3,000 BC, and claimed that riverine communication was well established when the smaller settlements began developing centralisation from about 400 BC. This latter claim might well be just an assumption based on the ample rivers that exist in the region. Settlements by necessity would have had to have been established close to a water supply, and whether the rivers were thus a major form of communication without
evidence of boats is perhaps unjustified. There is sufficient evidence that
elephants were common in the region which could well have been used for land
transport. Also, some of the maps prepared by the early French explorers indicate
the existence of old brick causeways, particularly in Cambodia. The exact use of
these appears to have not been studied in detail.

It is important to note here that the pre-historic and some proto-historic dates
which are referred to as “about x years BC, AD or BP” are mentioned as those
dates which have been assigned to certain developments usually based on
conjecture and often made to fit in with the Eurocentric views of the dominance of
Greek philosophical thought or of Europeans as a dominant race.

Whilst carbon-dating (\(^{14}\)C dating) has been used to refine such dates in recent
decades, it must be noted that there are periods in history in which the method
cannot be applied accurately. Often the methodology is not applied correctly, with
cheaper, less-accurate procedures being adopted and dates being extracted from
the range that the technique provides to fit in with pre-conceived notions rather
than accepting that the date range provided from the results is really the best that
\(^{14}\)C dating can provide. \(^{14}\)C has a half-life of 5568 ± 30 years (Renfrew, 1973),
leaving only a small percentage difference between 200 year intervals, requiring
that sampling and testing methods be very precise and performed under strict
conditions to ensure chronometric hygiene.
Many of the inscriptions had references to the astronomical occurrence at the time of their establishment, from which dates have been computed. These have been checked by C. Eade from 2000-2005, using his computer program developed from the detailed description of the Southeast Asian astronomy in Faraut (1910). This work is expected to be published late in 2006 (Eade, Personal Communication 2006). He has told this author that most of the dates that he computed agreed with the original computations (Eade, 2004 – personal communication). Chapter Four – Astronomy goes into more detail about the origins of this work.

It was beyond the scope of this thesis to try to emulate Eade’s work in order to gain a few more dates for the database. Aymonier (1901) was read in detail, but this provided only scant information for over 120 sites. Positional detail was seldom provided, and in many other references only positions such as “x leagues NW of village y” were published.

Currently, Vietnamese and European researchers are locating many pre-historic sites throughout the north and central areas of Viet Nam, with similarities to the renowned Sa Huỳnh sites of central Viet Nam and the Hoa Binh, Bac Son and Son Vi sites of northern Viet Nam, eg at Go Cam in Quang Nam province (Nguyen and Glover, 2004). These sites continue to provide evidence of changes throughout the pre-historic period in material culture as well as social standing, through the items found in graves in these areas as well as the arrangements of the graves which indicate a social class difference (Higham, 2002).
There are still many potential pre-historic sites to be found and excavated, as highlighted by the recent findings reported by Cameron et al., but, more importantly, to be collated and examined as a whole in a fully regional view of the pre-history. These sites should provide more detailed evidence of the development of societies throughout the region with more accurate and reliable dates which can be applied dispassionately to the regional history, reducing the reliance of historians on “probables”.

**The Missionaries**

Following the closure of China to the European traders in the late 1420s, the Europeans had to find a way from the Mediterranean Sea down the African coast and across to India and beyond. Very little trade had been done along this route by the Europeans during the first millennium AD due to the myths of sea monsters and sirens. One of the outcomes of this opening of direct sea trade between Europe and Southeast Asia was the Christian missionary work undertaken by, principally, the French Jesuits. By the 17th Century AD these Roman Catholic missionaries were operating in Southeast Asia, learning the languages and translating the Christian texts from Latin into those local languages and learning about the local history from the natives (Rhodes, *ca.* 1650a (Tr. 1966), *ca.* 1650b (Tr. 1999)).

The missionaries were well aware of the historical and archaeological evidence in the region, but in the late 1800s they were not accepted as being capable of providing ‘scientific’ research. Henri Mouhot, a French naturalist who was on an
expedition in the 1850s with the British Royal Geographic Society (Jacques, 1999), was credited with the discovery of Angkor in Cambodia. Actually, he was referred to Angkor by Father Bouillevaux, a Jesuit missionary who had discovered the site. However, due to the philology of the day, Bouillevaux, who was not a scientist, was not permitted to publish his accounts. Thus Mouhot received all of the credit for the discovery, even though his area of scientific expertise was botany rather than archaeology.

**The École Français d’Extrême Orient**

From the 1860s to the turn of the 20th Century research across Southeast Asia was reported by science-based personnel primarily through the French Académie des Inscriptions et Belles-lettres, with much of the research being undertaken in Paris. It was this requirement that only science-trained people were allowed to publish archaeological and other studies that made famous Mouhot and ‘his discovery’ of Angkor, with the ground-breaking work of the Jesuits pushed into the background.

In order to retain control of the research being undertaken across Southeast Asia, the French School of the Far East (l’École Français d’Extreme Orient – EFEO) was established in January 1900, two years after the creation of the Archaeological Mission of Indo-China by the Governor-General of Indo-China (Lorillard, 2001). EFEO was established under the scientific control of the Académie des Inscriptions et Belles-lettres of the Institute of France. Originally based in what is now Ho Chi Minh City, in 1902 the original director, Louis
Finot, moved the School to Ha Noi (Lorrillard, 2001). Finot was charged to direct the studies and works of the researchers as well as to establish the structures necessary to create a research institution – a library, a museum and a regular publication.

The library was opened in 1900. The museum was moved to Ha Noi in 1902. The first publication of the Bulletin (BEFEO) came in 1901, covering research from India to China, with the majority on Viet Nam. Working with Finot was Captain Lunet de Lajonquière, whose maps of the region are mentioned elsewhere. Initially, in 1900, they travelled along the Mekong River to Vientiane. Early volumes of the BEFEO contained descriptions and translations of the Sanskrit and local inscriptions found throughout Indo-China, prepared by Finot, Auguste Barth and Georges Maspéro (Lorrillard, 2001).

Another early employee was the architect Henri Parmentier, who prepared accurate sketch plans and profiles of hundreds of the temples found throughout the region (Parmentier, 1909, 1927). One of these is shown in Figure 2.2. Parmentier was also expected to report on the priorities of restoration of the temples, which he presented in 1912 (Lorrillard, 2001). In 1927, Parmentier completed the investigations on Lao temples that he had commenced in 1911. However the two volumes were not published until 1954, five years after his death (Lorrillard, 2001).
George Coedès was a renowned linguist, having published about 1910 his first book about the Far East from the 4th Century BC to the 14th Century AD, whilst based in Paris (Nugent, 1996). After spending some time with EFEO in Ha Noi, in 1918 he became director of the National Library of Thailand in Bangkok. Whilst there he “translated inscriptions from ancient stèles and monuments throughout Southeast Asia” (Nugent, 1996). In 1929 he returned to Ha Noi to become the Director of EFEO, returning to France in 1946. Although Nugent wrote that Coedès’ legacy was “his documentation of the cultural influence of India in most parts of Southeast Asia” (Nugent, 1996), with that influence bringing “Hindu and
Buddhist religious ideas, the Indian concept of kingship, the use of Sanskrit as an official and ceremonial language, as well as Indian artistic traditions to the peoples of southeast Asia” (Nugent, 1996), many documents by Coedès throughout and following his directorship seemed to ignore or overlook this Indian influence at a regional or cosmological scale. After his death, Coedès’ collection of journals, articles and texts relating to Southeast Asia was donated to the National Library of Australia where it forms a special collection in the Asian section.

In the 1940s, Jean-Louis Claeys was working for EFEO. Despite the Second World War during which the Japanese controlled much of Viet Nam, Claeys continued his archaeological work, digging at Tra Kieu in Quang Nam province and later at Oc Eo, in southern Viet Nam. This latter site is quite remarkable for its contents of Roman coins and its canal links with former cities over 60 km distant (Con, 2000). Its place in the region’s history is discussed below.

Although European explorers and missionaries had been in Southeast Asia since the early 17thC. (Rhodes, 1966, 1999), scientific studies of ‘Indianised’ Southeast Asia began only after France began to annex mainland Southeast Asia. This occurred in the mid to late 19thC. following the British colonisation of India. Once it was realised that there were large numbers of Brahmanic ruins and relics to be located across the Indo-Chinese peninsula, there came a need to collect as much information as possible and to develop a meta-narrative of the apparent Indian expansion across the region. One of the more profound statements from Coedès (1968) relating to the “Indianisation of Southeast Asia” is:
“... the Indian expansion was not ... a historical fact clearly delimited in
time and space. It was a phenomenon that touched vast and diverse regions
and lasted several centuries; …” (Coedès, 1968).

Despite this, many writers have given the impression that the process started with
the erection of the first brick temples in the 5th C AD, or at best from the carving of
the Vo Canh stèle dated from the 2nd C AD. Part of what this thesis is attempting
to demonstrate is that this process of ‘Indianisation’ most probably commenced a
few centuries BC, with the construction of timber temples in a spatially ordered
arrangement. This earlier start of the ‘Indianisation’ process would give it time to
diffuse to an appropriate level that is found today in the remnants of the brick
temples and other artefacts. The idea of the ‘Indianisation’ process starting several
centuries BC is supported by the legend published by Moura and quoted by
Aymonier in his second volume (Aymonier, 1901) as previously mentioned in the
Introduction.

From the 1860s to the early years of the 20th Century, scholars and explorers
based in Paris and at the EFEO in Ha Noi battled tirelessly and sometimes at the
cost of their own lives (eg. D. de Lagrée) to provide as full a description as
western science would then allow of proto-historic Southeast Asia and its peoples.
These descriptions predominantly were based on translations of the inscriptions
(Barth, 1885; Bergaigne, 1885; Coedès, 1966) - especially the Sanskrit rather than
the local epigraphic variations in Viet Nam particularly or Cambodia -, detailed
drawings of the temples (Parmentier, 1909) and preparation of maps of the region
(de Lajonquière, 1902).
This research, which produced some monumental scholarly works, reached their apogee with the preparations for the Colonial Exhibition held in Paris in 1931, when France showcased the cultures of its colonies on the world stage. After the exhibition, however, research into ‘Indianised’ Viet Nam or ‘Champa’ slowed significantly. The focus of the EFEO under the direction of George Coedès shifted to Cambodia and particularly to the Angkor region with its better preserved monumental architecture dating from the late first millennium AD, leaving studies of Viet Nam and particularly of ‘Champa’ and its proto-history to stagnate for more than 40 years.

The colonial investigation of south-central Viet Nam, which is referred to as ‘Champa’, began with Étienne Aymonier’s landing in Nha Trang in 1883, having been dispatched by the Académie des Inscriptions et Belles-Lettres. Further research into ‘Indianised’ Viet Nam was delayed, compared to the research into Cambodia’s history, due to difficulties in pacifying resistance to France’s desires to become a colonial administrator. The first science-based history of a polity called ‘Champa’ was produced by Bergaigne (in Paris) (1885) within a few years after the first explorations by Aymonier, Garnier and de Lagrée and its publication represents a monumental achievement.

However, the theories and data presented from this brief period of ‘scientific’ research must have been very much dependent upon, although not attributed to, the work done over many decades by the Jesuit missionaries, such as Alexandre de Rhodes (Rhodes, 1966, 1999). Rhodes had been a missionary in the early
17\textsuperscript{th}C., so he and his Jesuit colleagues had over 250 years start over the new philologists of the late 19\textsuperscript{th} to early 20\textsuperscript{th}C. in the understanding of the indigenous culture and in the translation of the ancient inscriptions.

Throughout the tumultuous and calamitous events of the 20\textsuperscript{th}C. that affected Viet Nam, the story of ‘Champa’ remained constant: trapped within a time bubble that preserved the early versions of ‘Champa’ history, yet did not allow further research to continue. In the period since 1931, occasional attempts have been made to re-start studies into ‘Champa’. Most notable amongst these attempts have been the efforts of art-historians such as Philippe Stern (Stern, 1942), Gilberte de Bernard Groslier (Groslier, 1962) and Jean Boisselier (Boisselier, 1963) to develop an evolutionary history of the art from ‘Champa’. Guillon (2001) has followed in this path, preparing an analysis of the contents of the Cham Museum at Da Nang which includes many articles which must be ‘fakes’ as they are from areas of Viet Nam which do not fit with the previous art history. Other attempts include a brief renaissance into the epigraphy from ‘Champa’ that occurred in the 1980s by a group centred on Pierre-Bernard Lafont, which included a number of ex-patriot ‘Cham’ scholars such as Po Dharma (Dharma, 1987; Lafont, 1987). These last two men were closely involved in the 1987 \textit{Seminaires sur le Campa} at the University of Copenhagen which tried to stimulate greater interest in the ‘Champa’ proto-history but which appears to have been largely ignored by the archaeological community.
In general, however, since 1931 there has been little new detailed research conducted into the development and extent of ‘Champa’ as a regional entity. As a result, the history of ‘Champa’ that emerged from the reopening of Viet Nam’s frontiers in 1986 is essentially unchanged from that formulated prior to the 1930s and indeed is little different from that by Bergaigne in 1888. As noted by Higham (1989), ‘Champa’ represents a missing part of the historical jigsaw that has gradually been pieced together by historians, anthropologists and archaeologists into the cultures of Southeast Asia.

Probably the biggest anomaly that this researcher has found through his review of the literature about Southeast Asia is the lack of discussion of the basis of the Hindu or Vedic philosophy of life and how this might have been built into the adoption by the Southeast Asian people in the ‘Indianisation’ process. Earlier research has centred on artistic and architectural styles, on pottery and other remains, on probable linguistic similarities or variations, but very little refers to the Vedic religions and how these might be evidenced in the temple relationships and distributions. The temples that were constructed in this region, whilst similar in style to those of southern India in particular, have a unique Asian style in the external engravings. Later, this thesis uses a Spatial Information System to attempt to demonstrate a relationship between the early temple arrangements and the Vedic cosmology and how that in turn relates to the region.


Viet Nam and its polities

As mentioned earlier in this Chapter, Viet Nam was divided into several polities during its proto-historic period. From the north, the Chinese protectorate of An Nam, the separatist Lin-I, then ‘Champa’, Panduranga and along the south coast Fu Nan. These are discussed in order below. The source for data about An Nam and of the origins of Lin-I is Taylor (1983). Although this text is The Birth of Viet Nam, he concentrates predominantly on the history of that part of Viet Nam north of the 18th parallel, as this area was under Chinese control until the 10th Century AD, a period for which there are significant volumes of Chinese annals.

An Nam

After some independence the Chinese took control of the Red River delta area in the first Century BC, for the Han emperor. In 85 AD, 100 AD and 132 AD there were violent uprisings by the indigenous people against the Han authority. The Chinese authority spread south of the 18th parallel of latitude and the Hoanh Son Pass, into the current province of Binh Tri Thien. The Han dynasty was replaced in China by the Sui dynasty. In 605 AD the territories conquered or overcome by the Sui commander became three ephemeral prefectures (Taylor, 1983).

In 622 AD the new T’ang emperor set up two administrations – one near Ha Noi to rule the Hong (Red) and Ma River populations, the second with control over the Ca River plain. In 678 AD the whole area was set up as An Nam, the ‘Pacified South’. This was a special term for frontier provinces. In 669 AD the province of
Phac Loc was established just north of the Hoanh-Son pass where they settled mainly Lao emigrants (Taylor, 1983). Figure 2.3 shows this area, with Lin-I to the south.

**Lin-I**

In 192 AD the son of a district official killed the Chinese district magistrate and proclaimed himself King of Lin-I. This kingdom is believed to have been centred near Huế, covering about a half of the province of Binh Tri Thien. This kingdom lacked sufficient arable land, so the king and his successors consistently carried out forays up to and north of the Hoanh Son pass. Finally in 413 AD the king of Lin-I was killed during a reprisal raid by the Chinese (Taylor, 1983).

In 424 AD the new king Yang Mai seized Nhat-nam, the area up to the Hoanh-son Pass. At this time a place called Khuc-tuc near the mouth of the Giang River was a major international trading port. In 431 AD Yang Mai sought assistance from Fu-Nan to take the northern towns near the Hoanh-Son Pass from the Chinese. The Funanese refused. Despite this, Yang Mai was successful, but in 447 AD the Sung leaders sent an army against Yang Mai and Lin-I, killing every adult in the border city and taking away a large quantity of gold and other wealth from it as well as from the capital. Despite this Chinese victory the border remained at the Hoanh-Son Pass (Taylor, 1983). This is a good indication that the raids by the Chinese and later the independent Viets from the north were not about expanding their territory, but primarily about maintaining what land they had and keeping the neighbouring population and/or their rulers in check.
According to Taylor (1983) Lin-I continued to exist as a minor entity, as in 628 AD and 635 AD Lin-I was “soothed and comforted”. Also in 628, Lin-I sent tribute to the Chinese Emperor (Wolters, 1970). In ca. 758 AD the Chinese annals replace Lin-I with Huan-Wang (Hall, 1985), a term which has been translated as Champa.

‘Champa’: The French version of its proto-history

The colonial research recounts with more or less eloquence and conviction the story of how the peoples of the central to south Vietnamese coast undertook a cultural transformation beginning in the first centuries AD and how the cultural
entity that they created, referred to as ‘Champa’, lasted until the middle of the
15th AD (eg. Coedès, 1968). The colonial account suggested that the boundaries
between this entity and the Chinese-styled northern entity (An Nam) were
gradually forced further and further south over that period, until the final
annihilation of the capital of Vijaya in 1471.

Although ‘Champa’ has come to mean all that coastal territory from the Hoanh-
Son Pass through to Phan-Rang, it was not always so. In 1903 Aymonier records
that the local Jesuit priest reports that the northern limit of ‘Champa’ was the
Song Ba (Aymonier, 1903). This accords with the versions from the interviews by
the Portuguese of the ‘Cham’ ethnic people remaining at that time in the Phan-
rang region, as recalled in Manguin (1981), whereby the ‘Champa’ frontier was
further north at some stage and was gradually forced south. This raises the
question of who forced the ‘Champa’ rulers to the south? Was it the Viets from
the Red River area, or was it an as-yet un-identified group between the two? One
must keep in mind the lack of Indic temples in the area referred to as Kauthara,
around present-day Quang Ngai, an alcove strangely deficient in Indic ruins for a
realm which was supposed to include it in its greater than 1,000 year existence.

However, Dharma (1987) maintains that there is sufficient evidence,
predominantly from Portuguese accounts, to demonstrate that this gradual
southward movement of ‘Champa’’s border actually took place after 1471 as the
Cham rulers finally retreated into the Phan Rang area, where remnants of a
different ethnic group are found today. According to Dharma (1987) this part of
Viet Nam remained as a separate entity (Panduranga) until the early years of the 19th Century.

So, according to Dharma (1987), the last four centuries of ‘Champa’ can be accounted for. The big question is: What can be determined about the early centuries of ‘Champa’? The Chinese annals refer to an entity called Lin-I as early as 190-193 AD (Coedès, 1968; Taylor, 1983), but the term translated as ‘Champa’ does not appear until much later – 758 AD (Hall, 1985). The actual positions of these entities along the Viet Nam coast are unclear. However, Lin-I is expected to represent the area around Huế north to about the 18th parallel of latitude.

‘Champa’, once formed, arguably occupied the regions further south, from the ‘Col des Nuages’ on the northern side of the Quang Nam province through to the southern Phan Rang area. As this length of coast is divided by the fingers of mountain ranges extending from the Truong Son range, which separates what is now the Lao Peoples Democratic Republic (Lao PDR) from Viet Nam, there have been various contentions put about whether ‘Champa’ was a single entity or a federation of these geographically separated provinces.

The historic overview given in Coedès (1968) which builds on almost a century of research conducted in the colonial period through the École Français d’Extrême Orient (EFEO) is based on a primary notion that ‘Champa’ was a nation-state throughout its existence from the second century AD and that it remained a monolithic cultural entity which included Lin-I until its ‘demise’ in 1471. This concept has been developed with no apparent evidence of what links existed at
any time between the various alcoves, other than similarities of Indic kings’
names honoured in the temple inscriptions. These alcoves were labelled
Panduranga, Kauthara, Vijaya and Amaravati. Some researchers have maintained
that they were provinces within the one entity – for example, Majumdar (1963),
although he does show in his chronology that there were times of fragmentation
followed by re-unification. Others have maintained that they were ‘kingdoms’ in
their own right united only in times of defence against a common enemy – for
example Leclère (1975) and Higham (1989) – or even that there is inconclusive
evidence that one ‘nation’ covered the above four regions (Higham, 2002).

The historical confusion is exacerbated when one considers the work undertaken
in the 1970s by the Centre d’Histoire et Civilisations de la Peninsule Indochine
(CHCPI) which showed that the writings or inscriptions in modern Cham had
been deliberately ignored in the early research by Aymonier in the 1890s.
Aymonier was not permitted to travel further north than Da Nang in the 1880s, so
he was not aware of the Indic ruins in the area around Huế. This ignoring of the
southern ‘Cham’ inscriptions presumably was because these works contradicted
the ‘easy’ proto-history of a gradual advance of the Viets from the north to
eradicate the ‘Chams’. Aymonier had published a dictionary of the ‘Cham’ script
in 1906, so he could have arranged or undertaken the full translations early in his
explorations. Aymonier apparently refused to consider that the locals around the
Phan-Rang / Ninh Thuan area were different from the peoples further north, or
that they maintained a separate realm for much of the period covering the proto-
history of central-southern Viet Nam. This concept suited the late 19th Century
philology that civilizations existed in a humanized life-cycle of birth, development, maturity and death, the latter caused by the development of writing (Thomas, 2004b).

Other than for the translations of some of the Sanskrit inscriptions and a meta-narrative predominantly developed by Coedès (Coedès, 1968), very little analysis of the Indic inscriptions has been published. Dharma (1987) maintains that the confusion in the current meta-narrative by the European archaeologists has occurred because the colonialists have tried to equate the king lists from the inscriptions found in the Phan-Rang area with those to the north, when they should in all probability be considered as separate entities for the most part of the period from the 2nd C AD to the 19th C AD. Perhaps now that these southern inscriptions have been translated finally a review can be undertaken of their contents along with an open minded review of the whole of the Southeast Asian proto-history.

Figure 2.4 provides some indication of the main modern centres of Viet Nam with the regions mentioned above along with the geography which demonstrates the reason for the term ‘alcove’ used above in the section on ‘Champa’. The modern road from Qui Nho’n to Stung Treng is included as a guide to a possible ancient trade route between the coast and the hinterland.
What can be confidently proposed about the Indic kings in the province of Quang Nam, of which Da Nang is the major city, is that in the 5th or 6th C AD a king had inscribed in a stone on the southern bank of the Song (River) Chiem Son a “message from the gods” granting to the people the land bounded by the “Mountain in the East, the Great Mountain in the South, the Mountain in the West and the River in the North” (Parmentier, 1909).

This inscription was taken to describe the land in which the religious centre of Mi S’on was developed, of which the Song Chiem Son formed the northern and
western boundaries. There are no real mountains around this valley, so the understanding of this requires a different paradigm. However, research based on this, seeking a walled city which would have been the capital, has led to several archaeological digs since the 1930s at Tra Kieu, just a few kilometres East of the location of the Chiem Son stone. Here remnants of a wall were uncovered, with ruins of an Indic temple found on a hill, now under a Roman Catholic cathedral. Figure 2.5 shows some of the results from these diggings, with the old earthen embankment on the south and east sides of the village and the hill. Archaeological digs are continuing in the neighbourhood of Tra Kieu, with Vietnamese-British-Japanese teams excavating from 1997-2000 (Yamagata, 2004).

It is contended in this thesis that ‘Champa’ was originally based in the region around today’s Quang Nam province of Viet Nam as a coastal outlier to the Indianised Fu-nan, Chen-la or Kambuja. The southern Viet Nam provinces and those provinces north of Quang Nam were essentially separate entities. At times these geographically separate entities probably were federated into an entity possibly called ‘Champa’, but at other times they reverted to their non-Indianised conditions, which might be reflected by the Sa Huyhn-style culture found throughout the region. Also, the regional geography as shown in Figure 2.4
Figure 2.5: A schematic of the results from the 1926-27 archaeological survey at Tra Kieu, Province of Quang Nam

(Source: Claeys, 1931)

demonstrates why the south-central coast of Viet Nam would have remained a fragmented entity politically during this proto-historic period. There might also have been a close relationship of the northern parts of south-central Viet Nam with Cambodia at times of the latter’s period of power. References are made throughout the literature to marriages between the royal families of ‘Champa’ and of Lin-I eg. Coedès (1968), although the sources are not disclosed.

