IMAGINED PASTS: ANASTYLOSION AND THE CREATION OF THE THAI NATIONAL PAST

John Victor Crocker
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Volume 2
Appendices 1 to 8

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Appendix 1

The Arch and the Stone; The Ring and the Corbelled Arch, and their Differences in Architecture

Introduction

Stone, including brick and cement mortar, is far stronger in compression (crushing forces) than in tension (pulling or bending forces). These effects are not significant in the simple case of a simple wall constructed in the usual way with courses of stones or bricks of equal size and with staggered joints. All elements in such a structure are in compression, and, provided that the wall is not built to a height where the mass of the elements above the base exceeds the compressive strength of the base elements, the wall will be strong and stable. The problem comes when an opening is made in the wall, which requires that the mass of the wall elements above the opening must be properly supported.

The ways of supporting the overhead mass of the overhanging elements may be broken into three basic means, lintels, corbels or ring arches. Khmer architecture found solutions to this problem by lintels and corbels, never by use of the ring (or true) arch. As a result, due to the weakness in the corbel system discussed below, Khmer architecture produced buildings which were prone to structural failure.

Briefly, the lintel is a beam across the opening and resting on the supporting elements on each side of the opening. The beam, of timber or stone, must be of sufficient strength to carry the load above it and transfer this load to its side supports. The forces on the lintel are bending forces, and stone is particularly weak in this mode, it will readily fracture if the span is too great for the load above it. Wood is far stronger than stone in flexion, but is prone to bacterial decay and insect attack over protracted periods, particularly in a hot, wet, tropical environment. Either material is limited in the length practically available, so the size of the opening is limited. In modern usage, steel lintels have made the piercing of walls a minor matter, although even these still have limits in terms of span and load.

The corbel and the ring arch are illustrated in the figures below, and discussed later.

H.H.E. Loofs-Wissowa has discussed the issue of the lack of the ring arch in Khmer architecture in a paper published in 1983 (Loofs-Wissowa 1983). His paper considered the cultural and artistic issues involved in the use of the corbelled arch and its influence in the building of Khmer monuments.

This note parallels the Loofs-Wissowa paper by considering, in a non-mathematical way, the engineering impact on the structure of Khmer buildings by the use of the corbelled arch, perhaps in conjunction with a lintel. It will attempt to show that this form of arch was particularly unsuitable for the weak sandstones which were used in Khmer constructions

A comparison of the load distribution in the ring and corbelled arch
The illustration from the 1983 Loofs-Wissowa paper will show the essential structural differences between the two arch types.

It may be seen that the corbel arch is, in essence, a simple brick or stone wall from which progressively less vertical elements in each upward course have been removed to form the arched opening. No direct means has been provided to transfer the load above the opening to the sides of the opening; depending on the amount of stagger between courses, it takes more or fewer vertical courses to cover the opening. Considering a particular stone or brick in the corbel, it may be seen that it is in two modes of operation, the part in the main wall supported underneath is in compression from the load above it, while the part with no under-support is in flexion, with the fulcrum being the edge of the stone below it. The greater the overhang between courses and the load above the stone, the greater is the bending moment on the stone. Corbels are easy to make in a structure and require no under-support while in construction.

The ring arch on the other hand is a complex structure where, by design, all of the elements are in compression, a far stronger mode of operation for stone. From the illustration above it may be seen that the load above the arch is carried around the opening by the wedge shaped voussoirs. Each voussoir takes a downward force and directs it sideways and downwards to the next voussoir in turn and so on. The sideways force on each voussoir is absorbed by friction between the voussoirs and the mass outside it. If the arch is semi-circular, as in the above illustration, all of the load above the arch opening is transmitted to the supporting column vertically, with no resultant horizontal moment at all, all of the elements below carrying the weight above in compression. If the arch is less than semi-circular, there is a residual component of the load which is horizontal and must be balanced by the structure alongside the archway. The set of voussoirs around the opening carrying the load above it is called the “ring” of the arch. The ring arch is not self-supporting during construction until the top central stone of the ring, the “keystone”, is set, so the structure must be supported by temporary framing (“centering”), usually in wood, while the archway is in building.