Other stone inscriptions have been found in Viet Nam and in Cambodia, but only one has been published with a similar description. This was in one of “The oldest inscriptions of Prasat Preah Neak Buos”, being the right-hand inscription on a “door of the old temple in the south-west corner of the yard”. In the twelve lines
that were extant in the late 19\textsuperscript{th}C there was a statement giving “the limits of the (the earth) these lands” presumably to the local people. There was no king name, but it was dated to 622 or 722 (Aymonier, 1901). An analysis of the meaning of the \textit{Chiem Son} inscription (Ronaldson and Thomas, 2000) - detailed in Chapter 5 - indicates that a different paradigm needs to be considered for the whole of the ‘Indianisation’ of Southeast Asia.

Throughout this early period (\textit{ca.} 2,000 year BP) the peoples of ‘Champa’ were a significant factor along the India to China and Indonesia to China sea trade routes. Inscriptions and records produced by the Chinese tell of a population that were portrayed both as a wealthy nation-state and also as very war-mongering (Coedès, 1968). The principal source of their wealth has not been determined. In contrast to the north, the southern and central stretches of present-day Viet Nam do not have vast mineral resources. However, the Chinese court records attest to trade embassies from the region carrying ivory, sandalwood and other precious items as gifts to the emperor, leaving researchers to suppose that the peoples of ‘Champa’ were involved in trade of the above products. One other source of wealth was obtained by charging passing ships for anchorage and one source of conflict was certainly the propensity of the peoples of the coast to periodically turn to piracy, particularly in the intervals between the fall and rise of trading centres (Wolters, 1970; Leclère, 1975; Manguin, 1979).

Whatever the truth of the influence of trade as part of the ‘Champa’ economy, what is certain, based on the extant inscriptions available at the end of the 19\textsuperscript{th}
Century, is that at some time beginning possibly as early as the 2nd Century AD, if not earlier, parts of this coastline began to express their religious devotion and kingship in forms that appear similar to those practised in India, classified as “Vedanta” (Maspero, 1928). A Sanskrit inscription has been found at Vo Canh, in southern Viet Nam, and dated to the 2nd century AD (Aymonier, 1891), indicating that Brahmanism was probably known before this date but that this is the earliest ‘solid’ evidence of it being practised in the region. Further evidence comes from Phum Banteai Neang (Battambang in Thailand) giving a list of kings, one of whom was Jayavarman I who reigned in 589 Ç (667 AD) and from Vat Chakret dated 548 Ç (626 AD) (Barth *et al.*, 1882-1897). Several references have been made to the replacement with the extant brick temples of earlier wooden ones (*eg* at Mi S’on in Quang Nam province), some of which were burnt down but many of which would have been replaced once the brick technology had been developed and diffused throughout the region from the 5th C AD.

What the authors at the EFEO cannot recount is the relationship between this transformed protohistoric society and another society which existed either prior to or concurrently with the adoption of Indic culture, called “Sa Huynh” after the town where archaeological evidence was first discovered, on the coast of central Viet Nam (see Figure 2.4). The “Sa Huynh” culture apparently existed within the same geographical boundaries that have come to represent the limits of ‘Champa’: Phong Nha in the north to Ninh Thuan in the south, although sites outside of this region have been discovered in recent times. Furthermore, the walled enclosures found at sites such as *Chien Dan* near Tam Ky seem to bear a strong resemblance
to those of elsewhere in Southeast Asia (Moore, 1988) except that they are square rather than circular. Descriptions of walled citadels captured by Chinese invaders are contained in the Chinese chronicles of the period (Coedès, 1968). Where these fit in is currently inconclusive as the *Chien Dan* walls do not appear to have created citadels but rather were low walls probably defining an area of ownership or as flood prevention measures.

It has been known for some time that the colonial history of Champa, as described above based on Coedes (1968), cannot be true. It is clear from the evolutionary model for art history that all of the peoples within ‘Champa’ did not undergo transformation to ‘Indianised’ religions at the same time. Based on the somewhat imperfect art history propounded by Groslier (1962) and Guillon (2001) for ‘Champa’, to the north of Da Nang, around Hué, sculptures and artwork on the temples at Indic sites should represent early forms. However, although apparently under the control of Indic people from the 3rd C. AD, the people did not begin building Indic temples on a large scale until the 9th or 10th Centuries AD. This was about the time that the northern Viets had gained independence from China and were supposedly forcing the ‘Indianised’ Vietnamese further south!

Likewise the provinces of Quang Ngai and Binh Dinh, although implicated in ‘Champa’ from the outset (Figure 1.1), have only an apparently 11th Century style of sculpture in their very few relics of Indic temples. Yet, further south down to the northern side of the Mekong Delta, there are many more sites dated over many centuries, starting as early as the 2nd or 3rd C. AD with the *Vo Canh* inscription.
(Aymonier, 1891), with varying levels of sculpture development. For analyses of the temples in Viet Nam see the maps of the sites in Chapter 5.

The colonial history presented in the *Royaume de Champa* (Maspero, 1928) contains many anomalies also. As evidenced by sculptures found throughout the region, the development of an ‘Indianised’ society continued at various times in the north, in at least one section of the region. For example, all of the Brahmanic sculptures and temples found north of Da Nang are attributed to the 9th C AD and later, demonstrating clearly that ‘Indianised’ religious observances continued after the supposed annexation by the northern Viets. This is clearly at odds with the colonial history, yet it appears to have not been challenged by previous researchers.

The anomalies and gaps within the proto-history as presented by earlier, colonial representatives have continued to grow. Davidson (1979) remarked that there was a need to review the proto-history of Southeast Asia, stating that “our knowledge of Champa remains so fragmentary, vague and inaccurate that the whole subject must be re-worked” (Davidson, 1979). This sentiment is echoed in Thomas (2004a). Too many writers appear to have been loathe to contradict the works of earlier authors, possibly either for political or philological reasons.

Additionally, archaeological theories and methods have shifted from a ‘story-telling’ method of presentation to publications based on scientific evidence using modern scientific processes such as $^{14}$C dating, ice-core drilling, sediment cores,
the use of total-stations (electronic theodolites) and/or photogrammetry in site mapping, and of Geographic or Spatial Information Systems (GIS/SIS) in the three-dimensional analyses of the data from excavations (Renfrew and Bahn, 1996). There is also a move away from excavations, as these are destructive, to remote-sensing methods such as magnetometry - which can reveal buried patterns of change to varying depths depending on soil types, yet do not interfere with the archaeological record - and ground-penetrating radar (Gaskell, 1961; Sternberg and McGill, 1995).

This thesis was to include work undertaken in Quang Nam Province using a magnetometer to uncover some of the hidden remnants surrounding the extant temples and other ruins. Unfortunately, due to a technical problem the data was found to be useless. One of the sites surveyed was at the Chien Dan temples near Tam Ky. The elaborately-carved footings around the bases of the temples had only been uncovered in the late 1990s by one of the local Archaeological survey members (Figure 2.6), so it is quite possible that further brickwork exists about one metre below the current ground level. Figure 2.7 shows the magnetometer survey being undertaken to the East of the temples, whilst Figure 2.8 shows the Chien Dan temples in full.
**Figure 2.6:** Vietnamese archaeologist – discoverer of the footings at Chien Dan temples, Quang Nam Province.

(Author’s photo)

**Figure 2.7:** Magnetometer survey being undertaken to the East of the *Chien Dan* temples

(Author’s photo)
There is evidence that Panduranga was a separate entity for most of the proto-historic period, in conflict with the colonial view of ‘Champa’. This area was certainly Indic, with many temples and inscriptions. From these inscriptions a list of kings was developed, but as the names conflicted with those in the list from the northern alcoves they were generally ignored by the French archaeologists (Dharma, 1987), as recognition of these would have cast doubt on the existence of ‘Champa’ as described by the colonial philologists.

Whilst some authors write sentences or paragraphs which allude to the possibility of a different paradigm, no-one has built on these. For example, Coedès refers to an overarching regent Paramabodhisattva who, in 1081, “repressed an attempt of the always rebellious Panduranga to achieve autonomy..” (Coedès, 1968). When this comment is put together with other comments, even published by the same
author, such as that in an extract from the Chinese author Ma Tuan-lin who suggests that there were separate kingdoms between Lin-I and Fu-nan (Coedès, 1968), sufficient evidence can be found to support the contention that ‘Champa’ was not a single entity along the length of the central to south Viet Nam coast for all of the first 1,500 years AD.

There is further evidence that rulers from Panduranga intermarried with the royal family from Fu-Nan, to provide closer bonds as neighbours (Chandler, 1983). However this was not always the case, as some raids apparently were made by this southern realm against the Cambodians (Kambujans) at various stages according to Coedès (1968), although his sources are seldom explicit. Alternative theories are presented after the following section on Cambodia and Thailand polities

**Cambodia and Thailand Polities**

**Fu-nan**

Fu-nan is the name given to a large religious/political entity which apparently crossed the southern borders of Viet Nam and Cambodia from the last few centuries BC to about the 5th to 7th C AD. The Chinese annals record that Fu-nan was about 1,200 km wide, with influence in the Siam-Malayan peninsula about 600 km to the south and west, and at least as far up the Viet Nam coast as Nha-trang (Coedès, 1968; Wheatley, 1983). Both Ba Phnom and Angkor Borei in south-east Cambodia have been suggested as a likely capital of Fu-nan, although Oc Eo on the coast some 60 km south was a major international trading port. In a recent study at Angkor Borei, Griffin et al. (2000) maintain that Angkor Borei
“probably gained prominence no later than the 3rd century AD”, having been
occupied from the 4th - 5th Centuries BC (this author’s emphasis). This finding
in some part supports the ‘legend’ found in Moura (1883).

Thus, some centuries prior to the Christian era a trading port was established at
which Chinese traders could meet with traders either from Europe and India or
other traders with goods from those western countries. This port was at Oc Eo in
south-western Viet Nam. Sufficient archaeological data has been unearthed to
establish this fact (Coedès, 1968; Leclère, 1975; Chandler, 1983; Stark et al.,
1999; Con, 2000; Griffin et al., 2000). However there are differences of opinion
as to whether the port and its hinterland developed into a large polity known as
Fu-nan, before that supposedly became divided into two Chen-Las, in turn prior to
the development of ‘Kambuja’ which eventually became Cambodia. Whilst many
researchers hold this theory, others have felt that this ‘history’ was a construction
to satisfy the ‘requirement’ that there must have been some large kingdom prior to
the civilisation that established the complexes at Angkor Wat and Angkor Thom
(Chandler, 1983).

The main construct in the history of the Southeast Asian region as a whole is that
Fu-nan, centred at either Phnom Da or Angkor Borei, with canals (still evident)
linking these two with the port at Oc Eo (Bishop et al., 2004), was a political
entity. After ‘peaking’ about the 3rd century AD Fu-nan reputedly split into two
entities, referred to briefly in Chinese annals as Chen-la of the Water and Chen-la
of the Land (Aymonier, 1903). From these two entities Kambuja, the early form of
Cambodia, was established by an Indian referred to as Kaundinya (Chandler, 1983). This is probably a myth, as it is unlikely that a foreigner could establish control and an acceptable royal lineage. What is more likely is that an Indian sage known as *Kaundinya* - a name given to several of the sages in the line of transferral of knowledge referred to in the *Rg Veda* (Griffith, 1889) – brought with him the Indian way of combining religion, the public service and diffusion of the power base which was accepted by the indigenous ruler (Coedès, 1968).

Some Chinese references make the capital of Fu-Nan 200 km inland. This is the distance of Angkor Borei from the mouth of the Mekong River, along which the Chinese possibly accessed it, at least some of the time. Angkor Borei was connected also by several canals with the sea-port of Oc Eo, at which Roman coins have been found, proving that the area was at the cross-roads between European and Chinese trade about the time of Christ (Chandler, 1983; Bishop et al., 2004). This is not to say that the Europeans themselves travelled that far, but more probably that some traders from the west (India) brought with them the Roman coins to use in the East.

Questions regarding the ‘Indianisation’ of Southeast Asia have usually rested on Fu-nan and its successors. The primary sources of data are the Chinese annals and their translations and publications, followed by the many Sanskrit and Khmer inscriptions found across modern Cambodia, particularly east of the influence of the Tonle Sap. Whilst the published works give some detail of the Chinese views of their southern trading partners and describe in detail how the king and his
entourage travel by elephant (Chandler, 1983), very little is revealed of the structure or the extent of power of the apparently wealthy king. Even Chandler writes that there is little evidence for Fu-nan being a major unified kingdom, suggesting that the Chinese wanted it to be one [so that it would regularly send tribute], and later that the French scholars wanted one as a predecessor to the one that apparently fostered the development of the complex around Angkor Wat from the 10th AD (Chandler, 1983).

**Burma-Thai-Malay peninsula**

The Burma-Thai-Malay Peninsula, which was under the control of Fu-nan at some stage around the 2nd to 3rd Centuries AD (Chatterjee, 1964), provides evidence of brick ‘Indianised’ temples dating to the early 6th C Çaka (Ç) [505 Ç and 506 Ç on two inscriptions (Parmentier, 1927)]. With some inscriptions found in Cambodia on Hindu temples dating from 548 Ç (626AD) (Barth, 1885) it would seem that ‘Indianisation’ on the Malay Peninsula was contemporaneous with that on the Cambodian mainland, indicating that Fu-nan was probably Brahmanic before the centre of power was moved and that it covered most of the Gulf of Thailand (see Figure 2.9).

There was a suggestion that the Peninsula was ‘Indianised’ first (Durand, 1931), with the process extending to the mainland later. The common dates for the early inscriptions, as mentioned above, might well have been due to the common period of the introduction of brick temples and stone carvings, which only commenced in India in the 5th to 6th AD.
There seems to be sufficient evidence that at some time in the early centuries AD Fu-nan was a significant entity:

i. Mannikka (1996) mentions that a General Fan Siun ascended the Fu-nan throne in about 245 AD and that during his reign he made an alliance with ‘Champa’. It is suggested by this author that this would be with those peoples based at Phan-Rang (Panduranga), as these neighbours would potentially pose a threat to Fu-nan. Alternatively, ‘Champa’ might have referred to that part of Thailand north of the Dangrêk mountain range.

ii. The founder of the ruling lineage at Fu-nan, mythically called Kaundinya, apparently “gave his son authority over seven dependent settlements”
(Higham, 1989). As they reputedly held control as far as the Burma-Thai-Malay peninsula, they potentially controlled a large area.

iii. Lin-I sought assistance from Fu-nan to take land under control of the Chinese either just south of the Hoanh-son Pass or just north of it (Taylor, 1983). Either Fu-nan was an abutting southern or south-western neighbour or it was the most powerful entity in the region.

iv. The results of archaeological field surveys at Oc Eo and Angkor Borei, as well as of the canal system between these, show that the occupation of the area extended for several centuries (Chandler, 1983; Stark et al., 1999; Griffin et al., 2000; Bishop et al., 2004). Whether this was as a regional capital has yet to be determined.

The extent of the canal system between Oc Eo on the coast and Angkor Borei, still visible on aerial photographs from the 1940s (as presented in Coedès’ *Etudes Cambodgiennes* XXV) and extending some 90 km, would suggest that a well-established civilisation was based there, probably with a pro-active and unifying leader. Studies of these canals are ongoing (Bishop et al., 2004).

Whereas Griffin et al. (2000) state that Angkor Borei gained prominence no later than the 3rd C. AD, Chandler (1983) states that Fu-nan lasted until the 6th C. AD. Whichever is true, they agree that the Chinese annals replace Fu-nan with two entities called Chen-la (or Zhen-la) - Chen-la of the Land and Chen-la of the Water. (These are referred to as “Cambodge de Terre et le Cambodge d’Eau” in Leclère, 1975). There is no mention in any Cambodian inscriptions of either of
these entities (Vickery, 1998). However, about that time (6th C AD) based on stylistic grounds, inscriptions and symbolic carvings that have been found on rocks in rivers across Cambodia and Viet Nam suggest that a powerful person known as Chitasena or Citrasena was stamping his authority on the region (Chandler, 1983). These river carvings could have been either:

- boundary markers of the territory controlled by Citrasena
- religious monuments to the God of the water, which might have been a link to the Śivaite ritual representation of the rivers being the hair of Śiva.

**Chen-la / Kambuja**

Fu-nan was replaced reputedly by two groups, “Water Chen-la” associated with the Mekong delta and “Land Chen-la” located somewhere on the upper reaches of the Mekong near the current border between Cambodia and the Lao PDR. Suggestions for the capital or centre of the latter include Wat Phu (Chandler, 1983) and Sambor (Chatterjee, 1964). In Mannikka (1996) a Chinese source, the “History of Sonei”, is quoted as stating that Chen-la is south-west of ‘Champa’. This would refer to either the former state of Fu-nan, which is south-west of Phan-rang or to north of the Dangrêk ranges. However, at that time (589-618 AD), the king was Chitrasena. This king’s son, Išānasena or Išānavarman, who succeeded him, was reputed to live at Išānapura, which is apparently Sambor (Chatterjee, 1964), although no proof is offered. This Išānavarman maintained the alliance with ‘Champa’, according to the Chinese records in Mannikka (1996). This was done by having or allowing his daughter to marry Jagaddharma of ‘Champa’. Their son became King of ‘Champa’ as Sri-Prakasadharma (Mannikka, 1996), a
name not mentioned in the colonial king-lists, which are based on the Sanskrit inscriptions in Viet Nam.

If factual, it would appear that the two Chen-Las (“Land Chen-La” and “Water Chen-La”) could have existed only for about 200 to 300 years, if Fu-nan collapsed towards the end of the 3rd C. AD. However, if there was some maintenance of control over the Malay Peninsula by the ‘Funanese’ into the 6th C Çaka, which is quite possible as the Chinese records indicate that the Funanese paid tribute to Chinese emperors until 519 AD (Chandler, 1983), then the “Land Chen-la” referred to by the Chinese might well have been a separate entity that was developing due to the ‘global’ aspirations of another leader from further inland. Chandler himself suggests this:

“European scholars in the nineteenth and twentieth centuries, perhaps forgetting the multiplicity of kingdoms that had characterized medieval Europe or pre-colonial Africa - to name only two examples - also chose to see Chen-la as a centralized successor state to Fu-nan, thus making a neat progression from the earliest of these ‘mighty’ kingdoms to the one concentrated at Angkor” (Chandler, 1983).

Chandler also maintains that the Sanskrit and Khmer inscriptions from this latter 6th C AD date “do not provide evidence for a major kingdom” (Chandler, 1983). This is not to say that it was not possible that someone did try to create either a large political entity over the ‘Indo-Chinese’ peninsula or establish a religious significance over the region that appealed to the intellect of a power-seeking
leader. To refer to the English situation, William the Conqueror took another twenty years after 1066 AD to have the regional ‘kings’ throughout England swear allegiance to him (Freeman, 1902).

There is insufficient evidence to confirm that the large entity Fu-nan was replaced by a similarly large entity centred further north and called Chen-la. However, for some time men known as Chitrasena and Citrasena wielded considerable power in the area, in the 6th to 7th Centuries AD. It would seem most pertinent to consider for the region, as Leclère (1914) suggested for ‘Champa’, that most of the time there were a series of principalities which occasionally came under some umbrella control, particularly in times of defence against attacks, such as the invasions by Kublai Khan in the 13th C AD.

**Alternative concepts**

One of the first publication of translations of the Cambodian inscriptions was by A. Barth in 1885 published in the *Notices et Extraits des Manuscrits de la Bibliothèque Nationale et autres Bibliothèques* under the title *Inscriptions Sanscrites du Cambodge* (Barth, 1885). Over three hundred documents had been returned to France by de Lajonquière following his travels in the region. These comprised both Sanskrit and Khmer language inscriptions, which had been provided to Paris as rubbings on some material. Even in his introduction to these Cambodian inscriptions Barth was referring to the problem of the location of the ancient realm of ‘Champa’.
The oldest of the inscriptions was in a Sanskrit form similar to that of southern India, with later forms developing from this. Barth goes on to provide direct translations (into French) of the inscriptions, but there is more information about their meaning in his footnotes. In one translation the name of the king çrí-Bhavavarman is mentioned along with his father Vīravarman. However, this latter name does not appear in the list of kings that had been compiled to that date (Barth, 1885). As the former king reigned ca. 627 A.D. it is possible that his father ruled at a time prior to the development of brick temples and the art of carving inscriptions in stone.

It would appear that this lack of consideration, in many of the regional histories, of the years leading up to the establishment of the brick temples, the remnants of which are extant today, that has led to the confusion over the entities to which the Chinese annals refer. It seems, as Chandler said, that there appears to have been a need to have large political entities existing prior to that which developed Angkor to justify the extent of Angkor’s influence and legacy (Chandler, 1983).

With remains of brick Indic temples and inscriptions on rocks in rivers being found in Cambodia, Viet Nam and the Thai-Malay peninsula dating from the similar time of the 6th Century Çaka (7th Century AD), dates which seem to be based more on artistic or calligraphic styles as much as on any date which might have been in or determined from the eroded inscriptions, it would appear that Vedism or specifically Śivaism was well established throughout the region by the early years of the Christian era. It is quite possible that someone tried to unite the
peoples across the region at this early stage, taking in the Burma-Thai-Malay peninsula as well as the mainland covering what are now Cambodia, eastern Thailand and Viet Nam.

A person known as Citrasena is reputed to have left many early inscriptions, usually on stones in river beds, across the eastern part of Cambodia and possibly in Viet Nam (Parmentier, 1927). These are usually accompanied by additional structures or sculptures, such as lingas and especially carved rocks forming ‘rapids’ (Figures 2.10 and 2.11). Such a procedure could be seen as a linking of a ‘supreme commander’ with a god of the river, which may or may not have been associated with a Hindu follower. However the carvings from Cambodia shown in Figures 2.10 and 2.11 are Indic in style.

**Figure 2.10:** Profile and plan of a group of Lingas in rapids at Anlon Pon Tai

(Source: Parmentier, 1927)
To the south, on the Thai-Malay peninsula, de Lajonquière found some brick temples at the sites shown in Figure 2.12, dated 505 and 506 Çaka (583 & 584 AD) (Parmentier, 1927), indicating a common era for the establishment of brick temples in the region, contemporaneously with brick Indic temples in parts of Viet Nam, Cambodia and Thailand.

It is generally accepted that ‘Champa’ followed Lin-I, covering the same or similar territory. However, according to Moura (1883) in Aymonier (1901) there was a local legend associated with Phnom Preah Vihéar that “The king of the Chams, in the year of the death of the Buddha (544 BC) was shipwrecked at Dangrêk. This king settled at Kouk Telok.” This offers another option that
‘Champa’ was originally an inland entity in Cambodia, perhaps with coastal access via what is now Da Nang. This concept fits with some of those mentioned below that have been postulated by Porée-Maspero and Vickery in Vickery (1998). The current brick temple at Phnom Preah Vihear dates from 586 Ç (664 AD) (Coedès and Parmentier, 1923) and could well have replaced an earlier timber structure as occurred in Viet Nam at Mi S’on (Finot, 1915). According to Finot (1915), one of the inscriptions at Mi S’on, dating from 653 Ç (731 AD), writes of a restoration by Vikrāntavarman of an altar of Lakṣmi erected first in brick by Čambhuvarman, then in stone faced with gold and silver by Naravāhanavarman on the orders of Prakaçadharma.

Figure 2.12: Map of the Thai-Malay Peninsula showing Indic sites found by de Lajonquière dating from no later than the 5th Ç AD (Parmentier, 1927)
Following the above legend regarding Phnom Preah Vihear, Aymonier states:

(Translated from the French by this author)

“What is most certain, is that, many centuries later, at the epoch when historical Cambodia was flourishing, the influence of its literature, directly imported from India, meant that the ‘Kambujas’ considered this chain as a miniature Himalayas which sheltered numerous hermitages and where many temples were built.” (Aymonier, 1901).