So far, only a two dimensional opening in a wall has been considered, but both types of opening may be extended indefinitely into the third dimension, depth, to produce a gallery or tunnel. A corbelled gallery is produced by building two walls a certain distance apart and at a given height, commencing to stagger the stones of each higher course apart until they meet in the centre. Clearly, the wider the spacing between the walls, and the degree of stagger of successive
courses, the higher the corbelling must go before the archway is closed. As the walls are being built there must be sufficient mass outside the opening to hold the corbels in place. An arched gallery starts off the same way, but at the curve, a series of parallel, interlocking rings must be made over a temporary frame to support the load above. A feature of the ring arch is that the ring need not be part of a circular section, any smooth curved shape may be used for an arch’s ring. An arch of the same height of opening may have a varying width depending on the shape of the arch ring, semi-circular rings give minimum width for height.

As noted by Loofs, the ring arch has never been used in ancient monuments in Southeast Asian, with the exception of Myanmar (Burma), where examples of ring arches may be seen in Pagan, although in a pointed (gothic, or drop) form.

The following illustrations show four examples of arches in Southeast Asia.

![Fig. 1 A ring, pointed arch from an ancient building in Pagan, Myanmar. Each of the parallel rings of the arch may be seen in the interior of the opening. (Photo by the candidate.)](image-url)
Fig 2. A series of corbelled arches from a stairway in the Borobudur, Java. Note the quite deep projections of each course.
(Photo from Miksic (1990))

Fig. 3. Rough corbelling over a door lintel in the Phnom Wan temple, Northeast Thailand, to avoid loading the lintel with the mass above it.
(Photo by the candidate)
Fig. 4. Corbelled gallery in Banteay Srei, showing collapse of stones in corbels and tie stones to keep the structure secure. (Photo from Marchal (1935))

Conclusion

Although the ring arch was known by the Romans at least two thousand years ago, and many examples are still standing all over Europe today, some of extreme height and span, nevertheless the ring arch does not seem to have travelled into Southeast Asia at any point before modern times. As seen above from figure 1, the ring arch seems to have been known to the Burmese one thousand years ago at Pagan, but never made its way to Cambodia or Java or what is now Thailand. With the regular and well-documented intercourse between India and Rome it would be possible that Indian architects were fully aware of the ring arch, but Coomaraswamy states that the arch was little used in India before the advent of Muslim influences (Coomaraswamy 1985: 73). The existence of examples at Pagan do not support this view, but it is unlikely but not impossible that the ancient Burmese independently developed the ring arch. The evidence is unequivocal, no ring arch appears in any Southeast Asian architecture of the time of Indian influence, say between the sixth and the fifteenth centuries, from Oc-eo through the Javanese buildings to the fall of Angkor.
Appendix 2

Report to the Ecole Française d’Extrême-orient by Henri Marchal, Conservator of Angkor, on a Visit to the Dutch East Indies May 1930

(Published in French in the Bulletin de l’ Ecole française d’Extrême-orient Vol 30, 1930, pp 585-627)

(Extracts)

(Translation by the candidate)

(p 585)

The mission of four months with which you chose to charge me comprised two very distinct parts:

1. A study of the functioning of the Archaeological Service of the Dutch Indies and the methods employed for the exploration, conservation, maintenance and restoration of historical monuments,

2. A study of monuments of the main eras of Hindo-Javanese art.

To meet this programme, after my arrival in Batavia [Jakarta] on 29 June, I got in touch with Dr. F Bosch, chief of the Oudheidkundinge Dienst, who, during the first week of my stay at Weltevreden, explained a great deal and put at my disposal all documentation required to prepare myself for a visit to the monuments of Java and to follow the current works of reconstruction.

The first part of my mission had to put me in touch with M. de Haan, an architect, Inspector of the Archaeological Service of the Dutch Indies and in charge of the conservation and restoration of the Hindo-Javanese temples. Unfortunately M. de Haan having become seriously ill a month before my arrival in Java, it was decided to move the first part of my mission to the second part of my stay, hoping that the state of his health would allow him to take up duty at that time.

I thus began with the second part of the programme I had been given and I visited the main temples in Java under the guidance of Dr. van Stein Callenfels and those of Bali with Dr. R. Goris

Characteristics of the Main Temples of Hindo-Javanese Art

It goes without saying that it was the least of my intentions to give here a summary, even brief, of the monuments which I visited: it was scarcely the aim of the mission. However, profiting from the knowledge that I was able to acquire over quite a long stay in the country of the Khmers, I believed it to be interesting to note points of contact in Javanese architecture and decoration, the resemblances or divergences of this art with Khmer art. These two arts came from the same origin and having so as to say a common source, have been more or less deeply changed by the indigenous and foreign influences on Hindu art in the course of their evolution.
From the comparison of the resemblances and divergences it seems to me that one could perhaps draw several deductions allowing one to define the contribution, heterogeneous or indigenous which caused the evolution of this art to produce such different results as Prambanan and Panataran on the one hand and Angkor Wat or the Bayon on the other.

I must add that certain elements, certain particularities of Khmer art have been clarified for me by that which I saw in Java, and from a comparison of the two art styles I have drawn a deeper knowledge of the temples of Cambodia.

I have thus, if I can express myself thus, visited the temples of Java and Bali as a function of Khmer art, noting on the way that which struck me most of whatever title.

I will follow in a general way, for Java, the order of my visits to the temples in accordance with the programme very carefully set up by Dr. van Stein Callenfels, who as far as the itinerary permitted, made me follow the chronological order of the monuments I visited. I profited from it and thank him for the time which he kindly gave to me and the very valuable information he gave me on each temple.

Java Central

I began my tour at the plateau of Dieng.

Dieng: The holy city of Dieng, of which one still finds in place the base of walls now cleared allows taking account of the definition of a certain number of buildings, some very clearly defined, showing platforms, raised in terraces. These could be, according to Dr Callenfels, meeting rooms, monk residences or shelter for pilgrims.

The point of view I will take in this report will make me note immediately the interest there will be in relating the plan and arrangement of these vestiges to those of the ancient Khmer cities which are pretty well of the same period. One is attached to the study of the prasats and temples of Cambodia taken by themselves more than by their separation and placement as a group in relation to the centers or cities of which they form part; the embankment built up in the course of the centuries during which these cities were abandoned and invaded by the forest makes evident this quite long and costly work and explains that it has been put aside until the present.

I was called, at the start of my work as Conservator in 1916 and 1917, to carry out research into the ancient royal Palace of Angkor Thom, just where the new discoveries of MM. Coedes and Stern have placed the Yasovarman's first Khmer capital, that is around the Phimanakas; and the results obtained proved that the sub-soil enclosed in this place a mine of documents (sic).

It was necessary that the soundings follow the walls of which I have unearthed several fragments. The primitive soil of the old city of Angkor Thom lays under a thickness of nearly two metres of earth; in a trench, to remove the waters from excavations, I have met in a hundred metres four transverse walls, fragments of paving and wooden posts (BEFEO, XVII, vi, p 54). Further north, after the
raising of the earth which borders Tep Pranam, was discovered in the sub-soil quite a series of walls and channels (BEFEQO, XXVI, p 507). If one dreams that the excavations around the Phimanakas allowed the discovery of two inscriptions quite important for the for the history of Cambodia, one can see the interest that there was to better know the old Khmer cities.

To return to Dieng, I have noted that the walls of several constructions are of a system of two parapets separated by a space of interior earth, a system which I had already found in the enclosing sandstone wall around the Baphuon (BEFEO, XXII, p 380). These walls are of single foundation destined, like those found at the royal Palace of Angkor Thom to support fences, wooden pillars or light constructions. ...

[detailed discussion of construction and decoration methods in Java, Bali and Cambodia] (p.591)

Borobudur: We now arrive at the architecture corresponding to the domination of the kingdom of Srivijaya, where Mahayana Buddhism flourished: I will begin with the most important temple and the most famous, Borobudur, which possesses for the public, for whom it sums up Javanese art, the fame of Angkor Wat for Cambodia.

Before discussing the curious problem which is raised by this monument, so different from the others, I will first make some comments on the construction and architecture.

In its general structure, this monument in a very particular style recalls temples of the stepped pyramid type of the classic Khmers, but here very clearly marked is the aversion which seems to have seized the Javanese builders for the covered gallery, which is in coeval usage in the second epoch of Khmer art. The bas-reliefs which constitute the essential part of the monuments and its reason for existence – it is a book of images according to Dr Callenfels – are open to the sky, while the great series of bas-reliefs of the temples of Angkor are on the wall of the back of a gallery which doubles as well as an exterior half gallery to protect it from sunlight or rain.