Whether Aymonier put the term “many centuries later” in an effort to bring the rise of the Cambodian civilisation into line with Greek / European supremacy is uncertain. Certainly the dates can only be taken as a guide, although the reason for the adoption of the region as a centre of an ‘Indianised’ state is plausible. Figure 2.13 is an extract from one of Aymonier’s maps, that of the Dangrek region, showing the position of Phnom Preah Vihear on the Dangrek ranges, at the source.
of the Khayung River. The range currently forms the border between Thailand and Cambodia.

The above legend of Phnom Preah Vihéar provides an option for the late pre-history of the region: that in the last few centuries BC, ‘Champa’ was the term given to the Southeast Asian region, the religious leadership (at least) of which was already ‘Indianised’. ‘Champa’ was then marginalised to the Viet Nam coast by the rise to power of Fu-nan. In the 6th C AD, the History of Sonei (589-618) states: ‘Chen-la is south-west of Lin-yi. It was originally a vassal state of Fu-nan. The family name of the king is Kshatriya, his personal name is Chitrasena. Under his ancestors this kingdom became more and more powerful…’ (Chatterjee, 1964). Thus the Chen-la of the land mentioned elsewhere co-existed with Fu-nan, not as a replacement for Fu-nan after the fall from power of the latter’s rulers, as mentioned in Chatterjee (1964).

More recently, Éveline Porée-Maspero has suggested that Lin-I and Fu-nan were closely linked, as the Chinese annals did not refer to them at the same time, from the second century AD through to the seventh century (Vickery, 1998) as opposed to Chatterjee (1964) mentioned above. This has led to four possibilities according to Vickery (1998):

- Lin-I and early ‘Champa’ are identical, distinct from Fu-nan (Maspero, 1928; Coedès, 1968);
- Lin-I and early ‘Champa’ were distinct geographically and politically, and distinct from Fu-nan politically (Stein, 1947);
Lin-I and early ‘Champa’ were distinct geographically and politically but of the same ‘Chamic’ ethnicity (Wheatley, 1983);

Lin-I and early ‘Champa’ were identical and probably formed a single political entity with Fu-nan (Porée-Maspero in Vickery (1998)).

Vickery (1998) mentions these possibilities as an aside to his work on the pre-Angkorian Cambodian inscriptions because they could impinge somewhat into the Cambodian region - being neighbours to the late Fu-nan / early Cambodia of the era of his study - and does not elaborate further about them.

It is suggested here that:

1. An ‘Indianised’ king in the Province of Quang Nam in Viet Nam gained control of Lin-I to the north in the late 5th C. A.D., using the Chiem Son inscription as a statement linking the Śivaite region of Quang Nam to those northern lands. Hence the reference to a point beyond the ‘Col des Nuages’ which marks the natural northern extent of that Province. This is elaborated on in the Chapter on the use of Remote Sensing.

2. Chen-la was a vassal state to Fu-nan, centred north of the Dangrêk ranges, possibly with Phnom Preah Viḥéar as its religious heart, similarly to Mi S’on in Quang Nam, Viet Nam.

3. The entity referred to as “Huan-wang” or “Champa” was based in Quang Nam. It would be this area, which was a coastal outlier to the Chen-la of Thailand, that was the core of ‘Champa’.

4. The Province south of Quang Nam – Quang Ngai – retained its separate religious and cultural identity, memorialised by the ritual jar burials that
were originally uncovered at Sa Huỳnh. Similar burial practices have been found throughout Viet Nam, suggesting that this was a common regional practice prior to and concurrent with the ‘Indianisation’.

5. The Provinces around the current cities of Qui Nho’n and Nha Trang were Indianised, and for most of the first millennium they remained separate entities.

6. Panduranga – modern Phan Rang – remained a separate entity for most of the period from the 2\textsuperscript{nd} C. A.D. to the 19\textsuperscript{th} C. This is why the script used on the monuments is predominantly in a different variation of Sanskrit. As they have only recently been translated in full the details associated with most of them have not been accessible to be included in this analysis.

The Chapter 6 – Data Analysis Part I : Remote Sensing and Quang Nam Province - uses these assumptions to provide a spatio-temporal analysis of the Indic temples of Viet Nam.

**Summary**

This Chapter has reviewed the literature covering the European histories of Southeast Asia, showing that where the Chinese had no control the Chinese documentation is limited in its capability to accurately describe the positions of some of the entities used in the European meta-narratives. These European histories cannot therefore be used as comprehensive documentation of the protohistory of Southeast Asia as they leave doubts and confusion through their reliance on pre-conceived European concepts of the development of Asian civilisations.
It is known from various Chinese sources that several entities existed in the region – Lin-Yi, Champa, Panduranga, Fu-nan, Chen-la, Kambuja – but their exact extents and type are not really known. King lists have been prepared by various authors, some of whom have applied the supernumerary II, III etc even though it is unclear from the inscriptions whether they were related or ruled over similar regions. The inscriptions rarely mention the ‘kingdoms’ used in the meta-narratives. Thus modern readers cannot be certain if some of the ‘kings’ mentioned were local ‘kings’ or princes while others were “king of kings”, a term used in several inscriptions.

Various alternative options have been offered, consistent with other reviewers, based on evidence previously mentioned by early researchers but which was overlooked in their final analysis as they needed to have a series of major entities in the region as forerunners to the civilisation that established Angkor in the 10th C A.D.

This thesis now looks at the age of some of the related technologies which existed in the region. Surveying and Mapping, in particular, have been around for millennia, with some aspects, such as plain (or plane) tabling, remaining unchanged from the 2nd millennium BC until the fourth quarter of the 20th C AD. Astronomical observations also have been made since the stone-age, gradually advancing over the millennia from simple naked-eye observations to today’s sophisticated Hubble telescopes and other modern equipment allowing astronomers to see back almost to the beginning of time.
These historical analyses are necessary to enable this thesis to establish that the ‘technology’ was available at least 2,000 years B.P. to enable the establishment of an Indic mandala over Southeast Asia. By establishing that the region had a similar relationship as the Indian Himalayas to the cosmological concepts of the Vedic religions, the priests were able to impress upon the indigenous rulers the value of the Vedic rituals along with the associated organisation of power distribution.
Chapter 3 – Brahmanism

This chapter reviews recent literature which throws light on the age of the Vedic texts. The general conclusion from these sources is that the Vedic texts are much older than European researchers have previously accepted, and support the claims of Indian researchers from early in the 20th Century, claims which they were encouraged to retract in a conference in 1951. Whilst some of the sources are Indian, there are several that would appear to be unbiased in their approaches.

The strength of the arguments for the Vedic texts being older than previously accepted comes from two points:

• The spread of English versions of the Vedic texts to enable non-Sanskrit experts to examine their contents for their veracity;
• The use of modern scientific analyses to help prove that the geography of the period described in the texts actually existed at one point in time – the time when the texts were originated, even though only verbal at that time.

The Age of Vedic Literature

The primary aim of this thesis is to shed some light onto the proto-history of central to southern Viet Nam (CSVN) with particular regard to the spatial arrangement of the Brahmanic temples found throughout the area, although far less prominently in the Nghia Binh Province in which are found the current city of Quang Ngai and the reputedly pre-historic town of Sa Huynh. Central to the discussion of the date of a broad-ranging adoption of Vedism or Brahmanism
A part of the problem with dating the evolution of ‘Indianisation’ in Southeast Asia is that there have been continuing arguments about the likelihood of the Hindu Religious stories being as old as the Indian scholars maintained (Needham, 1951). If this chronology is wrong, then it influences the time available for the early promulgators to have established their strong religious beliefs, customs, rituals and following in India and then to have it adopted throughout Southeast Asia, whether by force – which is unlikely and for which there is no evidence – or by cultural diffusion, at least at the ruling class or elite level.

This problem of dating was exacerbated by the European supremacists of the late 19th and early 20th Centuries AD, with their maintenance that Greek society of the late centuries BC and early centuries AD was the basis of all knowledge or social development. From this supremacy theory came the strong belief that Asian countries, including the Indian societies, could not have developed their societies prior to, nor even in parallel with, European developments.

This problem is associated with the change in philology during the 1870s, exacerbated by an incorrect interpretation by Müller in his translation of “aryas” in the Rg Veda (Rajaram and Frawley, 1995). Müller’s translation was that this meant a race of people, the ‘Aryans’, who came from outside the north-west of India to eradicate the Harappan civilisation in the third millennium BC. After ten
years he changed his mind about this but by this time there had been significant political and philological arguments based on this term which could not be rectified (Rajaram and Frawley, 1995). Unfortunately, the use of Aryan-invasion terms persists in recent literature, for example in Ashfaque (1977).

It would appear, though, that this philologic argument started as early as the late 1700’s, based on comments by H.T.Colebrook Colebrooke (1810) in his various articles in *Asiatic Researches*. For example, in Volume iv (1795) he wrote an article entitled *On the Duties of a Faithful Hindu Widow* which he prefaced with a comment about the scholarship of certain researchers and their publications. This comment refers to those European authors who doubted Indian scholars for the early dates they put for the origins of their religious texts. Further discussion on this point follows, with Table 3.2 giving the relevant dates.

Colebrooke (1810) later states that the “institutions of the Védas are anterior to BUDD’HA, …”. As Buddha is recorded as having died in 544 BC, it is not surprising that critics would want to make the origin of the Védas as close to this time as possible. For example, Pingree (1981) maintains that the Védas were written about 400 BC. Other commentators since the 1870’s debates on philology have also referred to such a date to support their contention of the supremacy of the Greek philosophers. Perhaps what has caused confusion amongst later writers (if their acceptance of a later date was indeed accidental) might be due to the part-revival of the Védas following the overthrow of Buddhism in India, as Colebrooke attests: “Most of what is there [in the Védas] taught, is now obsolete:
and, in its stead, new orders of religious devotees have been instituted; and new forms of religious ceremonies have been established.” An example of this is that a widow now was given a choice of whether to follow her dead partner onto the pyre or to remain as a widow performing devotional rites (Colebrooke, 1810).

The table on p. 452 of Bose et al. (1971) summarised below in Table 3.1 puts the \textit{Rg Veda} as being developed about 2,000 – 1,500 BC, up to 600 years earlier than the date determined by Colebrook. As the \textit{Rg Veda} was originally handed down by word of mouth, rather than written, it is almost impossible to put a date on its origins, let alone the origins of the belief system. However, a more plausible timescale has been developed recently (Rajaram and Frawley, 1995) as discussed below.

Throughout the various articles in the 1977 reprint of Colebrooke’s early presentations in the \textit{Transactions of the Royal Asiatic Society} (Colebrooke, 1827) but in particular in \textit{On Indian Sectaries} he mentions the various sects which are basically Hindu, but which have slight variations: Jainas, Buddhists, Sán'chýas, Vaiséshicas, Chárvácas, Lócayaticas, Máhéswaras or Şiva-bhágavatas of which there were 4 divisions, three of which are the Pásupatas, Páncharátras and Višnu-Bhágavatas (usually referred to as just Bhágavatas). Such diversity exemplifies the extent of philosophical discussion throughout the Indian religious people, which must have happened over many centuries, given the number of variations. Cross (1994) mentions in his Introduction that the religion is constantly undergoing revision. In Volume I of the Transactions, in his discussion on the \textit{Máhéśwaras} and the \textit{Pášupatas} Colebrooke states, following a discourse on the
similarities between the Greek philosophy and the Indian that: “I shall not hesitate to acknowledge an inclination to consider the Grecian to have been on this, as on many other points, indebted to Indian instructors” (Colebrooke, 1972, 1977).

Table 3.1: Summary of development of Hindu philosophy
(Source: Bose et al., 1971)

<table>
<thead>
<tr>
<th>Era</th>
<th>Literature</th>
<th>Brief description</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 2000 – 1500 BC</td>
<td>Rg Veda</td>
<td>Emergence of monistic ideas; Cosmic light (Visvajyoti); natural law (rta); sacrifice (yajna); primeval water (ap)</td>
</tr>
<tr>
<td>c. 700 – 600 BC</td>
<td>Upanishadic literature</td>
<td>Evolution of doctrine of the five elements Five elements and phenomenal knowledge</td>
</tr>
<tr>
<td>c. 600 – 200 BC</td>
<td>Buddhism &amp; Jainism</td>
<td>New approaches to matter and motion Direct perception only means of knowledge; only 4 elements</td>
</tr>
<tr>
<td>c. 200 BC – 400 AD</td>
<td>Systematic formulations of Vaisesika, Nyaya, Mimamsa, Samkhya; Jaina and Buddha literature</td>
<td>Examinations of the means of knowledge; the real and unreal about space, time and sound</td>
</tr>
<tr>
<td>c. 400 – 1200 AD</td>
<td>Commentaries on original works</td>
<td>Atomism among JAINAs; Momentariness of the Baudhas</td>
</tr>
<tr>
<td>c. 1200 – 1800 AD</td>
<td>Rise and Spread of neo-logic in eastern India</td>
<td>Physical concepts with knowledge theory; new meanings of space, time and atomism</td>
</tr>
</tbody>
</table>

Later in Volume I, in his discussion on the Pancharátras or Bhagavatas, Colebrooke concludes with another discussion on the similarities between these and the Greek philosophers, finally stating:

“I should be disposed to conclude that the Indians were in this instance teachers rather than learners” (Colebrooke, 1810).
In case there are any doubts as to the fairness of Colebrooke’s assessment of Hindu philosophy, due to his father being the Chairman of the East India Company, I refer the reader to Ganeri (2001), whose comments are supported in a review by Ishitobi (2002), and by an assessment of Colebrooke’s character in Whitrow (1970).

Thus it is important to take into consideration the conflicts between European and Indian or even ‘Indianised’ commentators on the respective value of early Greek and Indian philosophies, as well as the proposed age of the *Rg Veda*, particularly those commentators who were published during the 19th century and early 20th century. Colebrooke (1810) himself alluded to the philologic differences in some of his articles in *Asiatic Researches*, in the late 18th and early 19th centuries as noted above, and it is again noted in Ganeri. The in-depth discussion of these philological matters shall be left to other researchers.

In a current book, Dr. Vishnu Kant Verma details not only the age of the Vedic texts but also expounds that, rather than the Harappans being eliminated by attacking Aryans from their north-west, the Indian sub-continent was the birthplace of emigrants who developed many Middle Eastern societies (Verma, 2005). Verma cites several texts and journal articles resulting from recent archaeological explorations in the Indus and Sarasvati valleys which point to almost continuous occupation there from approximately 4,000 BC.
Verma’s interpretation of the Purāṇas is that they are not just myths – they are “genuine genealogies mixed with legends” (Verma, 2005). The Purāṇas are really moral stories, based on true events, for which the date of the original event is not of importance. The Purāṇas were stories derived from lessons from the past prepared for “posterity with special reference to the four aims of life which are prosperity, fulfilment of desire, righteousness and the emancipation of the human soul from the bondage of rebirth.” (Verma, 2005). These presentations of moral stories are similar to the stories translated by F.W. Bain and first published in 1903 (reprinted 2001) which by Western standards would be considered ‘fantastic’ or surreal, but which nevertheless contained sound moral values which they re-iterate in order to deeply impress those values upon the reader or listener (Bain, 1903b, 1903a, 1903d, 1903c).

Another writer supporting early dates for the age of the Vedas and hence the remaining literature is Professor Subhash Kak. He has written much in the 1990s on associated topics, with the most relevant to this article being On the Chronological Framework for Indian Culture (Kak, 2000). In this paper Kak makes several substantiated claims, of which four are:

1. The traditional Indian king lists go back into the fourth millennium BC;
2. Astronomical references in the Vedic literature refer to events as early as the fourth millennium BC;
3. The Sapta Sindhu region is associated with a cultural tradition that goes back to at least 8,000 BC, with the Sarasvati River at its centre;
4. The Vedic Samhitats should be dated to the third millennium BC and the Brahmanas to the second millennium BC.

Thus there is increasing modern evidence that support the earlier age of the Vedas, which is an integral argument of this thesis – that more time was required to establish the philosophies and rituals that became diffused throughout Southeast Asia after adoption in what is now the Indian subcontinent.

**Regional societal developments**

The importance of understanding the age of the Hindu religion, with its various forms of the one god, cannot be underemphasised. The Indian regions had a well established society as evidenced by the Harappans, which existed in the 3rd to 4th millennia BC (Bose *et al.*, 1971; Ratnagar, 1981). One must also keep in mind the histories of China and Egypt, both having a variety of dynasties of rulers from both within their countries as well as conquerors from outside, such as the Mongols and Libyans respectively. Additionally the middle east’s Babylon and Nineveh were centres of strong civilisations in the same epoch (Spence, n.d.).

Figure 3.1 gives a reconstruction of the structural capabilities of these societies, some 3,000 years BC, based on archaeological diggings. This demonstrates that in these early times various ‘civilised’ groups had the capacity to survey, plan and construct large buildings and walled cities.

The Harappan and Mohenjo-daro cities demonstrated the ability of these early Indians to lay out accurate right-angles, so that their buildings were truly square and fitted a regular orthogonal pattern of streets. The Harappa society
disintegrated, not caused by an invasion from the north or north-west (the “Aryan invasion”), but due to catastrophic climate changes which occurred about 2,200 BC (Rajaram and Frawley, 1995). This is supported by ice-core evidence from Mount Kilimanjaro in Africa, which shows that a 300-year drought affected Lake Chad in Africa (Thompson et al., 2002) which is on a similar parallel of latitude to the Harappan region of north-west India.

This evidence and a description in the *Rg Veda* of a climate which must have existed before this 300-year drought, puts the date of the *Rg Veda* as 3,000 to 4,000 BC. Thus the *Rg Veda* pre-dated the Harappan culture which itself coincides with the preparation of the sutras, at about 3,000 BC (Rajaram and Frawley, 1995). There is then some 2,000 to 1,500 years for consolidation and diversification of *Rg Veda*-based religious thought to have occurred throughout India, prior to the Indian expansion of trade to the east through the Mauryan empire of the 3rd century BC.

Some of the Indian literature since the 1950s, even up to the 1980s, is clouded by the outcome of the *Symposium on the History of Science and Technology in South Asia* held in Delhi in 1950 at which it was agreed that Indian scholars should be more circumspect about the age of the history of the sciences of India (Needham, 1951). Indian articles later in that decade fail to put years or eras on the dates of source material, for fear of again incurring the wrath of the Europeans. Needham writes:
Figure 3.1: A schematic of one of Nineveh’s royal palaces

(Source: Spence, n.d.)
“… the majority of the papers, which put forward quite unacceptable early datings, especially for texts purporting to date from the first two millennia BC; particularly bad examples are the two papers on astronomy (by Shukla and Dixit) as well as others on chemistry (by N.R. Dhar), embryology (R.V. Seshaiya) and medicine (G.V. Satyanarayananmurthi)…”

The papers mentioned above are in Table 3.2 which compares the dates of various Indian literature with the ‘accepted’ European dates. Despite that, there were those who agreed that insufficient credit had been given to Indian and Southeast Asian scholars. Needham himself concludes:

“In my opinion, future research on the history of science and technology in Asia will, in fact, reveal that the achievements of these peoples contributed far more, in all pre-Renaissance periods, to the development of world science than has yet been realized…” (Needham, 1951).

The above-mentioned symposium initiated a series of publications sponsored by the Indian government, called the *Indian Journal of History of Science*. In several recent articles the text seems to need a date, but the authors appear to take pains to explain the topic without referring to even probable dates (Chandel and Sharma, 1991; Datta and Singh, 1992). So it has now become difficult to determine the age of documents forming the basis of research upon which historic Indian scientific literature is based, whether written before or since 1950.
Table 3.2: Dating of Indian Texts
(Needham, 1951)

<table>
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<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vedic material</td>
<td>c. -14th C</td>
<td>-6000 / -1500</td>
<td>-4000 / -2000</td>
<td></td>
</tr>
<tr>
<td>Upanishads period</td>
<td>-10th to -6th C</td>
<td>-17th to -7th C</td>
<td>-2500 / -2000</td>
<td></td>
</tr>
<tr>
<td>Calendrical texts:</td>
<td>Jyotisha Vedanga</td>
<td>-600 / -200</td>
<td>-1400</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Surya Prajnapti</td>
<td>c. -400</td>
<td>-500</td>
<td></td>
</tr>
<tr>
<td>Astronomical texts:</td>
<td></td>
<td>+4th or 5th C</td>
<td>+/- 0</td>
<td></td>
</tr>
<tr>
<td>Surya Siddhanta</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic and</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>technological text:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arthashastra</td>
<td></td>
<td>-1st C</td>
<td>-4th C</td>
<td></td>
</tr>
<tr>
<td>Medical and</td>
<td></td>
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<td>biological texts:</td>
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<td></td>
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<tr>
<td>Susrutsa Samhita</td>
<td></td>
<td>-1st C</td>
<td>-7th C</td>
<td>-6th C</td>
</tr>
<tr>
<td>Charaka Samhita</td>
<td></td>
<td>+1st C</td>
<td>-7th C</td>
<td></td>
</tr>
</tbody>
</table>

It is pertinent to include here the dates accepted by Rajaram and Frawley (1995), which have the benefit of being determined later and being able to be corroborated by scientific data from a different field, as mentioned earlier. Table 3.3 is a summary of the table they present in their Appendix 1.
Table 3.3: Dating of Indian literature – a summary
(from Rajaram and Frawley, 1995)

<table>
<thead>
<tr>
<th>Date (BC)</th>
<th>Literature</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>8000</td>
<td>End of Ice age</td>
<td></td>
</tr>
<tr>
<td>4000</td>
<td>Rg Veda</td>
<td></td>
</tr>
<tr>
<td>3600</td>
<td>Yajur, Sama &amp; Atharva vedas</td>
<td>Late Vedic</td>
</tr>
<tr>
<td>3100</td>
<td>Mahabharata</td>
<td></td>
</tr>
<tr>
<td>3000</td>
<td>Sulbasutras</td>
<td>Harappa &amp; Mohenjo-daro</td>
</tr>
<tr>
<td>2200</td>
<td>Major drought begins; Harappa decline</td>
<td></td>
</tr>
<tr>
<td>1900</td>
<td>Harappa ends; old Babylonia</td>
<td></td>
</tr>
<tr>
<td>1300</td>
<td>Vedanga Jyotisa</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>Buddha</td>
<td></td>
</tr>
</tbody>
</table>

As can be seen from the above table, with the benefit of another five decades of research and modern ice-core technology between the 1950 conference and the research by Rajaram and Frawley, the dating of the Indian literature by the Indian authors of papers presented at the 1950 conference summarised in Table 3.2 is vindicated. This means that most European based literature on Indian history that reflects the dates in the column of Table 3.2 headed ‘Dating accepted by critical modern scholarship’ will need to be revisited and probably re-written.

The Brahmanic Philosophy in Practise in Southeast Asia

The contention made by the early European archaeologists regarding the protohistory of Viet Nam that there was only one ‘Indianised’ polity covering the coast from Hué to Ho Chi Minh City is contrary to the ‘India’ of that same period,
which comprised many ‘kingdoms’ (Cross, 1998), although there were times when there was an over-arching ruler, such as the Mauryan empire about the 3rd C BC. In this light it is considered necessary to consider all of the Brahmanic sites across Cambodia, Laos and Viet Nam to determine whether, particularly in the early centuries of ‘Indianisation’, the central coast of Viet Nam was actually a part of a larger polity emanating from the area of what is now Cambodia or whether it continuously functioned as several separate polities.

Previously this thesis has referred only to the Rg Veda. However, different groups placed different emphases on the various aspects of the one God – Śiva, Brahma, Viṣṇu et al. -, so that they worshipped one aspect of the one God.

“.. Brahman and all the gods and goddesses, as well as man and everything else in the universe, are parts of a continuum. The Hindu deities are not viewed as separate and rival powers, but as different functions, different aspects, different ways of understanding and approaching the one Reality.”