One finds in no part of Java a covered gallery, and however if the need could make itself felt, it would be at Borobudur where the pilgrims walk a distance of more than a kilometer to follow the illustrations of the sacred texts of Mahayanism. Any refuge from bad weather, any shade against thunderstorms which, in certain seasons in tropical climates, come down very heavily, were not provided for.

The construction in this monument is very meticulous, the courses are constant in height: always the bas-reliefs are carved on a wall in small pieces of 25 by 75 centimetres average, as in Khmer temples, and not on plaques planned in advance to form panels of the height of the scenes represented, as in Prambanan for example.
Always the distribution of the joints seems to be made with more care than in Cambodia for example to avoid splitting in a face, a nose or an eye.

On sees a few traces of corrections, or remains after cutting, but their occurrence, frequent in Cambodia, is here quite rare. Thus against the parapet wall of the first gallery which originally was not to carry bas-reliefs, one has added carved plaques; this wall itself seems to have received later the series of niches and stupas which surmount it as though they were not planned originally.

The redent already pointed out [above] on the higher part of the courses to keep the stones one on top of the other is current in Central Java ...

[discussion of details of structure of Borobudur]

(p. 594)

And now I come to the essential point of the problem raised by this monument. This monument is perhaps not, as told to me, a uniquely a “book of images” and the bas-reliefs which decorate the walls of this temple are perhaps not only the decoration of the foundation. The main and principal part [of the monument] would have been suppressed for a reason which escapes us, perhaps even for a reason of soundness in the face of several movements [in the structure] which had already been produced in this era in the lower parts.

In a word, Borobudur, such as we see it nowadays, at least in its higher parts (leaving aside the walled bas-reliefs) does it correspond to a primordial plan intended by its constructors or has it been modified in the course of its execution? Opinion is divided. For me, I side absolutely with the view put forward by M. Parmentier in knowing that the proportions of the base are to prepare for a central crowning quite different to that which we see today.

The disproportion, the lack of association for the eye between the three higher levels of stupas, with neither ornament nor decoration, and the sculptural richness of the base are the result of a change of mind which has had to reject the central element, probably an immense stupa which would have had to project very high into the air.

I know of the reasons which have been objected to this way of envisaging the monument: it is a symbol, a microcosm, an image of the different worlds of the universe. The lower level would be dedicated to Kamadhatu, the gross and material world of the senses, the intermediate levels, the Rupadhatu would represent a level more elevated, the place of appearances and illusions, finally, the three last levels, those of the round terraces, with neither shape nor ornament where the stupas are built, would be the Arupadhatu, the region without form, the limitless space occupied by the absolute void.

I believe, without pushing myself forward too much, that such an argument would never satisfy an architect. Gothic architecture in France, after having been released from the romantics where in whose commentaries all was explained by a mystical symbolism, has been purely and simply brought back to the single
resolution of a problem of construction. I will be excused if I reason in this way and to give some arguments which make me rally to the thesis of M. Parmentier.

It is difficult to understand how, after having accumulated at all the lower levels an abundance of decorative motifs, sculptures, mouldings, stupas, pinnacles, etc, of an extraordinary richness and magnificence, once arrived at the higher platform, one finds oneself in the presence of round terraces, quite poor and as bare, surmounted by stupas. Evidently the explanation which has been given to me and which I have just summarized gives the key to this mystery: one can thus mark the passage from the exterior world, burdened by phenomena, peopled by shimmering illusions, to the world of the absolute void, of the nothingness where nothing further exists.

I accept this way of seeing, but I will object this way: why is this region of absolute void represented by stupas which are reliquaries, tombs, commemorative monuments and as a consequence express no concept of a void, of the absence of all reality? A stupa defines a finite and limited conception, evokes a presence, an idea, something at last; it is an emblem, no matter how transcendent, and not the Nothing, the Nothingness.

And it is quite true that the same stupas which suddenly appear at the level symbolizing the Arupadhatu, equally appear, and very numerously, in the lower levels of the Rupadhatu.

The same emblem can scarcely represent two totally different ideas.

Having put together this criticism, I will begin here the second part of my argument: according to my suppositions, one would find, on reaching the fifth level, that of the round plan terraces, the base of a huge stupa of which the mass would be in proportion with the dimensions, height and size, of the base of the foundations which support it.