(Cross, 1998; p.31)

Whether the temples and other ruins across Southeast Asia reflected Śivaism or one of the other principal aspects of God is difficult and not for this thesis to determine. However, many of the temples were found with a liṅga in them, indicating that they could have been Śivaite. “The Śiva temple is an elaboration of the meanings generated by the liṅga: the axis of the temple is coincident both spatially and symbolically with the liṅga” (Snodgrass, 1990). The term ‘Brahmanism’ is used to indicate that the worship was based upon the Rg Veda
and the later texts, the *Upanishads*. There are four Vedas, each used by priests of different levels and each divided into three sections. The *Rg Veda* is studied and used by the Hotar priests to recite verses of hymns to invite the gods to the enjoyment of the Soma or other offerings; the *Samaveda* is used by the Udgâtar priests who chant verses as they prepare the Soma or other offerings; the *Yajurveda* is used by the Adhvaryus who perform the sacred rite muttering verses from it; finally, the *Atharva-veda*, which is referred to by the Brahmin. This latter Veda is the latest and “appears to derive from the level of folk religion” (Cross, 1998).

Each of the above four Vedas has four layers:

1. the *Samhita*, which is a collection of Mantras, one of verses, chants or sacrificial sentences: these form the core, “the original collection of verses around which the rest has grown” (Cross, 1998);

2. the *Brâhmanas*, which is used to teach the practical use of material in the *Samhita*. It includes *vidhi* (precept), *arthavâda* (explanation) and *vedânta* (being veda-end, containing philosophical thoughts);

3. the *Aranyakas*, which are transitional between the *Brâhmanas* and the *Upanishads* and which “do not have a strongly marked character” (Cross, 1998); and

4. the *Upanishads*, which brings together the contents of the *Brâhmanas*, condensing, systematising and completing them for practical life. These were passed on by word of mouth, to help explain the meaning of the earlier Vedas.
Next, there are three classes of Vedic Sutras:

i) Črauta-sutra, which regulates public worship;

ii) Grihya-sutra, which regulates domestic ceremonies; and

iii) Dharma-sutra, which explains the duties of the Castes and the Āçramas

(Deussen, 1912).

Wales (1977) seems to explain best how the Vedas were put into practice by the Southeast Asians. He explains first about the pre-historic and pre-Indian cosmology which was represented throughout the region as a Father Sky / Mother Earth duality. In Viet Nam the pre-historic Dong Son drums have designs which demonstrate the awareness of planetary cosmology. The prime aim of the rituals, presumably in which the Dong Son drums were used, was to “destroy historical time…to enable a new start” (Wales, 1977), not unlike modern New Years’ Eve celebrations, represented by the passing of the baton from Grandfather Time to the newborn Time ‘manager’. This sort of ritual is good for the well-being of both the individual and for the community which depends on living in harmony with the Cosmos, a realisation demonstrated by the Chinese with their Tao and the Vedic Indians with their Rta (Wales, 1977).

The next concept to consider is the Universe analogy, or macrocosm–microcosm doctrines. These relate the macrocosm of the Universe to the microcosm of the human body (Wales, 1977). The Universe is often represented as eight concentric spheres, with Earth at the centre surrounded by the Sun, Moon, the five visible planets and the stars (Mookerjee, 1983). From an Earth perspective, the central
point is the mythical “Mount Meru with its crowning heavens .. visualised as arising from the primeval ocean, while around it at the cardinal points are disposed four islands..” (the *Mahabharata* in Wales, 1977).

In the *Viṣṇu Purana*, “Earth itself consists of seven concentric circular continents separated from each other by seven great seas..” (Wales, 1977). “Around Meru the Earth .. is succeeded by the atmosphere .. which reaches to the level of the Sun. There begins .. the heaven of the inferior deities, which reaches as high as the Pole Star. Between this latter and the Sun are the orbits of the other planets and the lunar constellations..” (Wales, 1977). “Svarloka, the heaven of the inferior gods, comprises the cities of Indra (Amarāvatī) on the East, and of the other seven regents or Lokapālas, placed at the cardinal and sub-cardinal points..” (Wales, 1977).

Similarly, in the human body there are seven chakras aligned along the central axis. The central point, the bindu, is at the top of the head. A circle, centred on this Bindu passes through the Ājña chakra between the eyebrows. The next concentric circle passes through the Viṣuddha, the throat chakra. Thence come the Anāhata or heart, the Maṇipūra or navel chakra, the Svādhishthāna (below the navel) chakra and finally the Mūlādhāra or root chakra (see Figure 3.2).

Another representation of time in Brahmanism is in the descriptions of the passage of the Sun across the sky in its chariot. There seems to be a variety of descriptions, with different numbers of horses drawing the chariot or a different
number of wheels on it (Griffith, 1889). The Rg Veda also describes the passage of time in terms of the Sun’s movement from the south to the north then back to the south again during the course of a year, as a cycle of re-birth (Griffith, 1889).

Figure 3.2: The seven chakras of the subtle body.

(Source: Khanna (1979); p 123)

Further to this, in “the Brahmanic formulations the wheel is the Sun Wheel, whose spokes are the divisions of time: the four-spoked wheel is the wheel of the four seasons, the four ages of man, the four stages (aśrama) in the life of the Hindu, the four yugas; five spokes denote the five-seasoned year; six spokes are the projection of the sun-structured six-armed cross, the sign of the wheel of Fire, the sun descending from the summer solstice, as well as the six days of the week, the seventh being the central Sun (Snodgrass, 1985); the wheel with twelve spokes is the wheel of the months and of the zodiac; wheels with thirty spokes
denote the lunar mansions; and 360 spokes are those of the days of the solar year”
(Snodgrass, 1990, based on the Maitra Upanishad VI.14-16)

In *Empirical Time and the Vyūhāntara Gods of the Pāncarātra*, Gupta (1992) states that in the Pāncarātra cosmogony there are five cosmic powers which aided God in his creation:

i) *jnāna* or knowledge, the power of revelation;

ii) *prāna* or cosmic vibration, the concept of space;

iii) *icchā* or will power;

iv) *kriyā* or the power of action; and

v) *kāla* or Time, which marks the empirical nature of the final stage of creation. Time is symbolised by the three luminaries, Sun, Moon and fire, each of which generate life-sustaining heat (Gupta, 1992).

The wheel of Time is the Sun’s chariot, with twelve spokes representing the twelve *Vyūhāntara* deities, the gods of the months marking the ever-moving year progressing through the seasons. The symbol of Viṣṇu is the wheel or discus (Gupta, 1992).

Thus there are a variety of ways in Brahmanism to describe and represent the passage of time and the duality of the microcosm of man and macrocosm of the Universe. It is suggested here that for some form of Vedism to be diffused throughout Southeast Asia these would have been required to be demonstrated by the Indian Brahmins to the early ‘Indianised’ kings of Southeast Asia, particularly those who held the predominance of power, perhaps more by the ‘King of kings’.
Snodgrass (1990) has shown that there are a large number of ancient structures which were erected with alignments to sun-rise or sun-set at equinoxes or solstices, moon-rises, star-rises and also to the pole-star. These structures were built using these similar alignments for a wide cross-section of religions, both extinct and continuing. In particular he shows the relationships of many temples of the Angkor complex to each other and to sun-rise at the summer and winter solstices. Such alignments are shown to exist also in ancient Greek, Roman, African, American Indian and South American structures.

Snodgrass (1990) also shows that there was a significant inter-relationship of temples and sacred mountains centred on Delphi in Greece. These relationships reflected arrangement of the zodiac into twelve parts. Thus it is quite possible that similar constructs were used in Southeast Asia to establish the early network of Brahmanic temples.

Further, “the laying out of the Hindu temple is a ritual, enacted in a mimesis of the manner in which the manifested world proceeds from its Principle. In the ritual a square, which delineates the outer periphery of the temple, is geometrically derived from a circle that has been divided into four by axes oriented to the cardinal directions. The square symbolically denotes the boundaries of the cosmos; the centre of the circle is the terrestrial trace of the point of Unity whence the cosmos emanates into space and time; and the cross of the directions is a modulator that orders or cosmicises the square by relating it to its geometric
centre and to the centre of the Universe, the metaphysical Sun. The rituals are described in the Śilpa-śāstras” Snodgrass (1990).

**Summary**

In order to provide a sufficient time-frame by which the Vedic ideas could be spread by cultural diffusion from the Indian region to Southeast Asia, it has been necessary to demonstrate that the age of the Vedas and their related texts such as the Bhagavad Gita is older than European scholars have led us to believe. This has been accomplished by drawing on recent reviews of the contents of these texts, with particular emphasis on the geography described therein, and comparing that geography with recent findings from unrelated sciences, such as satellite remote sensing and more particularly ice-core samples.

It has been shown that rather than being derived in the 5th or 6th Century BC they were developed most probably from the 4th to 6th millennia BC, a period following the last ice-age when rivers were fed by the newly melting ice-caps of the Himalayan range, prior to them drying up once the meteorological conditions had stabilised. Hence the significant development of the Harappa and Mohenjo-daro archaeological sites which were abandoned due to the drying up of the rivers on which they depended, rather than by the forceful overthrow of marauding invaders from the north-west of India, as often claimed by Euro-centric researchers.

Alignments of a variety of structures across a diverse range of cultures to similar astronomical phenomena, based on similar beliefs to the Brahmanic literature, indicate that similar alignments could have been used in Southeast Asia.
Chapter 4: Early mathematics and surveying and mapping techniques

The aim of this Chapter is to demonstrate that knowledge for basic surveying and mapping were available far earlier than the time to which many scholars give credit, and particularly to early Indian societies. These are assessed in the following order:

- As a precursor to surveying, a knowledge of basic triangle theory is required, commonly referred to today as Pythagoras’ theorem. It is shown in the section *The development of mathematics* that the knowledge of right-angled triangles in several societies pre-dates Pythagoras by at least many centuries.

- The chapter then looks at the history of the processes of levelling, both for route levelling between places and for the levelling of sites on which to erect structures such as temples and pyramids.

- The history of mapping follows, showing that very early in man’s civilisation, although still in pre-history, successful attempts had been made at planar mapping – mapping that did not consider the ellipsoidal shape of the Earth.

- Later it is asserted that, based on the data with which Ptolemy was furnished on which he based his attempts at preparing a world map, simple mapping capabilities were used in various quarters. These would have been developed for the variety and extent of trade known to have been occurring between China, the Middle East and Europe overland, as well as Africa, India and Europe by sea. Many of these mapping techniques did not change until late in the twentieth century as electronics grew, but this is not to say that the basic
elements could not have originated in the centuries or even millennia before Christ.

- Finally the chapter reviews route surveying, demonstrating that the basic technique of plane tabling was established by about 2,000 BC and continued until late in the 20th Century.

**The development of mathematics**

It is important to this thesis that an understanding of the histories of surveying and of cartography be given, including the mathematics, the equipment and various techniques. A.P.H. Werner, a lecturer in Surveying at the University of New South Wales, published in several volumes of *The Australian Surveyor* in 1966-67 (Werner, 1966-67) a summary of the time-line of historical developments of surveying and cartography based on extensive research. Whilst many advances in surveying technology have been made over the past two centuries, it is interesting to note that the accuracies of many early surveys with much simpler equipment have not been greatly improved upon. For example, the pyramids at Gizeh were built from about 2,800 to 2,600 BCE with a base perimeter of about 800 metres. Re-surveys of this

“by British and German teams during the nineteenth century revealed that the ancient priest-surveyors had set out their work with simple instruments to an accuracy compatible with that of modern construction surveying of similar type” (Werner, 1966-67).
Around 3,800 BCE the Babylonians prepared clay tablets depicting land titles and law suits, with the titles described by bounds and metes (Werner, 1966-67). This method requires the representation of a measured straight line from which perpendicular offsets are measured. The Egyptians knew numerical operations of areas, volumes, proportionality and the inscribing of a right angle in a semi-circle (Werner, 1966-67). In about 500 BCE, if not earlier, the Babylonians expressed large numbers in multiples of 60, the Chinese used both decimal and hexagesimal systems depending on the purpose and the Romans expressed them in multiples of 12 and 16 (Werner, 1966-67).

Seidenberg (1962 & 1978) explains his reasons for adopting a much earlier date for the knowledge and use of the so-called ‘Pythagorean’ theorem, referred to above as the ‘right-angled triangle theorem’. Seidenberg argues that the Indians’ Rg Veda and its related texts, in particular the Sulvasutras, needed to know of the right-angled triangle theorem in order to set out the altars. In the Sulvasutras there is also a detailed explanation of the methods and the theory. In addition to the geometry or “geometric Algebra” are methods for the astronomy which was required, as G. Thibaut is quoted as explaining: “The want of some norm by which to fix the right time for the sacrifices gave the first impulse to astronomical observations.” (Seidenberg, 1962).

In the 4th Century BCE Chou Pei Suan Ching wrote the “Arithmetical Classic of the Gnomon and the Circular Paths of Heaven”. This contained the
“right angled triangle, Pythagorean theorem, … use of gnomon, circle, square, measurement of heights and distances, sun shadow at different latitudes, sun’s diameter by sighting tube, circles of equal declination with the pole star occupying the centre, calculations on the annual movements of the sun, use of waterlevel to obtain a horizontal surface for the sunshadow, meridian fixes from sunrise and sunset, culmination of stars, twenty-eight lunar mansions, constellations, ..” (Werner, 1966-67).

Chou Pei Suan Ching’s writing does not confirm that he developed or invented any of this mathematics; it just means that he felt the need for a (new) text describing the theory and use of the mathematics, which Werner (1966-67) demonstrates was well known much earlier. Similarly, Fletcher, E.N.R. (1967) states:

“Much of what has become dogma in Ancient (Linear) Metrology comes from the commentaries by XIX and XX Century philologists, on the writings of Greek and Roman philosophers and historians…There is no clear indication that those early writers were any better informed on the (basic) metrology which was in use by the ancients two or three or more millennia of years before their time, than writers are today..”

In 250 BCE Chinese astronomers and mathematicians defined \(\pi\) to 3.14159, having previously accepted the value as 3. In the first century CE the Chiu Chang Shuan Su was written containing nine chapters on the mathematical art, with 246 problems including:
“1. *Fang thien* (Surveying of land), areas of rectangles, trapezoids, triangles, circles, $\pi$ taken as 3, arcs annuli, …

2. *Shao a Kuang*: finding the sides of figures when areas and single sides are known, square roots, cube roots.


4. *Ying pǔ sū, Ying nǐ*: full moon, new moon …”

(Needham and Ling, 1959)

Once again, this text would not have been the origin of the mathematics, but another text prepared to assist students required to know this in the course of their profession.

According to Werner (1966-67), in about 100 CE Menelaos of Alexandria wrote ‘Spherics’ containing the ‘rule of six quantities’, meaning the sine function. This would appear to have been a new development, but there does not appear to be any proof either way. In about 400 CE the Indians produced modern trigonometry, written in the ‘Paǔlisa Siddhältä’. In about 505 CE Varāha-Mihira used sines and cosines in his work Pañca Siddhältikā, the work of which was then transmitted through the Arabs to Europe. The above two dates from Werner (1966-67) may well require revisiting in the light of the new chronology from Chapter 3, based on Rajaram and Frawley (1995). In c. 650 CE Brahmagupta in India was one of several Hindu mathematicians accepting Chinese knowledge, with no transmission of ‘western’ mathematics to China evident (Werner, 1966-67). This relationship between the Indian and Chinese mathematicians is demonstrated in Table 4.1. However, based on the modern chronology of Rajaram and Frawley (1995), it does seem quite unlikely that Brahmagupta actually derived something new from the Chinese other than possibly an explanation of the way they used the mathematics.
Table 4.1: Relationship between Chinese and Indian mathematics
(Source: Werner, 1966-67)

<table>
<thead>
<tr>
<th>Chinese Mathematics</th>
<th>Indian Mathematics</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Chiu Chang Suan Shu&quot;</td>
<td>&quot;Chou Pei&quot;</td>
</tr>
<tr>
<td>Area of segment of circle</td>
<td>Chao Chün-Chhing</td>
</tr>
<tr>
<td>+ 1st Century</td>
<td>Pythagorean theorem</td>
</tr>
<tr>
<td>Mahāvīra,</td>
<td>+2nd Century</td>
</tr>
<tr>
<td>+9th Century</td>
<td>Bhāskara,</td>
</tr>
<tr>
<td></td>
<td>+1150</td>
</tr>
<tr>
<td>Sun Tzu Suan Ching</td>
<td>Liu Hui</td>
</tr>
<tr>
<td>Mathematical Manual</td>
<td>Survey Geometry</td>
</tr>
<tr>
<td>+3rd Century</td>
<td>+3rd Century</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Brahmagupta</td>
<td>Aryabhata</td>
</tr>
<tr>
<td>+7th Century</td>
<td>+5th Century</td>
</tr>
</tbody>
</table>

Under the heading “Computing Machines” Werner (1966-67) states that about 3,800 BCE the “Babylonians used analog devices for surveying and map making. (a gunsight is an analog system, …)”, and by about 300 BCE the “Greeks had complex mechanical analogs of the solar system, driven probably by water, to predict moon phases.” About this time the Chinese also had mechanical devices (Needham and Ling, 1959).

The data in Table 4.1 is no doubt influenced by the late 19th century philologists, who either had or gained respect in their field, yet based a lot of their arguments on assumptions. Note that in the paragraph just prior to Table 4.1 in Werner (1966-67) the term ‘about’ was frequently used in expressing the age of these sources. So much of the data was not verified by archaeological evidence, a lot of which was available particularly in Greece where dates could be expressed in decades as against the Indian centuries. Yet once the English and Germans had
access to Indian literature and to some early archaeological finds there was still
debate about the age of Indian history in the 1950s, as mentioned earlier from the
work of Needham and the 1950 conference with the Indians on the age of their history.

So far it has been shown that there was a long history of development of
mathematical thought as it related to practical problems, usually related to the
setting out or measuring of land parcels for taxing purposes or more usually for
the solving of complex astrological and astronomical requirements for religious
observances. The main users of the practice of surveying and of the associated
mathematics were priests as, through their basic occupation, they needed these
skills for “astronomy, calendrical science, mathematics, philosophy and
geography. These men designed methods of observation, computation and
mapping for teaching purposes; ..” (Werner, 1966-67).

However, the dates in Table 4.1 appear to be quite late, as basic mathematics must
have been available for the building of the pyramids in Egypt in the 3\textsuperscript{rd}
Millennium BCE. It is suggested here that their knowledge could well have been
derived from Indians who traded with them or their neighbours following the
preparation of the \textit{Rg Veda} in c. 4,000 BC or of the Sutras in the late 4\textsuperscript{th}
Millennium BC.
Metrology

Before mapping can be undertaken, particularly in defining land parcels for taxation purposes, linear, areal, volume and weight standards of measurement needed to be defined. The common story of David and Goliath refers to Goliath’s height as ‘six cubits and a span’. Unless some definition of these measurements existed as a standard no-one would be able to make sense of them. Berriman (1953) provides an in-depth analysis of the various standards used throughout the ‘known world’ from the earliest times, including the inter-relationships between standards.

Berriman (1953) refers to the finding of a scale rule at Mohenjo-daro with two circles 5 graduations apart, these being equivalent to 1.32 inches (English modern standard). He shows that a great bath there, made of varying sized bricks, was of dimensions such that the hypotenuse was double the short side, such that the long side was \(\sqrt{3}\) times the short side. The area was within 0.05% of the area given by \(1/100\)th of a nivartana, this latter being a standard Indian unit of area (Berriman, 1953).

Berriman (1953) also shows that values for \(\pi\) more accurate than 3 were available from early times:

- Neugebauer’s translations of Babylonian Cuneiform texts allows Berriman to compare brick sizes and the volumetric measurement of a log. Here he states that “This text is historically important as cuneiform evidence for the use of \((25/8)\) for \(\pi\).”
On pp 77-83 Berriman (1953) describes in detail the relationships of the Egyptian pyramids to multiples of the royal cubit, as well as the use of $\pi$ as $3+1/7$. This latter revelation comes from the relationship of the heights of the pyramids being related to multiples of the circumference of the bases. That is, “the perimeter of the square base is equal in length to the circumference of a circle described with the height as radius;”.

To further show the continuity through the millennia of linear standards, Berriman (1953) states (p17):

“It is also clear from the evidence in general and from measurements of the Great Pyramid in particular that the Roman digit was a perpetuation of the Egyptian digit that was current in remote antiquity.”

This is just one example of the long relationship between standards of metrology from ancient times through to modern times and across many cultures.

**Figure 4.1**: A Chinese floating level, staff and surveyor with sighting board (Source: Needham and Ling, 1959).
**Levelling**

The bases of the pyramids would have been levelled by scraping the surface then filling the required area with water. As the water level dropped due to evaporation or seepage, raised areas would have been exposed. These would then have been scraped down to agree with the surrounding area. The lines of the large blocks could have been levelled using a water level, a simple instrument of a channel filled with water and two identical floats, one at each end, to give the line of sight. A common modern technique is the use of a flexible pipe filled with water, but it is considered that a similar device would not have been available in 2,300 BC. For more accurate work they would have had plumb-bobs suspended at each end to provide a more accurate line, and perhaps act as a balance to ensure that the channel was indeed horizontal. An example of a Chinese version of this is shown in Figure 4.1. It is envisaged that actually the ‘Surveyor with sighting board’ should be on the right, using the board as a screen to ‘focus’ his direction to the graduated staff.

**Mapping**

Werner’s summary of Ancient Surveys is enlightening. Records from Babylonian times (circa 4,000 to 3,800 BCE) include a map of Mesopotamia on a clay tablet, with land titles and law suits also on clay tablets. The land titles were “a description of land by bounds and metes (linear)”, which is a very descriptive method of defining a land title which still used in some Australian titles today (although these would generally be early titles not yet converted to the Torrens
system of land titling developed in South Australia in the 19th century) and similar to the title descriptions in the United Kingdom. Interestingly these Babylonian dates are in line with the new, earlier dates of the Indians’ *Rg Veda* and thence the Sutras.

Another important step in surveying history, and one which appears to have been quite international, was the adoption in c. 3,000 BCE of the northern cubit as a standard of length, which “spread through Mesopotamia, Egypt, N. Africa, India (Indus Valley), China and Western Europe” (Werner, 1966-67). The actual proof of this statement is not evident in his text. However, Berriman (1953, p.54) has determined from Gudea’s ruler that the graduations were 0.66 inch (English standard), equivalent to a Sumerian *Shusi*. Further, “The proportional Sumerian foot of 20 shusi measures 13.2 in; and there is evidence of the use of this foot in the construction of the first century (A.D.) fort known as the Caburn, on the Sussex Downs near Lewes.”

As previously mentioned, the pyramid at Gizeh was erected in c. 2,780 BCE. Late in the 19th century a tablet dating from c. 2,190 BCE was found in Iraq showing “Gudea, the High Priest in Lagash, (Sipurla), holding a plane table on his knees.” (Werner, 1966-67). {Lagash, now known as Tell al-Hiba in Iraq, was a region in Mesopotamia in the 4th millennium BC. Its site was rediscovered in 1877 by Ernest de Sarzec, who also found there the archives of Gudea’s temple, containing 30,000 inscribed clay tablets }. Figure 4.2 shows a statue of Gudea from the period.
The plane table is a simple device enabling a map to be prepared as one moves across a country or site, or around a coastline. It contains a flat board to which is attached the paper or other material onto which the map is to be prepared. A long flat and straight sighting implement is laid across but not fixed to the table. This sighting tool may be of wood or brass, with a sighting piece mounted at each end. Its edges should be straight, as they are used to draw the lines of sight from the current position to the forward position and to the features of interest to either

**Figure 4.2: Statue of Gudea from the Louvre**

(Source: Berriman, 1953)

Decapitated statue of Gudea, governor of Lagash c. 2175 B.C.; on his lap is the tablet with the graduated rule. This is one of several statues of Gudea in the Louvre.
side. It does not require any precise angle meter, but it might contain a magnetic compass to help one orient it at each position, or at least the starting points. A detailed method of use can be found in Galbraith (1849). Figure 4.3 shows a simple plane table. Note that Galbraith refers to it as a ‘plain table’. Either is correct. The use of these instruments was still being taught to surveying students at the University of Melbourne in 1972, where this author studied!

Figure 4.3: A 19th Century Plain Table with Compass
(Source: Galbraith, 1849)
Map Projections

Whilst most maps in the pre-Christian era would have been fairly localised and on a Cartesian coordinate system, with no actual projection parameters, in the first century or two of the Christian era people such as Marinos and Strabo were working to develop systems of projection for a map of the known world. Ptolemy was able to refine these due to his great mathematical skill, and he explained the methods in his book Geography. Throughout, he refers not only to the works of the two predecessors mentioned above, but also to the many suppliers of information regarding either astronomical observations to help fix the positions of towns in latitude and longitude or the descriptions of the travels of merchants and their aides who timed and described their journeys by land and sea (Berggren and Jones, 2000).

It is because a lot of the information that Ptolemy used to prepare his map of the known world was third-hand or worse that one cannot place much reliability on it to say whether the travellers were reporting on journeys as far east as Vietnam or even Malaysia. Details of the problems associated with mapping in remote or unexplored areas, even after aerial photography became available, are given in Filchner et al. (1957) and Collier and Inkpen (2003).

Ptolemy’s estimates of the width of the known world were about double what they really are. Some of the descriptions of journeys show that at some times either the sailors did not know where they were or in which direction they were going. This
is evidenced in the regional map of Southern Asia developed from Ptolemy’s description, particularly in the region of the east coast of India (Berggren and Jones, 2000). For the large distances that some traders were travelling by land or by sea, accurate maps were not required. A simple map created by plane table methods of the relevant features such as mountains and capes would have sufficed for many functions. Once appropriate materials for preparing the maps on, such as animal hides or clay tablets, or for writing on the selected material, had been developed, there would have been nothing to stop people making portable rough maps of a region.

Ptolemy in the second century AD might well have been the first to create a projection to display a world map, but there were definitely regional maps available before then, as evidenced by the clay tablet of Gudea mentioned above. The Chinese certainly had maps from ancient times, as alluded to in the discourse on the Chinese cartographer Phei Hsiu of the late third century AD in Needham and Ling (1959). In his instructions on how to create a map with appropriate grid lines, Phei Hsiu laments the loss of “maps and geographical treatises [which go] far back into former ages.” These were lost “when the Han people sacked Hsien-yang, [and] Hsiao Ho collected all the maps and documents of the Chhin. Now it is no longer possible to find the old maps in the secret archives…” (Needham and Ling, 1959).

Those maps that were available, from the Later Han time, were not well prepared according to Phei Hsiu, but whether the lost maps were better is impossible to assess. Certainly from that time maps were prepared to scale and with rectangular
grids. Phei Hsiu prepared his maps on 18 sheets which he presented to the Emperor. After preparation of the map sheets he obviously did some map checking, as he found “that there was not the slightest error” (Needham and Ling, 1959). Thus reasonably accurate maps were available in China at least from the 3rd century AD.

**Route surveying**

Most of the early users and developers of new surveying and mapping methodologies were seafarers, as coastal mapping and position-fixing were paramount to a successful return voyage. Thus many of the methods used on land were only slight modifications of techniques used on the seas. This control by the naval personnel was apparent even into the 19th Century AD. Collier and Inkpen (2003) show how the control of surveying education in Britain moved from the navy to the army after the latter had been compelled to revise and develop many techniques for the settlement of India once they had colonised it. In particular the methods used in the triangulation survey of the whole of India were new, and thus a whole new training regime had to be set up. The naval methods of mapping coastlines and rivers, based on the training provided to budding explorers and early administrative officials of the colonial powers, also evident in the maps of the missions in Laos and Cambodia by Aymonier (Aymonier, 1895), needed to be changed. An example of Aymonier’s maps is given in Figure 4.4. Despite the reduction in uncharted lands into the 20th century AD, Filchner et al. (1957) still thought it necessary to publish a text on route mapping and position locating in unexplored territories.
Filchner et al. (1957), though, had, through the lateness of their publication, the advantage of being able to include the benefits of photography, both aerial and oblique, to assist their mapping. The benefits of aerial photography and other remotely-sensed earth-observation techniques, such as satellite remote sensing using both optical and radar observing equipment, is briefly demonstrated and explained in Renfrew and Bahn (1996). Their book demonstrates the value of modern surveying equipment such as total stations, with their inbuilt Electronic Distance Measuring devices and on-board computers to analyse observations in three dimensions, in the provision of accurate and precise positioning of the location of the boundaries of archaeological sites as well as the position in space of each artefact found within a dig.

Renfrew and Bahn (1996) also demonstrate the value, in the analysis of the ‘bigger picture’, of radar imagery which allows the highlighting of variations in the apparent natural features of a potential site caused by an oblique sideways looking angle. This technique was used by Associate Professor Roland Fletcher of the University of Sydney in 2000 to determine the extent of roads and other structures that were developed to support the 9th – 15th Century AD complex at Angkor Thom in the Siem Reap region of Cambodia (Fletcher, R., 2000). Other remote sensing devices include truck-mounted radar, magnetometers of various types and resistivity meters. In archaeological work they are used to assist in the definition and location of buried items through changes in the soil structure. These items include burial pits, clay bricks created by furnace baking and dried water courses.
From the above one can appreciate that the basic surveying techniques have been in use for several millennia, with developments in technology only improving accuracies in the last 150 to 200 years, and to the maximum extent since the advent of Electronic Distance Meters (EDM) from the 1970s.

**Figure 4.4:** One of the maps from Aymonier’s voyage through Laos and Cambodia in the late 19th century AD.
(Source: Aymonier, 1895)
Summary

This chapter has reviewed the historicity of the related sciences of mathematics, metrology, levelling, surveying and mapping, showing that there is sufficient evidence proving that appropriate knowledge was available from, at the latest, the beginning of the second millennium BC. This knowledge was widespread, with definite relationships between standards adopted across many cultures and millennia proven (Berriman, 1953).

Knowing that these basic skills were widely known and understood in early times will enable the contention of this thesis to be accepted - that the early temples of Southeast Asia were built in strategically located positions based on a good understanding and knowledge of the region.
Chapter 5: Early Astronomy

Introduction

This chapter reviews the extent of primitive astronomy, both with current indigenous peoples as well as with the stone-age peoples. The common elements of using the astral patterns to relate tales of moral stories is quite compelling evidence that ‘star-gazing’ is as old as mankind. The development of astronomy in India in the third or fourth millennium BC and its adoption across Southeast Asia over 2,000 years ago is evident in the similar constructs of the science and level of development of understanding of planetary as well as astral motions between Southeast Asian peoples and the Indians.

The chapter uses modern computer technology to demonstrate that the planetary alignments referred to in the Vedic literature must have been based on actual observations. This conclusion is developed from the need for rigorous mathematical formulae to back-calculate the alignments, which would have been almost impossible using the geo-centric view of the cosmos that was common until the renaissance era. This is demonstrated in the complex equations developed by the famed Ptolemy in particular to describe the reverse motions of the planets Mercury and Venus.

Vedism has an underlying view of cosmology, this being essentially the relationship between the Universe and the inner human. This chapter looks at the
history of Astronomy and uses modern computer software to demonstrate that the start of the current period amongst the long periods of time referred to in the Vedic literature were most probably based on actual observations of a conjunction of all of the planets at sunrise in 3102 BC.

Many nations around the world have used studies of the stars to relate social and moral values. These verbal stories are remarkably similar across cultures and continents, particularly those concerning the Pleiades (del Chamberlain, 2000; Haynes, 2000). It is apparent through a full reading of the various offerings in Astronomy Across Cultures (Selin, 2000) that the star positions and regular risings of planets at repeatable intervals was widespread knowledge from very early in man’s development into societies. As Krupp writes in his review of work by Joseph Campbell The Way of the Animal Powers (1983):

“.. the first function of mythology is ‘to waken in the individual the sense of wonder and participation in the mystery of this finally inscrutable universe.’ .. We construct a congruent reality out of nature that we believe reflects the structure of the cosmos. Our vision of the cosmos is an exercise in ordered space and time. That mythic cosmic order is imposed by and revealed by the sky. What happens in the sky is therefore inextricably linked to the maintenance of society and culture, which to be valid must conform to cosmic order.” (Krupp, 2000).

This is very much the view adopted by Vedic religions in their stories, and why the study of the stars and planets was so important to them.
The histories of astronomy and astrology as used in the Southeast Asian context are clouded by Eurocentric views, which maintain that the Greeks must have originated the studies and the mathematics behind them. There is ample evidence, discussed below, that astronomy developed long before the Greeks, either in India or in the Middle East as well as separately in China. Based on the findings from Rajaram and Frawley (1995), detailed in Chapter 3 above, many of the dates from European authors, whilst included here as a part of the history, will have to be reviewed. The discussion below ignores for the most part the Chinese history as their system is different from the Indian, which is the primary concern for this thesis. However, Burgess (1860) gives an in-depth comparison of the Chinese, Middle Eastern and Indian astronomy through the use of the asterisms, and concludes that the Chinese were either the first or there was a fourth group which developed the asterisms from which the other three developed their respective astronomical deliberations. For the Indians this was produced in the Surya Siddhanta, which Burgess (1860) has translated and analysed in full (Burgess, 1935).

**Pre-historic Astronomy**

The pre-historic astronomers could only make observations with the naked eye, so only five planets were referred to: Mercury, Venus, Mars, Jupiter and Saturn. The remaining planets were only discovered in the ‘modern’ era - Uranus in 1781, Neptune in 1846 and Pluto in 1930. Even in the Stone Age, monuments were erected which were aligned to some celestial phenomena, such as the direction of the rising sun at the Spring equinox. Evidence of such monuments include the stone alignments at Menec in Brittany (Stevens, n.d.) (Figures 5.1, 5.2), the stone
circles at Stonehenge (Cornell, 1981; Stevens, n.d.) and the Egyptian pharaonic pyramids (Cornell, 1981). Krupp (2000) writes also of a site at Nabta Playa in Egypt which dates to being more than 4,800 years BP, according to the authors of the article Malville et al (1998).

As the early astronomers considered that the Earth was the centre of the universe, the motions of the Sun and of the Moon, being more visible, were very much a part of the equation. The original seven became the basis of much of the Hindu cosmology and its relationship with the inner self. The earth is in the centre,
A Spatial study of Southeast Asia

Phil Ronaldson

represented by Mount Meru, which is on the axis leading to the North Pole star. Around its base is a land mass, Jambudvipa, split into four like lotus petals, representing the four continents. This is surrounded by seven concentric bands of oceans and continents (Ashfaque, 1977). In the depiction of the heavenly bodies, Earth is again at the centre, with the others in concentric spheres. In order they are: The Sun, the Moon, Mercury, Venus, Mars, Jupiter and Saturn, with the outer sphere containing the stars. The stars are considered to be attached to the (North) Pole star by cords. The above concepts have been depicted in some Tantric symbols (Mookerjee, 1983), with the Sri Yantra being based upon it.

In the middle of the 3rd millennium BC, when these ideas were being developed, $\alpha$ Draconis was very close to the north astronomical pole, around which the others rotated. This gives a common night-time reference of north which aided navigation and position fixing. Cornell (1981) records that a scientist, Michael Overden, has shown that the constellations were prepared at a time corresponding to the star positions for the celestial equator ca. 3,000 BC.

The astronomy researchers who give early dates which correspond to a reasonable degree with those revised dates given in Chapter 3 for the Rg Veda, include Bentley (1825), Pingree (1978 &1981), O'Neil (1986) and Hunger and Pingree (1999). These dates range from the middle of the 3rd Millennium BC to about 1,140 BC. Although this author does not fully agree with some of the conclusions made by Bentley (1825), at least Bentley (1825) is some fifty years before the main philological crisis, so most of his works and conclusions are free from
Eurocentric bias, unlike Dreyer who takes a typical Eurocentric viewpoint in his volume on the history of planetary systems, preferring to differentiate his work as a study of “cosmology, distinct from mythological cosmogony, [and which] dates only from Greece” (Dreyer, 1906).

**Indian and Southeast Asian astronomy**

Another unbiased source of early commentary on the Indian astronomy is Bailly (1787), who wrote that “the first knowledge of Indian astronomy came to us [Europeans] from Siam, through the Ambassador ...sent by Louis XIV in 1687”. Two different versions were returned to Europe through different missionaries. There were two different years: one civil and lunar starting at the winter solstice, the other solar and astronomical starting at the spring equinox. The zodiac had two divisions: one having twelve signs of 30°, being arbitrary and mathematical, the other having 27 constellations of 13° 20’, being a “true working zodiac”, based on “lunar time and related to agriculture and the return of the seasons” (Bailly, 1787).

Bailly writes of four different tables. Three of these are: – one from the town of Chrisnabouram, one from Masulipatnam, another from Tirvalour. Whilst they each appear different, they actually present the same results. “When the Brahmans wish to calculate their position, they speak of their epoch, that of the age of caliougam, fixed from the year 3,102 before our era, and multiply the number of years elapsed by 365\(d\) 6\(h\) 12’ 30”, the duration of each year.” (Bailly, 1787). These early astronomers were able to determine their longitude relative to another place,
and knew that “Siam is 18° 15’ east of Benares”. In further applauding the talents of the Indians, Bailly wrote: “En partant de ce principe, on ne trouve point que les époques Indiennes de 1491 et de l’an 3102 aient pu être déduites des époques ni de Ptolémée ni d’Ulug-beg.” (Bailly, 1787). That is to say, the Indians were not reliant on Ptolemy nor Ulug-beg, two renowned astronomers to whom many astronomy researchers attribute the world’s knowledge of astronomy.

**Figure 5.3:** The Eastern Sky from Ujjain, India just after Pluto rose on February 17, 3,102 BC, showing ALL planets in conjunction (*Starry Night* image).

In describing the early Indian eras, Bailly (1787) mentions the era beginning at the conjunction of February 17, 3,102BC, as shown in Figure 5.3. He then reports that fifteen days after the start of the Kalyuga, the Indians saw four planets disengage
successively from the rays of the sun: first Saturn, then Mars, then Jupiter and Mercury (Figure 5.4). Although Venus did not appear, they thought it marvellous that there was a general conjunction of all of the planets – “doit être fondé sur une véritable observation.” (Bailly, 1787). They would be most pleased to know that ALL of the planets, even those three only discovered since the 18th century, were in conjunction at that time!

Figure 5.4: The morning sky 15 days after the dawn solar eclipse, showing the appearance of Saturn, Mars, Jupiter and Mercury as per Bailly (1787).  
*(Starry Night image)*.

Contemporaneously with Bailly was John Playfair, a Scottish mathematician who maintained that the starting-date of the astronomical observations recorded in the tables still used by the Hindu astrologers was 4,300 BC (Elst, 1999). Whilst this decision is not elaborated on, there was a conjunction of all of the (visible) planets
on May 2, 4,300 BC, with risings spread over just under four hours. Figure 5.5 is a Starry Night output of this date.

**Figure 5.5:** The conjunction of all planets on May 2, 4,300 BC.

(Starry Night image).

Further support for the Indian origin of astronomy comes from Johnson (2003), the 5th Edition of his *Exegesis of Hindu Cosmological Time Cycles*. In this work Johnson shows that the source of the time cycles is the *Surya Siddhanta*. He explains in detail the breakdown of the Caturyuga in terms of the Kṛtayuga, the Tretayuga, the Dvaparayuga and the Kaliyuga, and how these relate to the start of the Kaliyuga on February 17, 3,102 BC. Johnson (2003) also shows the relationship between these years and the various time measurements, such as the lunar cycle and the sidereal year, and the basis for the sexagesimal numbering system they developed.
Eade (1989) is a pragmatic look at the interpretation of the Indian astronomy as adopted by the Cambodians and Thais, using his detailed study of Faraut (1910) to write a computer program from which he has produced ephemerides for Southeast Asia from AD 638 – AD 2000. Eade (1989) maintains that there was a system which had rules which remained intact over several civilisations for more than a thousand years. There were slight variations for different regions and even for parts of regions.

With the *Rg Veda* probably dating from around the 4th Millennium BC, the conclusions of Ashfaque (1977), based on extensive research of archaeological relics found from the Harappan and Mohenjo-daro civilizations, indicate a concurrence with the Classical Sumerian period of ca. 2,500 BC. Whilst Ashfaque still refers to the ‘Aryan invasion’ of north-west India he provides enough material for his findings to work without that aberration. Ashfaque (1977) also refers to the Sarasvati River and its drying up at some stage, supporting Rajaram and Frawley (1995), yet maintaining his comparison of the Sarasvati River with the heavenly river in which the Sun, Moon and planets travel daily.

Whilst modern zodiacal signs are applied almost universally, this is only since 1928 after the International Astronomical Union (IAU) was formed and the official constellations were adopted (Fuchs, 2004). O'Neil (1986) claims that the zodiac (under a different name) was invented by the Mesopotamians in the 2nd millennium BC. However, the names of the seven planets in the old languages – Akkadian, Sanskrit, Greek, Latin and Arabic – seem to be unrelated, confirming
that the constellations, particularly the twelve main ones of the zodiac, were originally also separate. The constellations appear to depend on those four that mark the beginnings of the seasons about 2,500 BC, with the others ‘thrown in’ to provide continuity or possibly a further measure of time (Ashfaque, 1977; O'Neil, 1986).

This early date compares very favourably with the apparent origins of dates used by Eade (1989) in his computer program, the value coming out to about 3,102 BC as discussed above. At this time, according to Eade’s program, all but one planet would have arisen at about the same time one morning, an extremely rare event which would have caused wonder among any of the early stargazers, of which there were plenty according to Cornell (1981). A detailed article about this date was presented in the Journal Centaurus in 1980 (van der Waerden, 1980). This has been checked in the software package Starry Night (Figure 5.3). Whilst the latter article suggests that this date would have been computed rather than observed, the conjunction would not have gone unnoticed by experienced observers of those eras, as Bailly (1787), Johnson (2003) and Playfair in Elst (1999) wrote.

**Middle Eastern Astronomy**

Much work was carried out from the 8th Century BC. Hunger and Pingree (1999) give details of many fragments of diaries and Almanacs which date from the 8th century BC and which are claimed to be the basis of a mathematical, predictive
system. That beginning was most likely the first year of Nabû-nasir, 746 BC (also known as Nebuchadnezzar). The observations begun by this king were continued for at least 700 years, as proven by the large number of fragments of clay tablets which have been recovered and transcribed and which record planet movements and solar and lunar eclipses (Hunger and Pingree, 1999). Many observations must have been made prior to this king for him to accept the need for and to initiate such meticulous observations, which would have been based upon recommendations from the religious leaders. The need for these observations to aid in earthly decision-making by the king of the day is described in detail in Campion (2000) and DeYoung (2000).

The lengthy observations from Nineveh and Babylon were passed on to the library at Alexandria, in Egypt, where the renowned Ptolemy studied them. Using the mathematics developed by his predecessor Euclid, Ptolemy was able to determine to a greater accuracy than those before him, in that part of the world at least, the mathematics involved in determining the periods and motions of the planets. Ptolemy adopted a geo-centric system, which required complex concepts and mathematics. In Toomer (1984), Ptolemy is shown to refer to the currently-known zodiacal signs in part 8 of Book II, the *Table of Rising-times at ten-degree intervals*, and in part 13 of Book II, the *Table of zenith distances and ecliptic angles*, but he gives no source of these names nor description of them. It is only in a footnote in Book IV that one reads of the *Canobic Inscription*, an earlier work by Ptolemy. One would expect to find in this work the definitions of the zodiacal signs and the relationship between Ptolemy’s names and the names used by the
earlier observers of Mesopotamia and Babylonia. Unfortunately this author has not been able to source a copy or translation.

In translations of Ptolemy’s work (Toomer, 1984), Ptolemy describes his dissatisfaction with previous writers, thinkers and calculators on Astronomy, as he presents his calculations based on his greater understanding of Euclid’s mathematics. So Ptolemy did not develop new theories, but developed better mathematics to describe the noted anomalies of the planetary movements based on the earlier observations, notably the 800 years of observations from Babylon and Nineveh and the theories and discussion of Hipparchus (ca. 130BC) and Eudoxus of Knidus (4thC BC). Hipparchus is referred to widely in the *Almagest* as having appreciated the twofold anomalies and retrograde arcs of the planetary motions and to whom Euclid’s fifth book is due. Having said that, it is a wonder that Ptolemy did not adopt the helio-centric model of Eudoxus to prove his point about simplicity, considering that the mathematics involved are phenomenal in proving the planetary motions using the geo-centric and epicycle theories, which are also presented in detail in the Surya Siddhanta (Burgess, 1935).

Various aspects of early astronomy are similar between the Indian and Mesopotamian reports. Hunger and Pingree (1999) state in the section on Omens, that “Babylonian omens as well as astronomical knowledge were transmitted to India, beginning probably around the middle of the first millennium B.C.” It is quite possible that this date and direction of information flow will require review based on the outcomes from Rajaram and Frawley (1995). Ashfaqe (1977) also
has indicated that the Indians were first, although the proof at that time was inconclusive.

Hunger and Pingree (1999) show that some time elements such as the Indian division of the nychthemeron into 30 muhūrtas, and then into 60 ghatikās or nātikās are common between the Babylonian texts and the Indians, these being found with many other Mesopotamian features in the *Jyotisavedānga* composed by Lagadha. The dating of this text requires review.

In a discussion of the measurement of time, Hunger and Pingree (1999) realise that the Mesopotamians were using a water clock, or *clepsydra*, as were the Chinese. Again they confirm that even by the end of the second millennium and beginning of the first B.C. the inhabitants of Mesopotamia recognized the periodicity of many celestial phenomena and had devised methods to predict them. Some of these were not mathematical, but others were. In particular, some periodic deviations were being described by linear zig-zag functions, some of which are also found in the old Indian literature. These facts tend to demonstrate that the Indians and Mesopotamians, if not the Babylonians, were in close contact regarding the developments of astronomy.

The Indian lunar *naksatras* are similar to Mesopotamian constellations, although the Indians have modified this concept to suit their needs, in particular the requirement to have the moon pass through 13° 20’ or 800 minutes of arc each month. In the *Mul.Apin* and the Indian *Kausitakibrahmana*, the descriptions of the
risings and movements of the planets are very similar. The latter also describes the
movement of the sun as it passes from Winter solstace, through the equinox to the
Summer solstice and back again (Hunger and Pingree, 1999).

Hunger and Pingree (1999), in a discussion of the spread of the use of the
gnomon, maintain that the Indians and Greeks both learned its use from the
Mesopotamians. In India the gnomon or śanku of 12 digits appears first in texts
that can be dated to the first few centuries of the Christian era: the Arthaśāstra
ascribed to Kautilya (II 20, 39-42) and the Vasisthasiddhānta as reported in
Varāhamihira’s Pañcasiddhāntikā (2, 9-10). These dates need confirmation.
However, two Seleucid ambassadors to the Mauryan court in the third century
B.C. are known to have made gnomon observations in India (Hunger and Pingree,
1999). These contradictory statements need further review as it would appear that
at least one of them is a typical Eurocentric ‘statement of fact’ which might not be
based on actual evidence. Ashfaque (1977) writes that the Harappans must have
had a gnomon or something like a gnomon to enable them to accurately align their
streets and houses, the feature that makes the remnants of the Harappan and
Mohenjo-daro civilisations so remarkable.

An Egyptian astronomer of the third century B.C. is also quoted as being quite
knowledgeable of the stars and of keeping time throughout the night (Hunger and
Pingree, 1999: p83). Interestingly, having said often that the Egyptians et al.
borrowed this astral knowledge from the Mesopotamians who did not use the
same fractions of a day as we do, Hunger and Pingree (1999) write that the
Egyptians were the first to divide the nychthemeron into 24 hours in the era of Seti I (1,302 to 1,289 B.C.). This seems to be the same time unit used by the early Indians.