The illogicality for me is to have just placed a stupa so petty, of so little importance, on such a base. As a result, if the stupa represents the absolute void, its dimensions are not going to get in the way, and, even allowing the symbolic explanation of the succession of the three worlds, I do not see that which could prevent planning an important stupa on the mass, to form a crowning for the monument in sympathy with the importance of its foundation. Perhaps the material reason of the strength of the sub-soil limited the builders to the timid and bastardized solution which they had to adopt, modifying their original conception.

It is probable that all that which the Javanese built was regulated, ordered by laws, canons establishing the relations of heights, of proportions fixed by texts, like the Cilpashastras. These rules would be immutable.

Now, among the numerous examples of stupas which I have been able to see as well in Java, on the bas-reliefs even in Borobudur where they are quite often represented, as well as others, I have never seen anywhere else another example presenting the soft and crushed silhouette of Borobudur.
Why is Borobudur of a form unique in the world if the rules which obtained when it was erected were formulated in texts which were not only codified for this monument, and why does one not see it in other examples?

In Burma one finds several edifices of the same type as that of Borobudur, terminating as it had been conceived according to me, a monumental central stupa on a series of pyramidal platforms. The temple of Shwe Dagon, that of Shwe Hmaudua, that of Shwe Tshandau present, under a harmonious, elegant, architectural form which satisfies the eye and the spirit at the same time, the same elements as at Borobudur: successive terraces decorated with bas-reliefs supporting a great central stupa. One can as well cite as belonging to this type the Minglazedzi at Pagan. These monuments thus belong to a planned type meeting a well-defined canon.

Why did Borobudur alone respond to a unique conception, with neither precedent nor copy, if imperious reasons had not interrupted its construction and made them modify the central stupa?

Candi Pawon

To Borobudur one can add Candi Pawon and Candi Mendut.

[Brief discussion of Candi Pawon]

(p.596)

Candi Mendut

At Candi Mendut, the interest is more in the interior of the sanctuary, where a spacious chamber houses three Buddhist statues, which are amongst the most beautiful left to us in Java, than in the exterior.

In Khmer sanctuaries, by contrast, the *cella* is quite small, without decoration, and houses a single divinity isolated in the centre and not tied to the wall, as is the frequent case in Java. It is to be noted that when the statue stands in the middle of the sanctuary as in Cambodia, it is however tied to the *stela* which hides the lower part of the body.

The beautiful simplicity of the moldings and the relief with very pure profile, and not overloaded with ornamental motifs, leaves here all their value to the bas-reliefs which decorate the pediments.

Candi Ngawen

[Brief discussion of Candi Ngawen]

(p. 597)

The Prambanan Group, Candi Kalasan
This monument, dated by an inscription (end of eighth century AD), which is quite rare in Java, shows a technique superior to all up until here by the device of its interior vaulting. A clever and quite fortunate reconstruction allows us to quite accurately judge its former state. It is certainly one of the most beautiful which are in Java and I note right away, because of the importance which it presents in the art of the Far East, that which struck me: here the external façade of the monument is not deceptive and it corresponds in all its height to the interior construction.

In fact, in Cambodia, in Champa, in Central Java even, for example in Candi Mendut or in Candi Pawon, the external aspect in the form of stepped towers superposed and set back one upon the other is misleading. The interior vault rises from the base and nothing indicates the steps so clearly marked on the outside.

At Kalasan, for the first time, logic reigns in all parts of the structure, the external decoration is not a mask, a facing which covers a simple vault with a cloister arch with corbelled courses.

Finally, the skill and the sureness witnessed by the execution of the vaulting of this monument contribute to giving to the interior cella an imposing and majestic aspect which transports us quite far from the appearance at the bottom of the wells presented by the Khmer prasats. (The ceilings planned for these must, it is true, modify this aspect). At Kalasan, the vaulting carried out in small materials with great care passes from a square plan to a polygonal plan conforming to the solid central exterior; on this last rises from the four faces an important upper body crowned by an attic forming a chapel. If the technique as well as the silhouette of this temple is remarkable, the decoration carved on the walls is equally one of very great richness while remaining sufficiently sober to not detract from the architectural line. The prolongation in height of the heads of Makara gives them a very fortunate proportion which results in one of the most beautiful examples of this motif. The pilasters supporting the arches of niches or doors recall those of Hindu art, while the Khmer pilasters, without bulbous capitals, without intermediate bands, recall those of classical Mediterranean art, with the profusion of decoration as well.