In part of Ptolemy’s works (Toomer, 1984) he refers to a period which the earlier mathematicians had endeavoured to compute from their periodicities of each of the planets, wherein at some stage they are all aligned. These calculations would necessarily be wrong, given the incorrect assumptions on which they were based. However there were some similarities. Working from some dates tabulated by the Spanish king Alfonso X based upon the astronomy which he was ‘recovering’ from the Arabs for the end of the European Dark Ages, one can compute that the “Great Flood” was in 3,102 BC. Comparison with the computer program of Chris Eade in 2003, and demonstrated above in Figure 5.3 with the sky chart from Starry Night, shows that on this date all of the planets indeed did rise at much the same time in much the same direction. Either there was an actual “Great Flood” from an extended period of rain or some other natural phenomenon which was concurrent with this planetary alignment, or the observers of the astral sign spoke of the “Great Flood” of planetary alignments which was interpreted incorrectly by later and distant chroniclers as a period of great wetness.

In Figure 5.3, the time displayed is 11:56, allowing the display of Uranus and Pluto which have just risen, although they would not have been visible even if they were known to the ancients. At the actual sunrise of 08:22, the Moon eclipsed the Sun. This type of event, a sunrise eclipse, was a major phenomenon
in normal circumstances. It probably allowed the viewing of the later risings of
Jupiter and Venus (about 09:04 rise), thus establishing it as a critical moment in
history. Interestingly even Neptune (04:42 rise), Uranus (10:20 rise) AND Pluto
(11:00 rise) were a part of this conjunction, even though they were not known to
the observers of that early period nor those famed astronomers of the first
millennium AD!

**Summary**

The origins of ‘star-gazing’ are much earlier than dates considered by some early
Southeast Asian historians, with orientations to the risings of the sun or the moon
at particular times of the year evident in such early structures as the stone
alignments at Carnac, the stone structure at Stonehenge and the Egyptian Pharoah
tombs (Cornell, 1981). Studies of Astronomy in non-western cultures across the
globe have indicated that there were substantial similarities in the star myths as
they relate to social and cultural values (Selin, 2000).

There is ample evidence of detailed Mesopotamian observations as early as the
8\(^{th}\)C BC, with many similarities between these and Indian texts. With extensive
trade between the Harappan peoples of western India and communities along the
banks of the Persian Gulf into which flow the Tigris and Euphrates Rivers of
Nineveh and Babylon (Ratnagar, 1981), there is a good chance that there was also
transfer of knowledge in both directions. The direction of information exchange
with regard to astronomy is yet to be proven, but with the confirmation of the *Rg
Veda* describing an area of India about the late 3\(^{rd}\) to 4\(^{th}\) millennia BC, it is
obvious that the Indian societies were well developed much earlier than the eras with which European researchers have been prepared to credit them.

It has been noted by several of the 17th C and 18th C writers and translators of Indian treatises on Astronomy - Bailly (1787), Colebrook (1810, 1827), Burgess (1860) - that the Indians were amongst the first, if not the first, to develop the systems, even though they be to a cruder extent than those developed by Ptolemy and his associates.

Not only do the Indian religious texts date from earlier than previously considered by historians studying Southeast Asia, but also the Indians’ knowledge of basic surveying and mapping techniques were more extensive. Further, their knowledge and development of astronomy was probably based on sightings of an actual event from which actual dates have been kept. Thus, one can confidently state that the Hindu and other Indic religions were well developed by the time the Indians had established major trade links with Southeast Asia.

The broad basis of the Vedic religion and the way of life that it encouraged would have lent itself to its advocates as they spread through Southeast Asia, demonstrating to the powerful leaders of those realms how this knowledge could be blended with the locals’ beliefs and supposedly extend their power. The linking of the meaning of life with time as expressed by the annual passing of the Sun, Moon and planets would have enabled the more knowledgeable Indians to
become mentors to the kings. In Chapter 8, how these beliefs were manifested by the arrangement of the temples will be demonstrated.
Chapter 6: Data Analysis Part 1 – Remote Sensing and Quang Nam Province

This chapter is the first of two detailing the outcomes from the research undertaken using electronic Geographic or Spatial Information System (GIS/SIS) programs, such as MapInfo and Erdas Imagine. This part reports on the use of the latter to study satellite imagery over Quang Nam province in Viet Nam and how it was used to demonstrate that a 4th Century AD inscription, the Chiem Son inscription, applies to the whole province. This outcome is in contrast to previous researchers such as Aymonier (1891), Bergaigne (1885), Claeys (1931), Coedès (1923), Wolters (1976) and Yamagata (2004) who have maintained that the inscription pertains to a small locality around the religious centre of Mi S’on.

Chapter 7 then looks at the Southeast Asian region as a whole, using MapInfo to display information about the temples and other Indic sites in Viet Nam and across Cambodia, with some in Lao Peoples Democratic Republic (Lao PDR), Thailand and Malaysia.

Introduction to Remote Sensing

Satellite imagery is supplied in discrete parcels even though they come from a continuous stream of data along a revolutionary path from North to South. The data can be supplied with approximate coordinates in an earth-referenced system, or be supplied with individual scene coordinates, as with the data used here. In either case the scenes are comprised of rows and rows of pixels, representing a rhombic space on the earth. The actual ground space represented by each pixel
depends upon the satellite system used, and whether the imagery was in
panchromatic (black and white) or multi-spectral mode. In the following
discussion there were two types of imagery used:

a) Système Probatoire de l’Observation de la Terre (SPOT) imagery in
panchromatic mode with \( ca. 10 \text{m pixels} \);

b) Landsat Thematic Mapper (TM) imagery in multi-spectral mode with \( ca. 28 \text{m pixels} \).

In order to use the imagery so that each image could be related to the others,
coordinates were required from ground points in a regular projection and
coordinate system. These were scaled from 1:50,000 topographic maps supplied
from the Australian Defence Forces. These were applied first to the SPOT images,
which were then mosaiced to create a single image of the region. Coordinates
were then extracted from this mosaic and applied to the Landsat image to rectify it
to the same projection. An annotation layer was then superimposed over the
image to demonstrate the meaning of the *Chiem Son* inscription according to a
regional perspective.

**Remote Sensing**

Remote Sensing is described as the determination of information about an object
without actually touching it. In human health the familiar forms are x-rays and CT
scans. In geography we can use a variety of remote sensing devices. In this project
it was envisaged that three systems be used:

1. aerial photography
2. space-borne imagery
a) SPOT and/or Landsat spectral data

b) Radar data

3. ground based methods - magnetometry

Remote Sensing, particularly space-borne imagery, has the capacity to cover large areas at once. By utilising these images it is possible to recognise patterns which fit old moats and canals, which these early people of Southeast Asia had developed. “Early delta populations began to control water by constructing moats that surrounded settlement centres, with canals and roads radiating from the settlements” (Hall, 1985). This review was consistent with Chinese 5th -6th Century reports (Pelliot, 1903). Similarly in Angkor, “the water supply in the area surrounding Angkor was irregular, such that natural conditions did not allow for the expansion of its economic base and thus limited the state’s potential for expanding its political authority. An elaborate system of irrigation networks was constructed around the Khmer capital at Angkor during the ninth through eleventh centuries. This network controlled the monsoon season flooding of the Tonle Sap..” (Hall, 1985), thus allowing three to four harvests per year. Similar accounts of canal building are mentioned in Higham (1989) in reference to the region around Oc Eo, which was highly developed in Roman times.

1. Aerial photography was sought due to its high spatial discriminatory characteristics to help in the identification of possible sites and old road, river and canal systems. It would be of extreme benefit if a series existed prior to the 1960s and was as extensive as that covering Cambodia from
the late 1940s and early 1950s which was located, sorted and profitably
used by Moore in her thesis and subsequent book (Moore, 1988).

Unfortunately the aerial photographs of Vietnam which the Australian
Army had were considered of high security risk until the mid-1990s. Just
as the availability of these aerial photographs was being investigated the
Australian Army decided that there was no further use for the photographs,
which were destroyed (Anonymous, 2002). The official line in a letter
from the Minister for Defence in 2000 was that they were still classified.

2a) It was anticipated that space-borne spectral imagery could be used to assist
in the location of unknown temples, particularly in the mountainous
hinterland and other regions where current access is difficult or dangerous
due to the aftermath of the war of the 1960s and 1970s. This can be done
by merging the 10m spatial resolution of the SPOT panchromatic imagery
with the seven spectral bands of the Landsat data (nominally 28 m spatial
resolution). Scaled plans of various known temple styles can be overlayed
on the images to see if the software can recognise patterns in the
landscape. If necessary, and certainly at far greater expense, more accurate
satellite imagery is now available, at 0.60 metre resolution in
panchromatic mode and 2.40 metre resolution in multi-spectral mode, to
aid in clear identification or proof of the existence of temples and other
features which show up in the less-spatially resolved SPOT and LandSat
images. This more accurate imagery has not yet been sought.
2b) Radar imagery has not been incorporated into this study. However, work by the archaeology school at the University of Sydney has demonstrated its value in locating old roads or canals emanating from the Angkor complex in Cambodia. Brief mention of similar work around Oc Eo on the Mekong Delta is made by Higham (1989) and Bishop et al. (2004).

3. The use of a magnetometer in archaeological survey is relatively new, particularly in Australia, and should help to determine temple extents and other aspects of the underground cultural remains without having to dig up possible sites and leave them exposed to potential interference from (local) people who are led to believe that they are sites of golden treasures (of which some undoubtedly would be). Some magnetometer surveys were taken over parts of the Quang Nam province in 1999, but unfortunately, due to a technical problem with downloading the data, the data was irretrievably scrambled.

**Imagery**

The second of the above-mentioned three systems, satellite imagery, was used in the following study over the province of Quang Nam. Three scenes of SPOT imagery were purchased and rectified to the grid of the 1:50,000 scale topographic maps provided by the Australian Defence Forces. They were then mosaiced to form a single map of the whole province. The multispectral image from the Landsat system was purchased and the SPOT images used to rectify that. This is so the two image-maps will overlay each other as accurately as possible. It was
then possible to create an annotation layer on which to plot the features mentioned in the *Chiem Son* inscription – “the mountain in the East, the mountain in the West, the great mountain in the South and the river in the north”. As shall be demonstrated below, this enabled the determination that the inscription was referring most probably to a megacity or city-state, covering the whole of the Quang Nam province and extending north into the neighbouring province of Thua Thien.

Satellite images are provided in picture element or pixel format, also known as raster. Although the data was collected continuously as the satellite orbits, the data was separated on a regular basis to provide scenes which are rhomboid in shape. Although the scenes are usually provided according to the Path and Row, a scene centre can be specified which is along the Path but not in the usual latitudinal position. This facility is useful to minimise the cost of the data. The scenes are referred to by the path number and the row number which approximates the scene centre. Thus from the scene names acquired from SPOT for the Quang Nam province, 277-318, 277-319 and 278-319, one can deduce that they are from Paths 277 and 278, with scene centres approximating Rows 318 and 319. For ease of recognition in the file directory these were given the following names:

- 277-318 Danang
- 277-319 Ben Giang
- 278-319 Tam Ky
There are several methods of providing the data, such as Band Sequential (BSQ) and Band Interleaved by Line (BIL). In BSQ, each band is provided starting from the top left corner of the scene, going across a line then moving down to the next line from the left and continuing to the end of the scene. For a multi-spectral scene such as Landsat TM scenes which includes seven bands, BSQ can take a while to provide data for a given area. With BIL, each band is listed starting at the top left hand corner and going across one line, then the next band is listed until all the bands are listed. Then the sequence starts again at the next line and continues to the end of the scene.

Most image analysis software packages have subroutines enabling each of these methods to be used depending upon the description in the header lines of the file. Thus the transfer of the data from the supplier to the end-user is seamless.

With each scene pixel numbering starting at the top left hand corner, there is no capability of directly joining two scenes. The scenes need to be registered to a common datum, with new rectified scenes created such that the pixels now have map coordinates. In order to rectify the scenes for Quang Nam province mentioned above, 1:50,000 scale topographical maps were acquired from the Australian Defence Forces. These maps had been prepared in the mid 1960s, so there were quite a few differences between the maps and the satellite imagery, the latter being taken in the late 1990s. The coverage made available is shown in Appendix 3.
Image Rectification

In the software package Erdas Imagine, approximately 23 points were identified in each scene which could be located on the topographical maps. Tables were created in the rectification subroutine of Imagine containing the pixel coordinates of the points in the image beside the map coordinates. Once these tables had been created the program compares the relationship between them in both coordinate systems and determines errors in the x and the y directions. These errors are presented as the Root Mean Square (RMS) error. These should be less than one pixel. Attention must be paid to minimising the RMS values. Smith and Atkinson (2001) showed that using Ground Control Points (GCPs) derived from 1:24,000 scale maps was over three times less accurate than when Global Positioning Systems (GPS) coordinates were obtained. Gao (2001) obtained similar results using 1:20,000 scale topographic maps. As the GCPs for this project were obtained from scaling from 1:50,000 topographic maps, and as either maps or features were not available for parts of the imagery, the results obtained could be improved using a GPS survey. This was not undertaken in the 1999 tour as the satellite imagery had not been purchased.

Some of the major problems occurred on the western parts of the imagery, where the maps were on a different Grid Zone of the Universal Transverse Mercator (UTM) projection. Greater care had to be taken to ensure that the pencil lines drawn between the tick marks depicting the grid on which most of the maps were plotted were sharp and accurate. The topographic maps used were 1:50,000, so that each millimetre on the map is equivalent to 50 metres on the ground. Thus
estimations of the coordinates were to ± 25 metres. With each SPOT image pixel representing about ten metres on the ground, care had to be taken to accurately identify the intersections on the image as well as in the scaling on the maps.

**Imagery results**

The three SPOT images were re-organised for rectification. As they had been provided in *ERMapper* format (another image analysis software package) and the software to be used was Erdas *Imagine*, they were opened as ERMapper (.ers) images and saved as ERDAS Imagine (.img) files. For each of the .img files a basic contrast enhancement using breakpoints was undertaken to enable better identification of the GCPs. The same projections were set up to equate as closely as possible with that used for the 1:50,000 topographic maps being used for reference, as displayed in Table 6.1.

<table>
<thead>
<tr>
<th>Projection type</th>
<th>Transverse Mercator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spheroid</td>
<td>Everest 1830</td>
</tr>
<tr>
<td>Datum</td>
<td>Indian 1954</td>
</tr>
<tr>
<td>Scale factor @ Central meridian</td>
<td><strong>0.9998</strong></td>
</tr>
<tr>
<td>Longitude of Central meridian</td>
<td><strong>111° 00' 00&quot;E</strong></td>
</tr>
<tr>
<td>Latitude of origin of projection</td>
<td><strong>0° 00' 00&quot;N</strong></td>
</tr>
<tr>
<td>False Easting</td>
<td><strong>500,000</strong></td>
</tr>
<tr>
<td>False Northing</td>
<td><strong>0</strong></td>
</tr>
<tr>
<td>Map units</td>
<td><strong>Metres</strong></td>
</tr>
</tbody>
</table>

The following tables (Tables 6.2 to 6.4) show the pixel and row coordinates of the GCPs on each image, with their UTM Zone 49 coordinates scaled from the topographic maps and the number of the map from which the reference coordinates were scaled. They also include the RMS errors for each point, with all
included, and with the aberrant GCPs excluded. The RMS errors were computed by *Imagine* using a third order polynomial. The preferred value for the RMS errors is less than 1.0, which means that the errors are within one pixel, which for these scenes is within about 10 metres.

**Table 6.2:** Listing of GCPs for Danang image (277/318)

<table>
<thead>
<tr>
<th>Pt. no.</th>
<th>pixel</th>
<th>row</th>
<th>Map Coordinates</th>
<th>RMS error (pixels)</th>
<th></th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
<td></td>
<td><em>Easting</em></td>
<td><em>Northing</em></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1008.8</td>
<td>-683.3</td>
<td>181340</td>
<td>1800770</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2397.5</td>
<td>-2099.8</td>
<td>192570</td>
<td>1784380</td>
<td>6641-3</td>
</tr>
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<td>181580</td>
<td>1785500</td>
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<td>1776040</td>
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<td>1777370</td>
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<td>-5832.5</td>
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</tr>
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</tr>
<tr>
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<td>6640-1</td>
</tr>
</tbody>
</table>

The scene coordinates were saved in the file danang_scene_input.gcc, whilst the map coordinates were saved in the file danang_map_ref.gcc. Twenty-two (22)
points were used, with a concentration along the southern edge where the scene joined with the Ben-Giang image. The distribution of the GCPs can be seen in Figure 6.1.

**Figure 6.1:** The Unrectified ‘Danang’ or 277 / 318 image with the positions of the GCPs

There are few points on the western side of the image as that area was not developed when the topographic maps were prepared in the mid-1960s. Figure 6.2 shows the rectified image.
Figure 6.2: The rectified Danang (277 / 318) image without the GCPs

A similar process was followed with the image 277-319, which is referred to as Bengiang. Twenty-four (24) GCPs were identified and used in the rectification process. Point #14 was difficult to define and is not used in the final calculations. Table 6.3 lists the GCPs with their image and map coordinates and the RMS error from the third order polynomial.
Table 6.3: Listing of GCPs for the Bengiang image (277 / 319).

<table>
<thead>
<tr>
<th>Pt. no.</th>
<th>pixel</th>
<th>row</th>
<th>Easting</th>
<th>Northing</th>
<th>Map number</th>
<th>All points</th>
<th>Without GCP #14</th>
</tr>
</thead>
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<td>2887.3</td>
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<td>1740140</td>
<td>6640-3</td>
<td>2.03</td>
<td>1.62</td>
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<td>1723300</td>
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<td>1.12</td>
</tr>
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<td>197750</td>
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<tr>
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<td>1734520</td>
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<td>1.43</td>
</tr>
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<td>1738420</td>
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<td>0.94</td>
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</tr>
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<th>yRMS 0.79</th>
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<tbody>
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The scene coordinates were saved in the file bengiang_image_input.gcc, whilst the map coordinates were saved in the file bengiang_map_ref.gcc.

The positions of the GCPs in the unrectified and rectified bengiang images are shown in Figures 6.3 and 6.4.
Figure 6.3: The Unrectified ‘Bengiang’ or 277-319 image with the positions of the GCPs

There are no GCPs in the south-western corner of this image as the topographic map for this area was not provided.
Figure 6.4: The rectified ‘Bengiang’ or 277-319 image with the GCPs

The values for the third image 278-319, referred to as TamKy and which is to the east of the Bengiang image, are listed in Table 6.4.
Table 6.4: Listing of the GCPs for the TamKy image (278 / 319)

<table>
<thead>
<tr>
<th>Point number</th>
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<th>row</th>
<th>Easting</th>
<th>Northing</th>
<th>Map number</th>
<th>RMS error (pixels)</th>
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</table>

| Total RMS with ALL points | xRMS 0.73 | yRMS 0.79 | Total: 1.08 |

The scene coordinates were saved in the file tamky_image_input.gcc, whilst the map coordinates were saved in the file tamky_map_ref.gcc. The TamKy image (278-319) had good road intersections and the whole image was on the same map grid. As the highest RMS for the GCPs in this image was 1.76, none of the selected GCPs needed to be omitted from the final third order polynomial rectification process.
The positions of the GCPs in the unrectified and rectified images are shown in Figures 6.5 and 6.6.

**Figure 6.5**: The Unrectified ‘Tamky’ or 278-319 image with the positions of the GCPs

Note: the twenty-three (23) GCPs are well spread across this image.
The first two rectified images, Danang and Bengiang, were mosaiced into western.img (Figure 6.10). This latter image was then mosaiced with tamky_rect.img to create qnam_mosaic.img (Figure 6.11).
Mosaicing images

To create a mosaiced image from two or more separate images is not a straightforward process. One of the rectified images to be mosaiced needs to be displayed in Erdas Imagine. An overlay layer of the Area of Interest (AOI) type needs to be prepared. Using the polyline tool a series of linear vectors need to be drawn along linear features, such as a road or a river, within the area of overlap between the two images to be mosaiced. This cut-line AOI should be displayed over the second image to ensure that it fits within that image. The cut-line AOI file is used in the mosaicing process to cut the images so that an apparently seamless join is made.

Also, the spectral data should be feathered across both images to minimize the evidence of the differences in the spectral data from the various positions of the moving satellite. The rectified Tam Ky image with the linear AOI used in the mosaic of the western pair of images is shown in Figure 6.7. A close-up is shown in Figure 6.8.

![Figure 6.7: Part of the Danang image with the linear AOI (in white) for mosaicing with the Bengiang image](image-url)
Figure 6.8: A close-up of the cut-line AOI on the Danang image.

Figure 6.9: A close-up of the merged ‘western’ image near the cut-line

In Figure 6.9 there is no difference between the top and bottom parts which are on opposite sides of the cut-line. This shows that the process has been performed correctly so that the merged image will look as if it was one scene, from which they were derived.
Figure 6.10: The mosaiced western_qnam from 277-318 (Danang) and 277-319 (Bengiang)
Figure 6.11: The fully mosaiced SPOT imagery covering QuangNam/Danang
Thematic Mapper (TM) Image Rectification

Whereas the SPOT images were rectified using GCPs matched with coordinates scaled from 1:50,000 topographic maps, the TM scene was rectified using GCPs matched between the SPOT and TM images. Thus, although parts of the SPOT images could not have GCPs from the maps due to changes between when the maps were created and the dates of the images, or due to a topographic map being not available over a part of a scene, the two images could use points in those regions as control to ensure that the TM image was rectified to the same extent as the SPOT mosaic.

Twenty (20) GCPs were identified on both the mosaiced SPOT and the Landsat TM images. Table 6.5 shows the reference and input coordinates of the SPOT and TM scenes respectively. The spread of the GCPs across the images is shown in Figure 6.12 for the SPOT mosaic and Figure 6.13 for the TM scene. The rectified TM scene is shown in Figure 6.14. Of the seven spectral bands supplied with the Landsat TM image, only three can be displayed at one time, by each of the red, green and blue parts of the screen. For the following scenes, the red ‘gun’ shows Band 1, the green ‘gun’ shows Band 3 and the blue ‘gun’ shows Band 5. This combination gives a realistic view of the region.
Table 6.5: Listing of the GCPs for the Landsat TM image.

<table>
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<th>TM scene Input Coordinates (pixels)</th>
<th>SPOT scene reference coordinates</th>
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Total RMS with ALL points: xRMS: 0.595 yRMS: 0.374 Total: 0.702
Figure 6.12: The SPOT mosaic with the GCPs

(Note: the different colours of the GCPs are for visibility on this image)
Figure 6.13: The Unrectified TM image with the GCPs
Figure 6.14: The rectified TM image
Defining the ‘City of Simhapura’

The purpose of using satellite imagery was to show the benefit of having a pictorial map of the region to help define in a novel way the reference in the *Chiem Son* inscription. Although a three-dimensional image has not been produced, a picture can still assist identification of the features mentioned in the inscription. The *Chiem Son* inscription was reported in Finot (1918), having been discovered by a Dr Sallet, of Hoi An. This inscription was similar to the Hon-Cuc inscription found some 350 m downstream.

Once the SPOT mosaic and Landsat TM rectifications were complete it was possible to start plotting the points of definition from the *Chiem Son* inscription to demonstrate that the inscription was referring to an area greater than that assumed by previous researchers. The reason for this is that the valley in which the Mi S’on temples can be found is surrounded by low hills, barely 100 m. above sea level (ASL). The reference in the inscription to “the Great Mountain in the South” is clearly denoting the peak of 1,362 m. ASL in the range forming the southern boundary of the province of Quang Nam.

The coordinates of the top of the mountain on Culao Cham (E 235,450.0, N 1,764,720.0) and the “Great Mountain in the South” (E 235,872.8, N 1,696,151.0) were scaled from the 1:50,000 topographic maps and plotted onto an annotation layer over the Landsat scene, thus defining the eastern and southern points respectively. These two positions were modified slightly to fit the geography evident in the image.
Adopting as the “River in the North” the mouth of the Song Hàn at Da Nang (Sheet 6641-III – Đà Nẵng) left out a significant part of the north-western corner of the Quang Nam geographical basin. However, by measuring the distance from the Great Mountain in the South to Culao Cham, then measuring further north from Culao Cham that same distance, the inscription’s “River in the North” became quite evidently the mouth of the Dàm Càu Hai (Sheet 6541 I – Q. Phú Lộc). Although this point is just off the images, it can still be defined by its scaled coordinates (E 171,250.0; N 1,810,300.0).

The “Mountain in the West” was initially considered to be around My S’ôn, based upon the importance of this valley to the culture. However, once again this would leave out part of the western side of the geographical basin. Also, the hills near My S’ôn were not very high in comparison with the eastern and southern mountains, so a range further west was investigated. The co-ordinates of a mountain referred to as Ban Cô (Sheet 6540 II – Bến Giang) were scaled (E 170,960.3; N 1,741,929.6) and placed onto the annotation layer. The vertices were joined using the line tool and measured using the ruler tool. This does not take into account the curvature of the earth, giving just plane bearings and distances. The bearings and distances of each side are:

- Western boundary: 68.3 km @ 179.15 degrees (approx)
- Eastern boundary: 68.6 km @ 179.16 degrees (approx)
- South-western boundary: 79.4 km @ 304.45 degrees (approx)
- North-eastern boundary: 78.7 km @ 304.59 degrees (approx)
Thus, whilst not an exact parallelogram, the ‘parallel’ sides are similar which is quite a geographical phenomenon which would lend itself to significant reverence in a religion closely related to the earth and which uses geometric shapes to depict various aspects of that religion (Khanna, 1994).

The axes can then be drawn and measured, and the coordinates of the intersection inferred. The axes are not orthogonal (at right angles) because the shape is not a rhombus. The axes dimensions are:

- “North-south” 131.2 km @ 149.71 degrees
- “East-west” 68.4 km @ 249.51 degrees

with the intersection scaling at E 203,452; N 1,753,412. This figure is shown in the Figure 6.15 and Figure 6.16.

The intersection is on the 1:50,000 scale topographic map sheet 6640 IV (Dai Lộc), and is about 2.5 km north and 0.7 km west of the Tra Kieu hill now housing a Catholic cathedral but previously housing an Indic temple. This hill was believed by the French archaeologists to be the centre of the ‘Cham’ capital of Simhapura. The intersection coordinates are only 3.2 km east and 1.2 km north of the point where the Chiem Son inscription was reported to have been found (Finot, 1918). The part of the 1:50,000 topographic map sheet which shows these points is displayed in Figure 6.17.
Figure 6.15: The SPOT mosaic with the city limits figure superimposed.
Figure 6.16: The Landsat image with the city limits figure superimposed
**Summary**

The use of satellite imagery has enabled the demonstration that the extent of the land granted to the people in the *Chiem Son* inscription of the 4th or 6th Century CE covered the whole of the current Quang Nam Province plus some land to the north of the ‘Col des Nuages’. There are three definite mountains referred to in the inscription which are still identifiable today. The mouth of the river to the north is identifiable, but at this stage it is hard to determine whether it is in the same position as it was in the 4th Century CE. However, some Indic temple sites have been located on both sides of this river mouth (Thomas, 2000, Personal Communication). The centre of the Indic city-state of the time is near to Tra Kieu, reputed by French and other archaeologists with interests in the Cham culture to
be the site of Simhapura, one of the capitals of ‘Champa’ during its 1,000 year or so existence. Figure 6.18 shows the site as it was excavated in 1927-28 (Claeys, 1931).

From the extent of this city-state (131 km x 68 km) it can be inferred that it was a part of a larger Indic culture on a par with Angkor in Cambodia of several centuries later. How it was connected politically at any time with regions to the North, South or West is discussed in the earlier chapters. The walls which have been found around several Indic temples in the Quang Nam province are thus not city walls, but could have defined the land which had been allocated to the administrators of the temple for their support base, as one of:

- definition of a housing area for the devotees;
- definition of limits for gardens for crops allowing them to be self sufficient;
- as a defence in times when there was an insurrection by the indigenous people against the imposed Indic religion or
- as a defence of the temples and gardens against floodwaters.

Having shown above that the Chiem Son inscription was referring to a much larger area than that considered by previous researchers, the analysis in the next Chapter of the sites that were mappable from the 1923-27 data was based on the premise that, in the early centuries of the Christian era, this province must have been a part of a regional representation of the cosmos referred to in the religious beliefs of the Hindu priesthood and/or their followers.
Figure 6.18: Excavations at Tra Kieu in 1927-28.
(Source: Claeys, 1931)
Chapter 7: Data Analysis Part 2 - Mapping the Southeast Asian Indic sites

Introduction

This chapter has three objectives:

1. To describe the sources of the coordinates of the Indic sites which have been included in the database;
2. To describe the setting up of the database and the issues associated with that; and
3. To demonstrate the value of the maps created by associating the coordinates from the database with a Spatial Information System.

A Geographical (Spatial) Information System (GIS/SIS) was selected for this study of the protohistory of Viet Nam and Southeast Asia to help establish the extent of the ‘Indianised’ area, through the importation of digital topographical data and the development of databases of known Indic sites. The digital data types include boundaries of countries, rivers and satellite imagery. The project required the development of a spreadsheet which enabled various questions to be posed to provide a map-based solution to the enquiry based on either numerical or Boolean information.

The spatial study of the Indic temple data aims to demonstrate which leader built which temples in which positions in which century, which in turn will shed some
light on the possible links between the groups on the coast of Viet Nam and other
groups in the region. These analyses might also help to demonstrate whether the
peoples around Phan-rang (Panduranga) in the south were associated at one or
more times with the Indic followers to the north. This is important as it appears
from the literature (Dharma, 1987) that the king lists from this area are not
compatible with the king lists of the north and have not been considered by the
colonial researchers. Another aspect of this is that the translations by the early
archaeologists were ‘coloured’ by a preconception of the proto-history of Viet
Nam, in that the whole coastline from Hué to the south was one polity. The
translations of the inscriptions which apparently supported these ideas need to be
revisited to ensure that they are correct. This proposal is supported by the claims
in Datta Vidyarthi (1893) which would appear to have not been followed up
during the 20th Century.

Previous studies of the inscriptions on the temple walls and the apparent
development of the script in these inscriptions over a period of time have
indicated that the group who developed the ‘Cham’ variation to the Sanskrit were
forced progressively south, leading to the protohistory propounded by Barth and
Bergaigne in the late 19th century AD. However, it is commonly accepted that the
Indic sites north of Quang Nam / Da Nang, in the Hué area, are from late in the
first millennium, about the middle of the period of ‘Champa’s’ existence as a
significant entity, although some have been dated as early as the 6th and 9th
centuries (see Chams23.xls). This suggestion alone should have been sufficient to
warrant a paradigm shift in the study of the region’s proto-history over 100 years ago.

Considering the art history developed by the colonialists and maintained by some researchers of the region today, surely if ‘Champa’s’ civilisation existed right along the coast all of the time from the first century AD to the 15th century AD, then the art and architecture of the Indic temples could have developed independently in the various geographic ‘pockets’, based on when the religious trainers reached those regions. However, the art historians themselves have shown that sculptures which must necessarily be later by virtue of their sophistication have been found in the northern provinces, leading them to define them as “fakes” rather than look for another historic paradigm (Guillon, 2001). As there is very limited written legacy prior to the fifth century AD, after the brick temples began to be constructed and stèles carved with stories of who had ordered their erection, the true story can only be conjecture. However with the assistance of over 100 years of exploration and data, along with new tools of computers, databases and computerised GIS/SIS, researchers now can provide better proofs of the hypotheses that form the basis of modern understanding of the regional proto-history and to proffer viable alternatives.

Differences in the apparent sophistication of the art and architecture of the Indic sites between the north and south could be attributed to influences on the south from the Javanese and Sumatrans, who were initially strong advocates of Hinduism, then embraced Buddhism and now are predominantly Islamic. These
southern ‘neighbours’ were excellent sea-farers, who might have had far greater influence on the art and architecture of the southern ‘Indic’ Vietnamese than has been previously discussed. It has been demonstrated that ‘Indic’ sites have been found on the Malay Peninsula dating from the 4\textsuperscript{th} century AD, so experienced craftspeople from that region might have migrated to Viet Nam and had some influence on the culture in the south or even right along the coast.

Databases which include spatial coordinates of temples and objects as well as dates of erection/formation enable analyses in the GIS to demonstrate spatio-temporal relationships in an endeavour to determine the ‘true’ coverage or migration of the ‘Chams’ over the 1,500 years under study. Some of the dates are necessarily ‘approximate’, as even when Aymonier and de Lajonquière were traversing the region in the late 19\textsuperscript{th} Century AD most of the temples were in disrepair, having been overgrown by the native vegetation or destroyed in various battles over the centuries. These approximate dates are based on stylistic variations in either the temple layout, the sculptures that could still be discerned on the walls and doorways or on the remnants of calligraphy on ruined stèles from which the names and dates had been effaced or broken off. The ‘exact’ dates are those determined from the astronomical positions mentioned in the inscriptions, which can give quite good results, particularly with modern computers and software, as certain astronomical relationships can only happen at certain times (Eade, 2003, Personal Communication).
So even after all of this time there are still some doubts by archaeologists that the previously determined dates are correct. The dates used in the database for this project are those provided by the references listed below. Where the transcripts of the inscriptions are provided an attempt has been made to use the software package *Starry Night* to confirm the positions of the stars (through their constellations), moon, planets and the sun. Unfortunately, a full list of transcribed inscriptions from Viet Nam has not been sourced in Australia, limiting the scope of the analysis at this time. However, it is believed that sufficient new analyses will be demonstrated in this thesis to suggest a further review of the ‘Indic’ Vietnamese data.

**Database structure**

The software package *Microsoft Excel* was used for this project, as it is compatible with the selected GIS, *MapInfo*. The structure of the database required a number of columns:

- The name of the temple or site;
- The coordinates in latitude and longitude, in decimal degrees, with the longitude based on the meridian through Greenwich, which is commonly called 0°. These had to be converted from the French longitudes which were based on a meridian through Paris;
- A brief description of the site—whether temple or just ‘ruins’;
- Several Boolean columns indicating what had been found, whether temple, sculpture, inscription or just remnants;
• The era of the site. Where accurately known from an inscription, this was
given as both the start and end date. Where an estimate has been made in
terms of century, the start date is given as the first year of that century with
the end date as the year 99 of that century. As most of the dates are given
relative to the Hindu cycle of Čaka, that is the date adopted in the
database. Where dates are given as being in the Christian era, these have
been kept in a separate database, as the difference between Čaka and
Christian eras is 78 years.

• A column has been set aside for the ‘king’ related to each site, where
this is known. However many of the sites do not have descriptions indicating
the king for whom they were erected, or under whose reign permission had
been granted for the erection. It is also unknown whether the ‘king’ would
have been just a local person of power or whether the temple was raised
for a ‘king of kings’ who ruled over the broader region;

• Columns for the references and the page numbers from those references.
Some sites have multiple references; however these can still be searched
on a particular reference using the enquiry tools in MapInfo. These
references are where each site was described, usually in an edition of the
Bulletin de l’École Français d’Extrême Orient (BEFEO);

• Columns for the original coordinates where these are given or scaled from
maps, often in grads. Such coordinates usually have the longitude based on
a meridian through Paris. Apparently there is an error in Coedès and
Parmentier (1923) about the difference between the Paris and Greenwich
datum meridians. This conversion has been corrected. The source for the
correct value is an email from Mr Manguin of the EFEO (Manguin, 1999, Personal Communication).

Table 7.1 shows the layout used in the database entitled *Khmerlajan_edit.xls*. This was revised from the original database in Coedès and Parmentier (1923), as the longitude and latitude coordinates given there were not precise enough so that the points plotted in a grid pattern, based on the nearest fraction of a degree. Appendix 2 shows an example of the early 20th C French topographic maps, on which the early coordinates were based. The corrected coordinates were scaled by the author of this report from maps in de Lajonquière (1902). The Viet Nam or ‘Cham’ data is contained in the file CoedesParm1923.xls, as this data was taken from the 1923 summary produced by G. Coedès and H. Parmentier (Coedès and Parmentier, 1923), with edits from Finot (1915). The coordinates of these points plotted as expected, as they were taken from or based on maps at 1:25,000 scale.

In Coedès and Parmentier (1923) there are lists of the ‘Indic’ sites known to that date, primarily summarising the previous inventories of de Lajonquière and Aymonier of the early 1900s. The first part of the book is by Coedès in which he lists the various sites, in tables containing their Province, Site of Origin, (then) current situation, a brief description of the site (eg stèle), the language, the definite or estimated epoch, the stamped numbers of the National Library and of the École Francais d’Extrême Orient (EFEO), and finally the sources. These are usually references to one or more of:
• Barth & Bergaigne’s 1885-1889 *Inscriptions Sanscrites de Campa et du Cambodge* (Barth, 1885; Bergaigne, 1885);

• E. Aymonier’s 3 volumes of *Cambodge* published between 1900 and 1903 (Aymonier, 1895);

• Lunet de Lajonquière’s three volumes of *Inventaire Descriptif des Monuments du Cambodge* of 1902-1911 (de Lajonquière, 1902); or


In the second part of the reference, Henri Parmentier has separate geographic tables for the ‘Cham’ and ‘Khmer’ relics. The ‘Cham’ table lists the site (as named in the original inventory of ‘Cham’ monuments), the number given by Coedès in the first part, the volume and page of either Parmentier (1909) or de Lajonquière (1902) and four columns listing their coordinates, two for the latitude and longitude in Grads and two for the position in Degrees. The longitudes are east of the meridian through Paris, France. However, they contain an error of -34” (Manguin, 1999), so that when converting to the currently accepted meridian through Greenwich, England, they require an addition of 2° 20’ 48” or 2.34667 degrees. If the coordinates in grads are used, they must be converted to degrees first, by multiplying by 0.9.
Table 7.1: Extract from the Excel Spreadsheet Lajon1902.xls

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<th>Sculptures</th>
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The coordinates were scaled directly from the 1902 map published in de Lajonquière (1902)
As the Vietnamese monuments have been coordinated from large-scale 1:25,000 maps, the coordinates are acceptable. However, the Cambodian sites have only been coordinated from maps prepared at 1:100,000 scale, and then quoted to only one or two decimal places of a degree. When these were plotted they came out in a grid pattern, as the accuracy was insufficient. To redress this situation, the original map from de Lajonquière’s publications, the 1902-1911 series of Inventaire, was located and the points on those re-scaled. Once again the correct conversion from the Paris meridian to the Greenwich Meridian had to be applied.

However, the accuracy at which the original ‘Khmer’ points were mapped is possibly insufficient. The original descriptions published in the various reference journals give such locational descriptions as “x leagues north-east of village Y”. The maps covering the whole of Cambodia were controlled using about 65 astronomical observations for position, into which the detail of rivers, mountains and villages were scaled (Garnier and de Lagree, 1873). The archaeological sites then had to be plotted from these, based on the published descriptions. It is possible that plane tabling was used to map the region, although no reference to the method has been found thus far by this author. The Cambodian and Laos maps were created by Aymonier and published in Aymonier (1895). Other than for the first map in each of the two volumes showing grids of latitude and longitude, and depicted as being at scales of 1:5,000,000, the remaining maps are plotted at scales of 1:500,000, with no North point, no bearings of any description (although the original work was probably done using magnetic compass) and no coordinates. Figure 7.1 gives an example of such a map, taken from the two
volumes of Aymonier (1895). It is probably these maps to which the texts refer when they describe the location of some ruins relative to a village, as only 53 sites of ruins are mentioned on the 49 detailed maps. These maps can be accessed using the data on the CD in Appendix 4, where polygons outlining the areas covered by the maps are ‘hot-linked’ to scanned images of them. Figure 7.1 shows a screen-dump of part of the region with the coverage of several of the Aymonier maps shown. By selecting the hot-link tool from the main menu (on the lower-right of the image), the mouse pointer changes to the shape of a bolt of lightning, indicating that a hot-link exists. Figure 7.2 shows one of these maps.

Figure 7.1: Screen-dump showing part of the Aymonier map coverage (red and green hatched areas).
Thus if the distances shown are not accurate, or there is an error in the bearing given, then the person creating the coordinated maps could very well have been approximating as to the location of the mentioned ruin, albeit with perhaps some knowledge of the region. Thus if any spatial pattern existed in the setting out of the early temples, it could only be approximate if the coordinates derived from de Lajonquière’s maps and Parmentier’s tables are to be used. Considering the likelihood that some errors would have been involved in the surveying of any pattern, particularly in the fifth or sixth century Çaka, then these errors will either cancel out with the 19th century mapping, or be exacerbated. Despite these possible errors the analyses will still be valid based upon the scale required to cover the whole region.

The region around Angkor Wat in Cambodia was mapped by the French colonialists at larger scales than the other areas. However some of the publications are significantly in error, or perhaps more correctly, are significantly different in their position from the overall maps of de Lajonquière (1902). For example a published map provided by the National Library of Australia had the meridians different by about 0.7 grad and the parallels differed by about 0.5 grads. Unfortunately there was no cross-reference available to any text to enable checking of its origins, other than that it was produced by the Geographic Service of Indochina in 1939, “after the works of the French School of the Far East, the French Air Force and the Geographic Service”.
Some of the detailed maps of this area have no coordinates, yet appear to be direct copies in all other respects. Figure 7.3 is an example of the Angkor Wat/Angkor

Figure 7.2: One of the maps of Aymonier’s voyage around Cambodia and Laos
(Aymonier, 1895)
Thom complex without coordinates. These maps can really only be used as references for what existed at the time of the explorations, not for any data relating to coordinates.

Figure 7.3: Map of the Angkor Thom complex without coordinates
(Map scanned from National Library of Australia)

Lunet de Lajonquière prepared excellent maps of the Cambodia and Laos regions, with scale, north point and grids of latitude and longitude (de Lajonquière, 1902). However, of the original 1,100 or so sites contained in the 1923 summary of Parmentier, only about 750 were able to be located on the map published by de Lajonquière (1902). In searching the original tables a lot of sites were found to not have coordinates available at all, as the origin of the stèle or stone which had an inscription to be translated had not been recorded before its removal to one of the museums at Hanoi, Bangkok or Paris in the late 19th C AD. These missing 350 or so sites could not be mapped in this project.
To provide a suitable background to the maps of the sites, initially a commercial tourist map of the region was scanned and the image rectified using the intersections of the meridians of longitude and parallels of latitude. However, this took up too much computer volume when displaying, and made the points too difficult to see. It was eventually decided that the best source of background data was vector data from the Digital Chart of the World (DCOW), as this was available free from the World Wide Web site http://www.maproom.psu.edu/dcw/. This product is provided and maintained by Penn State University. The data which was downloaded included the national boundaries – as both polygons and arcs -, the rivers, roads and other transport infrastructure. Some contour information is also available, but it is not displayed as this obscures the main purpose of the mapping for this project.

From the information downloaded from DCOW the map in Figure 7.4 was created in MapInfo. The map projection chosen to cover the entire region was the Indian for Thailand and Viet Nam. This same projection was chosen when creating the maps of the Viet Nam and Cambodian data.

Superimposing the Viet Nam data onto the map in Figure 7.4 gives Figure 7.5, with the bulk of the rivers turned off. It is interesting to note from Figure 7.5 just how coastal the sites are. However, this might be more of an indication of how little exploration was undertaken inland from the Vietnamese coast at that time, as there was some resistance to the French colonialists (Truong-Vinh-Ky, 1881).
Figure 7.4: Part of the maps covering Viet Nam, Cambodia, Laos and Thailand, showing the modern political boundaries and rivers.

Figure 7.5: The ‘Indic’ sites in Viet Nam.
(Source of coordinates: Coedès and Parmentier, 1923)
Whilst the printed version of this digital map probably will look similar to any other printed version, the advantage of doing this digitally is the variety of maps that can be produced, as well as the interactivity available in a GIS/SIS. In MapInfo or some other GIS, each symbol can be ‘hyperlinked’ to a document giving a description of the site, or ‘hot linked’ to a file of pictures, so that whenever the cursor is passed over a point with a hotlink, a new function will be displayed.

A variety of maps at different scales or covering different regions can also be produced easily. Additionally, queries can be made of the database to assist the user in making an inquiry with results visible in a spatial context. For example, one might ask of the sites in Figure 7.5 “At which sites were sculptures found?” This is set up in a query panel as in Figure 7.6 and stored in a new table which can be saved and later displayed as required. In the map the selected sites are highlighted, so the spatial variation is instantly apparent. Another feature is that a new layer can be added at any time, and the visibility of layers already on can be changed, without turning off or closing any of the layers or tables. So in Figure 7.7 the Cambodian sites as mapped from the de Lajonquière map of 1902 have been added, and the Vietnamese (‘Cham’) sites switched off for the moment.

There is obviously a high density of sites particularly located around the Angkor Wat region at the north-western end of Tonle Sap (Figure 7.7). This is an indication of the importance this inland water source had for the ‘Khmers’ and their continued existence over centuries. However, more sense can be made of
these if queries are made as above. For example, ‘select all those sites attributed to
the fifth century Čaka’, then the following centuries separately. In this way the
development of the temples can be modelled over time, or selected temples

![SQL Select](image)

**Figure 7.6:** Query prompt from *Mapinfo.*

(Only the column name needs be entered in the ‘Where Condition’ clause as the
required column is Boolean.)

from a particular era can be compared directly between each other. For example,
Figure 7.7 shows the temples or sites collated from the summary in de
Lajonquière (1902), Figure 7.8 shows the early Cambodian art sites according to
Parmentier (1927), Figure 7.9 relates to the sixth century, Figure 7.10 relates to
the seventh century, Figure 7.11 relates to the eighth century. The Čaka era is
used as these are directly computed from the inscriptions. These are 78 years less
than the Christian era. In other words, this era starts from 78AD. The variations
in the numbers of sites and the spatial relationships between those created in the
different centuries are quite marked, although there are still a large number of sites that have not been or cannot be dated.

Figure 7.7: The Cambodian and Thai sites as scaled by the author from the maps published in de Lajonquière (1902).
Figure 7.8: The sites in Parmentier (1927)

Figure 7.9: The sixth century Çaka sites
Figure 7.10: The seventh century Çaka sites

Figure 7.11: The eighth century Çaka sites
Whilst it is easy to say that many or most of these temples were placed near to water sources, which would have to have been the case to sustain the priests and carers, there are many which had water courses modified to supply the temple complex and its supporting region. Whilst some temples in (Parmentier, 1927), which are supposed to be all ‘early Khmer’ temples, are plain, many are quite elaborate. Figure 7.12 shows an elaborate Prasat Phum Prasat in Cambodia, which could be one of four that have been mapped, of which none has been dated.

Figure 7.12: The elaborate Prását Phum Prását
(Source: Parmentier, 1927)
Is it possible that some of these temples were set out to some pattern that fitted with the Hindu philosophy, at least in the early years? There is a row of eight temples in Quang Nam province which are due east–west, despite the natural water-courses nearby. Figure 7.13 shows a close-up of these seemingly aligned temples over a distance of almost 35 km. 3 have been dated to the 4th to 6th centuries AD, a fourth to the 9th century and the other four are undated. The east-west line was drawn in MapInfo to demonstrate the linear relationship of the temples.

**Figure 7.13:** The line of 8 temples starting near Hoi An in Quang Nam Province, Viet Nam. Temples with known dates are shown with the date – Year Çaka. (Background data from Digital Chart of the World)

In Chapter 6 it was demonstrated that the *Chiem Son* inscription described the boundaries of what can be termed a ‘city-state’. To demonstrate that this shape was important to later kings, Figure 5.16 is shown in Figure 7.14, modified to show the relationship between the axes of the city-state configuration and the later
positioning of the Buddhist temple of Dong Duong. As previously stated, the axes of the original quadrilateral (in light blue) are not orthogonal. However, producing a line at right angles to the ‘east-west’ axis from the centre point towards the north has it passing through the centre of three mountains in the ridge bounding the Quang Nam province, in the range known as the ‘Col des Nuages’. Producing this axis south from the centre the line passes through the centre of two high peaks in the southern range, several kilometres west of the ‘Great Mountain’. It is on this axis that the temple of Dong Duong has been erected. Although it is a Buddhist temple, it shows the apparent requirement that new kings needed to demonstrate an ancestral relationship between themselves and previous great men or kings. At this stage it is difficult to determine whether this fitting of the city-state entirely within the ‘Quang Nam caldera’ is associated with a diminished expanse of the power-base of the king of the time, or is just a way of showing a link to the past king.
Having shown that the Province originally appears to have been a large component or city-state of an even larger entity, defined by a shape which extends beyond the normally acceptable geographic limits, is it possible that at some stage there was a powerful man who accepted the Vedic concept of an Earth cosmos on a larger scale than the mandalas explained in Higham (1989)? Was the shape which was shown above to be a parallelogram actually thought to be a circle.
because the maps were inaccurate, or was it really meant to be an ellipse? Figures 7.15 and 7.16 demonstrate how these shapes look over the area using MapInfo data.