Here as at Ngawen, the memory of Khmer art is evoked by the silhouettes of the palace with stepped roofs which one sees above the niches.

At Kalasan, the niches on the facades enclose statues of the principal gods of the Brahmanist and Buddhist pantheon, very Hindu motifs unknown to Khmer art which reserves these places for divinities of the second order or of inferior rank, dvarapala, apsaras etc, often surrounded by garlands of flowers.

The ornamental decoration of this temple, on the coating, that which is a new parallel with the art of Indravarman, has an accent and a firmness which is often lacking in Java.

One may note, further to the raising of the corners of the profiles of certain mouldings, the same movement emphasized by the rings of the base (the cornices of the entablature are always in straight moulding) which do not have a absolutely cylindrical section.
Finally, for the first time in Java, and I well believe that this will be the only one, I recognized on the base of a stairway the first step cut off in the form of a brace which is current in Khmer art.

Why is it necessary that this beautiful temple, which was the object of so much assiduous care on the part of Dutch Indies Archaeological Service, appear so ordinary and a little heavy when seen on the way from Djokjakarta [Jogjakarta] to Solo? It lacks a foundation which lifts and gives value to this architectural gem; perhaps as well the raising of the terminal stupa would make more elegant the currently truncated profile of the structure. Finally, the demolished fore-bodies showing their gaping wounds unpleasantly mutilate the facades.

And then, here seen from outside most of the buildings which I have visited, these temples which are arranged in an unexpected way in the middle of fields, rice fields, gardens or plantations, lack a little in presentation; I am used, it is true, to solemn entries in the axis of the sanctuaries which give value to the Khmer prasats that an enclosure, wall or moat, if not both, isolates from the exterior and that a gopura most often announces and precedes.

[Discussion of Candi sari]

(p. 599)

Candi Prambanan

This group comprises a central platform raised on a foundation with six principal and two secondary temples, surrounded by lines of small chapels which are not without monotony.

What appearance could be presented by this group when all the temples are put together completely: this question obsessed me greatly during my quite long stay in this place and remained unanswered for me. The three temples of the central terrace leave between them and the three other smaller temples which face them make a sort of avenue oriented North-South; two sanctuaries, a little less important, situated near some access steps intercepting the axes in this direction. Nothing thus actually indicates where to find the main entrance, not without following the pilgrims who must have come to make a procession around the temples. Was there a part reserved for the king and important people who came to make their devotions? When ceremonies took place, where did the processions form? All that stays a mystery for me.

It is true that frequenting Khmer temples, of whom the plans for many seem to have been worked out in the studios of the Ecole des Beaux-arts reserved for aspirants for the Prix de Rome in architecture, has made me used to quite different dispositions of buildings.

Another thing which equally haunted me, is to know how planned were the changes of level of the bases of the three alignments of structures around the central platform: these *ressauts* are currently marked by grassed-over slopes, carefully aligned: but I hesitate to believe that this was the original aspect. At
least in Cambodia, structures placed on different levels are on foundations with little containment walls and steps. But I was not able to see any drawing or plan on which one could take account of the different levels and which gives an interpretation of the former situation.

The presence of sheds, pavilions and offices which stand on the central platform even alongside the main temples, contribute to erase all memory of former general disposition of the buildings. The passanggrahan where I stayed was constructed on the site of four structures in the southeast corner of the alignment of the chapels.

It must not be forgotten that there is a sort of mystery enclosed in the architecture of past centuries and which survives in the ruins. Even a fragment of a portico, a plinth, a statue, taken from the milieu for which they were created and placed in the halls of a museum, lose their flavour and become dead things, the same as an old monument of which the ambience of other times has disappeared and and which is placed in too close contact with the scenery of our modern life seems depopulated and without soul. And it is that, I believe, is the secret of the attraction exerted on visitors by our lost Khmer temples, isolated in the forest or the bush.

These reservations made, it is necessary to recognize that the temples of Prambanan present designs of quite the first order. The three principal sanctuaries dedicated to Shiva, Vishnu and Bhrama contain absolutely remarkable decorated panels.

The bas-reliefs begin on the foundations: they are made up by a repetition, but with an infinite variety in the details, of motifs richly framed: the lion, this animal, shapeless and sometimes a little ridiculous in Java as in Cambodia, occupies the centre. It is fortunately sheltered, I was going to say dissimulated under the motif of Kala-makara, but the head of Kala here is transformed into an arch of Kudu.