**Figure 7.15:** Quang Nam province as a City-state based on an elliptical cosmos (background data from Digital Chart of the World [DCOW])

As can be seen from Figures 7.15 and 7.16 the elliptical cosmos suits the Quang Nam caldera far better than a circular one. However, the elliptical shape does not appear in any of the Tantric symbols in Khanna (1994), whereas the circle is quite prominent. The reason for the ruler extending this ‘mandala’ north of the caldera, defined by the ‘Col des Nuages’, to the next province to the north is unclear. However, it is possible that in the early 6th century, when this city-state
was being defined in the *Chiem Son* inscription, that Lin-I, which was the Chinese name for the area around Huế, was weakening and this was the way for the king of the Quang Nam region to show that he was going to take over control of that area as well. This would have been possible as it is evident from the fact that over 100 sites are located in this northern region, up to the 15th parallel of latitude, dating from the 6th century Ç, that this region was also dominated by ‘Indic’ rulers.
Chapter 8 – Spatial Analysis of Indic sites

Introduction

As shown in Chapter 7 Mapping Indic Sites, by transferring the data from the old records into a table which can be mapped, with an appropriate database structure, a variety of new maps can be easily derived. By selecting dated sites based upon the era in which they were constructed, the spatial relationships for each era can be studied. This chapter seeks to demonstrate that there are a variety of patterns based upon which the early temples might have been erected. This pattern (or these patterns) would have been derived to show a relationship between the sphere of influence of the King of Kings and the earthly bounds of the cosmos, in the mid-level of cosmos theory between the human scale and the universal scale. Due to the unavailability of the date of many sites, only spatial analyses were undertaken. These show the possible arrangement of temples.

The first question which needs to be addressed is which centre of power would have been the centre of such an earthly cosmos? It could have been the main temple for the region known as Fu Nan, the centre of power of which appears to have been Ba Phnom or Angkor Borei (Coedès (1968), Stark et al. (1999), Griffin et al. (2000)) or it could have been further north at the site of a temple complex which has been translated as “The God of the Commencement (or origin)” – Ba Doem (Aymonier, 1901).
Fu Nan Cosmos

Angkor Borei has been the site of intense study over the past few years (Stark et al., 1999; Griffin et al., 2000; Bishop et al., 2004), with many papers and conference presentations being made about its antiquity and its relationship with Oc Eo through the extensive canal network. These studies have shown that Angkor Borei was inhabited from several centuries BC, contemporaneously with Oc Eo where artefacts have been uncovered dating from Roman Empire times.

Fu-nan was considered by previous researchers to not be Indic. However, it is known that whoever ruled had an extensive territory, over 1,200 km east-west and possibly the same north-south, considering that the Thai-Malay peninsula was under its control and that at least as far north on the Vietnamese coast as Nha-Trang was also considered to be part of Fu-nan (Coedès, 1968). If a circle representing the cosmos under the control of the Funanese ruler is placed over this region, it extends as far as Da Nang in Quang Nam province. Figure 8.1 illustrates this extent. The circular ‘mandala’ has been divided into twelve components, as per Bailly (1787) and Gupta (1992), dividing the cosmos into the twelve periods representing time, although the eight prime directions might be more appropriate and in keeping with the arrangement of most of the temples.

Each of these rays, separated by 30°, has a temple on it, admittedly at different distances from the centre (Figure 8.2). Some of the temples might have been to assist in controlling the direction of the ray on the way to the furthest point, some might have been built later to show the relationship of the new king with the old
king(s), as with Dong Duong in Quang Nam province of Viet Nam. The site considered to be the capital established by Citrasena to replace the capital of Fu-Nan, Isanapura, is 30° east of north of Angkor Borei, the centre of this ‘cosmos’. Other temples on the rays are listed in Table 8.1, which is shown pictorially in Figure 8.2.

**Figure 8.1:** A possible cosmological view of southeast Asia, centred on Angkor Borei, the alleged capital of Fu-Nan (Base data from DCOW).
Table 8.1: List of Temples on 12 major radii from Angkor Borei

<table>
<thead>
<tr>
<th>Direction from Angkor Borei</th>
<th>Temple</th>
<th>Country / Distance (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0° (North)</td>
<td>Phnom Penh</td>
<td>Cambodia - 63</td>
</tr>
<tr>
<td></td>
<td>Kalo</td>
<td>Cambodia - 160</td>
</tr>
<tr>
<td></td>
<td>Khnà (Kompong Svay)</td>
<td>Cambodia – 294</td>
</tr>
<tr>
<td></td>
<td>Neak Buos</td>
<td>Cambodia – 363</td>
</tr>
<tr>
<td></td>
<td>Huen Hin</td>
<td>Laos – 590 (beside Mekong)</td>
</tr>
<tr>
<td>30°</td>
<td>Tuol Komnopp</td>
<td>Cambodia – 234</td>
</tr>
<tr>
<td></td>
<td>Phu-Gia</td>
<td>Viet Nam – 674</td>
</tr>
<tr>
<td>60°</td>
<td>Prah Vihear Thom</td>
<td>Cambodia – 66</td>
</tr>
<tr>
<td></td>
<td>Chot-mot (Hoa-duc)</td>
<td>Viet Nam – 124</td>
</tr>
<tr>
<td></td>
<td>Long-tuch (on coast near Song Cau)</td>
<td>Viet Nam – 540</td>
</tr>
<tr>
<td>90°</td>
<td>Giang-tay (on coast near Phan Thiet)</td>
<td>Viet Nam – 371</td>
</tr>
<tr>
<td>120°</td>
<td>Thap-Muoi</td>
<td>Viet Nam – 95</td>
</tr>
<tr>
<td>150°</td>
<td>Thap-tra-long (near coast)</td>
<td>Viet Nam – 200</td>
</tr>
<tr>
<td>180°</td>
<td>Ang Pou</td>
<td>Viet Nam - 18</td>
</tr>
<tr>
<td></td>
<td>Oc Eo</td>
<td>Viet Nam - 90</td>
</tr>
<tr>
<td>+210°</td>
<td>Tumpat (coastal town – near limit of Hindu influence a/c de Lajonquiére and to Thai border)</td>
<td>Malaysia – 620</td>
</tr>
<tr>
<td>240°</td>
<td>Thleai East</td>
<td>Cambodia - 16</td>
</tr>
<tr>
<td></td>
<td>Phnom Trotung</td>
<td>Cambodia - 60</td>
</tr>
<tr>
<td></td>
<td>Pak Phanang (on Malay Peninsula)</td>
<td>Thailand - 620</td>
</tr>
<tr>
<td>270°</td>
<td>Phnom Khlong</td>
<td>Cambodia – 140</td>
</tr>
<tr>
<td></td>
<td>Ban Huai Sak (minor town on Isthmus of Kra – possible site)</td>
<td>Thailand - 600</td>
</tr>
<tr>
<td>300°</td>
<td>Sras Keo</td>
<td>Cambodia – 30</td>
</tr>
<tr>
<td></td>
<td>Vicinity of Bangkok ?</td>
<td>Thailand – 580-600</td>
</tr>
<tr>
<td>330°</td>
<td>Phnom Ta Mau</td>
<td>Cambodia – 30</td>
</tr>
<tr>
<td></td>
<td>Ta An (9th Ç)</td>
<td>Cambodia – 330</td>
</tr>
<tr>
<td></td>
<td>Banteai Teap</td>
<td>Cambodia – 390</td>
</tr>
<tr>
<td></td>
<td>Banteai Chhmar</td>
<td>Cambodia – 397</td>
</tr>
<tr>
<td></td>
<td>Tavang Tok Nan Rang</td>
<td>Thailand - 467</td>
</tr>
<tr>
<td></td>
<td>Vat Ku</td>
<td>Thailand - 624</td>
</tr>
</tbody>
</table>
**Figure 8.2:** 12-spoked cosmos centred on Angkor Borei

**Table 8.2:** List of Temples on 8 major radii from Angkor Borei

<table>
<thead>
<tr>
<th>Direction from Angkor Borei</th>
<th>Temple</th>
<th>Country / Distance (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0° (North)</td>
<td>Phnom Penh</td>
<td>Cambodia - 63</td>
</tr>
<tr>
<td></td>
<td>Kalo</td>
<td>Cambodia - 160</td>
</tr>
<tr>
<td></td>
<td>Khnà (Kompong Svay)</td>
<td>Cambodia - 294</td>
</tr>
<tr>
<td></td>
<td>Neak Buos</td>
<td>Cambodia - 363</td>
</tr>
<tr>
<td></td>
<td>Huen Hin</td>
<td>Laos - 590 (beside Mekong)</td>
</tr>
<tr>
<td>45°</td>
<td>NIL</td>
<td></td>
</tr>
<tr>
<td>90°</td>
<td>Giang-tay (on coast near Phan Thiet)</td>
<td>Viet Nam - 371</td>
</tr>
<tr>
<td>135°</td>
<td>NIL</td>
<td></td>
</tr>
<tr>
<td>180°</td>
<td>Ang Pou</td>
<td>Viet Nam - 18</td>
</tr>
<tr>
<td></td>
<td>Oe Eo</td>
<td>Viet Nam - 90</td>
</tr>
<tr>
<td>225°</td>
<td>Thleai West</td>
<td>Cambodia - 22.7</td>
</tr>
<tr>
<td>270°</td>
<td>Phnom Khlong</td>
<td>Cambodia - 140</td>
</tr>
<tr>
<td></td>
<td>Ban Huai Sak (minor town on Isthmus of Kra – possible site)</td>
<td>Thailand - 600</td>
</tr>
<tr>
<td>315°</td>
<td>Sneng</td>
<td>Thailand - 300</td>
</tr>
</tbody>
</table>
As can be seen from Table 8.2, selecting a cosmos with 45° rays centred on Angkor Borei makes no sense, with no temples on the 45° nor 135° rays, and only close to Angkor Borei on the 225° ray.

Whilst the dates assigned to some of these temples are late, as in 12-13\textsuperscript{th} Century Çaka, it is popularly known that many temples were built on the site of previous temples, to maintain the link with the ancestors. On the Thai-Malay peninsula two towns are shown, where Indic temples have not been demonstrated to exist (to the knowledge of the author). However, Tumpat is on the north coast of the peninsula from the point on the south coast where temples from the 5\textsuperscript{th} Century have been
located [de Lajonquière in Parmentier (1927)], so this is an area which could be investigated in future. Also, further up the peninsula, near the Isthmus of Kra, is a small town in a section of the peninsula which could house some Indic relics, as de Lajonquière seems to have only scantily searched this area on his way north into the Bangkok area.

As each ‘super’ king was replaced by another, a new cosmos would have had to be described, related to the extent of his power. There is no evidence of later control of the Thai-Malay peninsula being by rulers from the Indo-Chinese peninsula, so a later cosmos could be represented as shown in Figure 8.4. This circle is centred on \textit{Ba Doem}, near Stuong Treng. Again the twelve spokes are shown with temples which appear to be aligned along them.

Whilst the true diameter of the cosmos cannot be determined, if the dates of the sites on the spokes of the wheel can be determined and are of an early 5\textsuperscript{th} to 6\textsuperscript{th} Century AD period, a more substantial conclusion can be drawn from this use of the GIS and the historic site data.

As most of the temples are square and considered to be aligned East-West (most openings are to the East), with their perpendicular obviously North-South, their corners are on the sub-major axes – NE-SW and NW-SE. If in the description of the cosmos only the 8 major axes are considered, different results ensue. If the cosmos centred on Angkor Borei is re-mapped, the temples listed in Table 8.2 and
shown in Figure 8.5 are highlighted. Only two sites are located, on the 225° and 315° spokes, so it would appear that this can be ignored.

**Ba Doem Option**

*Ba Doem* is a complex of ruined buildings upstream from Stung Trêng on the Srêpok (or Sé Kong) River, opposite the confluence with the San River (Figure 8.1). A sandstone stèle was found there, apparently in the style of Y’asovarman (*ca. 9th c.*). This does not mean that the temple or complex also dates from that era. It could well be from an earlier period to which Y’asovarman was paying homage with his stèle.

However, if *Ba Doem* is selected as the “Commencement” and the cosmos centred there re-drawn with the twelve spokes, the temples in Table 8.3 and shown in Figure 8.4 are highlighted. If the radials at 45° are used instead, the pattern of temples as displayed in Figure 8.5 and Table 8.4 is displayed. The arrangement of temples found using the 45° spokes shows the link with the previously defined city-state covering Quang Nam province in Viet Nam, with the North-east radial passing through the temple on the island of Culao Cham. It is suggested here that this link is not just purely accidental, but was developed by design.
**Figure 8.4: Ba Doem complex.**

(Source: Aymonier (1901); p 220)
Figure 8.5: A cosmos of approximately 360km radius centred on \textit{Ba Doem} with temples on the 12 ‘spokes’

(Modern political boundaries and rivers from DCOW).

Table 8.3: List of sites on 12 spokes from \textit{Ba Doem}

<table>
<thead>
<tr>
<th>Direction from Ba Doem</th>
<th>Temple / Site</th>
<th>Distance (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
<td>Hương-phương</td>
<td>410</td>
</tr>
<tr>
<td>30°</td>
<td>Luong-van is nearest, 2.9 km North</td>
<td>369</td>
</tr>
<tr>
<td>60°</td>
<td>Chanh-lo Quang Ngai</td>
<td>347</td>
</tr>
<tr>
<td></td>
<td></td>
<td>348</td>
</tr>
<tr>
<td>90°</td>
<td>Drang-lai (1331 Č) 3.2 km North</td>
<td>243</td>
</tr>
<tr>
<td>120°</td>
<td>Hòa-lai</td>
<td>400</td>
</tr>
<tr>
<td>150°</td>
<td>Vache (island off Ham Tan)</td>
<td>375</td>
</tr>
<tr>
<td>180°</td>
<td>Koh Krieng Trapeang Prei (605 Č) Chambak Meas;</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>82</td>
</tr>
<tr>
<td></td>
<td></td>
<td>107</td>
</tr>
<tr>
<td>210°</td>
<td>Ta Prohm (kuk) (Kompong Siem) Phnom Hu Phnu (6th Č) Phnom Prasat (Peam)</td>
<td>189</td>
</tr>
<tr>
<td></td>
<td></td>
<td>287</td>
</tr>
<tr>
<td></td>
<td></td>
<td>358</td>
</tr>
</tbody>
</table>
### Table 8.6

<table>
<thead>
<tr>
<th>Bearing</th>
<th>Sites and Locations</th>
<th>Coordinates</th>
</tr>
</thead>
<tbody>
<tr>
<td>240°</td>
<td>Sambuor (Sambor Prei Kuk @ Kompong Svay)</td>
<td>122</td>
</tr>
<tr>
<td></td>
<td>Bang Damnak</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>Mokung</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>Aek</td>
<td>154</td>
</tr>
<tr>
<td>270°</td>
<td>Ba Chong</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Khtop</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Chhuk Phnom Srok</td>
<td>138</td>
</tr>
<tr>
<td></td>
<td>Prah Thvear</td>
<td>192</td>
</tr>
<tr>
<td></td>
<td>Spean Memai (Puok)</td>
<td>262</td>
</tr>
<tr>
<td></td>
<td>Banteai Plang</td>
<td>262.5</td>
</tr>
<tr>
<td></td>
<td>Lobok Run</td>
<td>270</td>
</tr>
<tr>
<td></td>
<td>Bangkok (?)</td>
<td>620</td>
</tr>
<tr>
<td>300°</td>
<td>Kang Het</td>
<td>141</td>
</tr>
<tr>
<td></td>
<td>Khla Deng</td>
<td>146</td>
</tr>
<tr>
<td></td>
<td>Sneng Krabei</td>
<td>149</td>
</tr>
<tr>
<td></td>
<td>Ban Kau</td>
<td>263</td>
</tr>
<tr>
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<td>Taphan Hin</td>
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**Figure 8.6:** Temples on the 45° radials centred on *Ba Doem.*
Table 8.4: Temples / sites in the cosmos centred on *Ba Doem* with 45° spokes.

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<td>Tan-ly</td>
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<tr>
<td></td>
<td>Huong-que</td>
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</tr>
<tr>
<td></td>
<td>Culao Cham</td>
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<tr>
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<tr>
<td>225°</td>
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Summary

This chapter has followed from the mapping of Chapter 7 to demonstrate some spatial analyses of the temples. Using Angkor Borei as a centre of a mandala extending to the Malay peninsula was inconclusive. However, using a mandala centred at *Ba Doem* and covering the mainland, major temples are found on the rim at the cardinal directions and at 45° spokes from the cardinal directions. There is also a link to Culao Cham, the eastern corner of the 5thC city-state shown in Chapter 6 to have covered Quang Nam province in Viet Nam.
Chapter 9 - Conclusion

Previous descriptions of the proto-history of Cambodia, Laos and Viet Nam have considered each of them in isolation, have forced 19th Century European ideas based on false presumptions onto the Asian history, and have not considered the basis of the Vedic or Brahmanic religious traditions as a concept by which the ‘Indianisation’ process was adopted by the local population, particularly of the ruling classes.

Some of these concepts have been caused by a refusal to accept the possibility of the Indian culture being superior to that of the Greek, despite evidence that there were close relations, particularly in the area of trade, between the Indians and their neighbours in Mesopotamia and Egypt. Although some of the early people involved in the discovery, mapping and description of the Brahmanic temples of Southeast Asia provided excellent pragmatic data, for example the maps of Aymonier and de Lajonquière, the dictionaries of the local epigraphy based on Sanskrit and the temple descriptions provided by Parmentier, many of those people following them presented analyses of the data in meta-narratives rather than provide more detailed presentations of the translated inscriptions first.

There was also the problem caused by the transfer of interest from a regional one to the specific study of Angkor Wat and its related complexes, due to the large amount of material available in a confined area, compared with the sparseness of data from Viet Nam other than for the complex at Mi S’on.
This thesis has shown that:

- there is sufficient knowledge now available to prove that the Hindu religion, on which the layout and probable geographical relationship between the temples is based, is much older than previously considered;
- ancient societies had the capability to develop mathematical skills that enabled them to develop their surveying, mapping and astronomical knowledge to previously unconsidered levels; and
- a renewed effort must now be initiated to redress the imbalance in the study of the proto-histories of Cambodia, Laos and Viet Nam in particular and to a lesser extent that of Thailand and the northern part of Malaysia, to include the Brahmanic religious aspects upon which the proto-histories so obviously depend.

Much of the literature reviewed has shown glimpses of ideas that fell outside the standard approach by the European archaeological community but which failed to spark questions as to why certain of the ideas previously promoted did not fit the story that had been created. Of particular concern is the history of the art based on the view that civilisations followed a natural human pattern of birth, growth, development, old age and death which provided the concept that art-works found in one area must be fakes as they did not fit in with this accepted and unchangeable concept.
Other concerns include:

- the ignoring of data from the south of Viet Nam because it did not fit with the previously developed story, and thus forced the proto-history of the central part of Viet Nam onto the peoples of the south-eastern area;
- the emphasis on race or linguistics from the relics of the ruling caste of the society as paramount descriptors of the whole of the population; and
- the enforcing on the whole population over a period of nearly 1,500 years of one aspect of the culture without regard for possible concurrent variations, as is widespread in modern western communities.

It does appear that there was a relationship between the placement of temples and water or other geographical features, in a ‘topophilic’ manner, but very little if any previous research has considered how this relates to the actual religion and to how this might have manifest itself. Very few commentators have compared the temples of Southeast Asia with those of India, particularly southern India, where there appear to be great similarities with temple presentation if not other aspects of the culture. However, comparisons have been made of the use by various cultures to align their religious structures to astronomical events. It is therefore quite probable that similar alignments and relationships were used in the early development of the brick temples to a Brahmanic religion across Southeast Asia.

This thesis has shown that the Vedic part of Hinduism relates the astronomical cosmos to a local geographical cosmos which in turn is related to a human-level cosmos. This cosmos is presented in the form of a circle, or a series of eight
concentric circles, divided by twelve rays representing periods of time, in particular the annual cycles between Spring equinoxes as measured by the passage of the Sun, Moon and visible planets through the constellations of the stars. This concept was developed in the 4th millennium BC and was symbolised by the observed ‘grand’ conjunction of the planets in 3,102 BC, which has been shown to be a conjunction of all of the planets, not just of those visible to the ancients and which marked the beginning of the current epoch of the Vedic religion which has been suppressed by many previous researchers of the Southeast Asian region.

This thesis has developed a database – using Microsoft Excel - of over 1,500 sites of Brahmanic origin known to exist in Southeast Asia by 1927, through analysis of records by the early researchers of the region. This database has utilised the links available through modern Spatial Information Systems to create maps of these sites in the software MapInfo to show the potential for spatial relationships to have existed in the early development of these Brahmanic sites.

This thesis has used image analysis software to demonstrate that the Chiem Son inscription which dates from around the 5th Century AD, defined a city-state covering the Quang Nam province and extending into the region to its north, despite the intervening mountain range. A Spatial Information System has been used to demonstrate that a regional cosmos could have been adopted for the polity of Fu Nan, centred on Angkor Borei, a city which has been shown to date from several centuries BC. A later cosmos has been shown to cover the mainland, centred on a temple complex in Cambodia known as Ba Doem – translated to
mean the “God of the Commencement” – and which links to the previously-defined city-state covering Quang Nam in Viet Nam.

Further research should be undertaken along these lines, firstly by mapping with modern positioning equipment the known sites throughout the region, then developing the database initiated in this thesis to include the latest known or expected dates of origin of as many sites as possible so that a true spatio-temporal analysis can be undertaken. Additionally, a probability analysis could be undertaken on the early sites to confirm that these sites could have been set out by design and not formed a pattern accidentally.
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Appendices

Appendix 1: Sample of Aymonier’s Maps of Laos

Appendix 2: Sample of French Topographic Maps of Viet Nam

Appendix 3: Map showing coverage over southern Viet Nam of 1:50,000 Topographic maps provided by the Australian Defence Force

Appendix 4: CD
Appendix 1: Sample of Aymonier’s Maps of Laos

Regional map of Cambodia showing coordinate system
Appendix 2: Sample of French Topographic Maps of Viet Nam

Part of Map of Tourane, now known as Da Nang
Appendix 3: Map showing coverage over southern Vietnam of 1:50,000 Topographic maps provided by the Australian Defence Force
## Appendix 4: CD containing the following files for use in MapInfo:

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To visualise the Mapped tables in the above list please follow these instructions:

1. Open MapInfo
2. Select ‘Cancel’ on the ‘Quick Start’ prompt
3. Press ‘Control U’ to open the ‘Run MapBasic Program’ sub-window
4. In the ‘Look in’ Window use the down arrow to select your CD drive and the subdirectory “PhD_Data”.
5. Choose from the following four programs:
   a. Angkor39diff – This program sets up the data to show the difference between the coordinates obtained from de Lajonquiere (1902) and those scaled by this author from a 1939 map obtained from the National Library of Australia.
   b. MapcoverVN – This program shows the 1:50,000 topographic map coverage of Viet Nam provided by the Australian Defence Forces.
   c. Openhotlink – This program sets up the base map of Cambodia, Laos and Viet Nam overlayed by the approximate positions of the maps produced by Aymonier in 1895 and 1901 (Aymonier, 1895, 1901). Select the lightning symbol, pass it over the shaded map region required then left-click. The .jpg file will display in a window started by your preferred image software.
   d. SEAsiaIndicSites – This program sets up the base maps of current southeast Asian countries overlayed with the Indic sites from Coedes and Parmentier (1923) and de Lajonquiere (1902).

6. Between running each of the above programs, from the top menu of MapInfo select ‘File -> Close all’ to close the previous maps and allow problem-free opening of the new maps.