I note the characteristic of all the temples which has been pointed out by Dr van Stein Callenfels: the attributes and emblems represented are the same in both Buddhist and Brahmanist temples, and it follows that there is no place to consider them other than as elements of decoration without attaching to them meanings representative of a cult.

The same as in Cambodia, the decoration of lintels, pediments, pilasters, etc, use the same decorative elements, divines, hermits, flying figures, devotees, common to the two cults.

It is thus, then at Prambanan, which is Shivaite, the monuments receive stupas as topping the levels, on which otherwise it would not be possible to recognize the termination in a linga.

From the point of view of construction, I note one peculiarity which has struck me, because it is in complete opposition to the construction method of the Khmers. They began in effect by raising the stones one upon the other without the slightest concern for decoration or moulding which would have to be carved later: at Prambanan, all the decorated motifs of the bas-reliefs, ornamental or scenic, are carved on panels of dimensions planned in advance for the location.
where they would be placed, that which as well facilitates construction (fig 95).

These carved slabs are put in place and sometimes, to form the thickness of the wall, there are two, one exterior and the other interior, between which there is a filling of small material.

If the bas-reliefs here are more tumultuous, more agitated than those at Borobudur, the composition is less pure and lacks a certain serenity which harmonises so well with the architecture: the stories are perhaps treated in a more lively fashion, but form less a decorative fresco making a part of the whole.

One finds for the first time at the temple of Shiva miniature chandis placed against the balustrades of the steps and which are of a type current in East Java, which would seem to indicate for this temple a more recent date than the others.
I note as well the multiple transformations which the head of Kala take appearing sometimes stylized, sometimes realistic, sometimes purely ornamental, sometimes even treated (in certain gargoyle heads) in a very funny characatural comic way. This comic character is here desired by the sculptor and is not due to chance, as is the case for certain heads of Asuras in Cambodia.

Finally I insist again on the care with which the chamber of the divinity is decorated. One feels in Java that the god awaits visitors, to receive and make the honours of his sanctuary, while with the Khmers the cella reserved for the divinity must remain invisible to the crowd. It is the god who is going to it [the crowd] when on the occasion of great ceremonies or of certain festivals he was walked in great pomp in the middle of the official procession. It is moreover why the Khmer stairways rising to the sanctuaries are fairly impractical with their very narrow and very high treads. While in Java the steps have normal proportions, and the stairways play a purely decorative role, as it is the case most of the time in Cambodia.

[Detailed discussion of other temples in the area]

East Java

[Detailed discussion of several temples in East Java]

(p. 614)

The Batavia [Jakarta] Museum

It remains to me, before arriving at Bali, which will terminate this first part of my task, to note down certain comments made in the course of my visit to the Batavia Museum.

In a general way, as I have already had occasion to say several times, but here the general impression is again reinforced, Javanese statuary borrows much from Khmer statuary by the modelling of the shape of the body, and above all the care with which the legs are treated: fabrics, drapes, skirts and belts etc., are very finely executed and rendered with great skill.

On the other hand, the expressions of the face are often superior to those of the Khmers where the artist has particularly succeeded in expressing in a slightly ironic smile the Buddhist teaching of renunciation, gentleness and meditation.

Certain Javanese statues have the torso clothed, that which is unknown in Khmer art, where the Buddha with his monk’s robe on one side, the chest is always shown bare, ornamented only with jewels: I point out for example nos. 112 and 247. This last statue shows a completely bare breast and the panel of the scarf which falls across the shoulder on one side brings to mind the way in which the modern Cambodians wear the scarf. The Kali no. 296 carries a single band around the breast.

16 Appendix 2
The Avalokiteshvara, no. 247 and the standing Buddha, no. 233, both marked as coming from Sumatra, present much in analogy with pre-Khmer art: one could conclude from it that an influence from the kingdom of Srivijaya to Cambodia. The head of the Buddha, no. 235 from Palembang also confirms this relationship between the two countries.

I have already referred to the undulating band used in East Java, very often as a decorative ornament in a frieze motif: one finds here many examples of it on the slabs at the foot of standing statues.

Number 20. Vishnu seated on a throne, which has a serpent around the base and of which the foot rests on the head of the reptile, calls to mind the Khmer Buddhas which sit on the coils of the naga, but it is a fairly unusual occurrence in Java, while it is a very frequent motif in Cambodia.

I was allowed to see the *pesani* tablets at the Museum of Majakerta quite similar to those which one finds at Angkor, but the top of the tablet was straight and not curved.

To summarise the difference which separates Javanese from Khmer art, I thought it necessary to bring together in the following table the principal points on which both arts differ:

<table>
<thead>
<tr>
<th>Java</th>
<th>Cambodia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation decorated with panels often separated by pilasters</td>
<td>Foundation simply moulded</td>
</tr>
<tr>
<td>Normally proportioned stairs easy to climb, often set within the thickness of the walls</td>
<td>Stairs very steep and very high with narrow treads, always on the outside</td>
</tr>
<tr>
<td>Wall of sides of banisters inclined and curved</td>
<td>Walls of banisters forming support of <em>sen</em></td>
</tr>
<tr>
<td><em>Cella</em> of the sanctuaries decorated on the inside with niches for lamps and sometimes little windows</td>
<td><em>Cella</em> of the sanctuaries generally remain undeveloped, without moulding, decoration, niches or windows</td>
</tr>
<tr>
<td>Construction quite clean and very judicious without reference to wooden construction</td>
<td>Construction very defective and application in the work of stone in the style of wood</td>
</tr>
<tr>
<td>Construction of the crown of the sanctuary in the form of a stupa (Central Java) or a rectangular altar</td>
<td>Construction of the crown of the sanctuary in the form of a pointed stone on top of several lotus crowns</td>
</tr>
<tr>
<td>No galleries or pillared vaults</td>
<td>Galleries covered with vaulting or demi-vaulting on pillars</td>
</tr>
<tr>
<td>Capstone forming closure of the interior vault and sometimes decorated on its exterior face</td>
<td>Capstone enclosed in the peak of the tower</td>
</tr>
<tr>
<td>Mouldings most often without decoration</td>
<td>Mouldings overloaded with decoration</td>
</tr>
<tr>
<td>Kala head forming essential part of the decoration with the <em>makara</em>; naga very little used and always with one head</td>
<td>Heads of the naga forming the essential part of the decoration; the <em>makara</em> disappears with the classical era and the head of the monster only appears in lintels</td>
</tr>
</tbody>
</table>
Bas-reliefs on defined panels
Statuary in full round, very good for the body, sometimes inferior for the body
Jewels sculpted on the statue

Bas-reliefs detailed in the jointed stones
Statuary in full round, very good for the heads and upper torso, shapeless for the lower parts
Jewels often attached to the statue

These differences which define the separation between Javanese and Khmer art show clearly that if, at the start, these two arts originating from a Hindu source can show some relationships (the art of Dieng and Gedong Sanga with early Khmer art), important factors came to modify them and to make them evolve in diverging directions.

What analogy by example would one wish to find between the art of Majapahit and the art of Angkor Wat and the Bayon? It thus seems to me that to bring together such dissimilar arts under the same classification and calling them all Hindu art does not match the truth and risks falsifying ideas.

Hindu art it is true has contributed greatly for a part in their formation and in their transmission of Chaldean influences (stepped towers), Egyptian and Sumerian (?) (for decoration and sculpture), but other elements came to be incorporated and based in these influences so well, that to mention a single foreign source is quite delicate and at least reckless in my opinion.

Bali

[Detailed discussion of Balinese temples and their structure and decoration]

(p. 622)

Current Method of the Dutch Indies Archaeological Service for the Reconstruction and Maintenance of Ancient Monuments

I get this part of my report from:

1. photographic documents graciously put at my disposal by the Dutch Indies Archaeological Service in Java,
2. verbal explanations which were given to me, first at Batavia by Dr. Bosch, and later by the various inspectors of the Service met at the various work sites (I unfortunately could not benefit from the knowledge and experience of M. de Haan, too seriously ill),
3. my personal observations over the quite long stay I made at Prambanan where I was able to put the current methods into practice on the spot, and during visits to other reconstruction work sites. (Pring, Apus, Gedong Sanga etc).

I saw removed the first stones of the parts of the South temple still standing at Prambanan to lay them out on the ground, and on my return from Bali, I assisted in the replacement of the stones up to the cornice of the foundation. I also saw joined, spread out and placed on the ground the bases of the third stage of the temple of Shiva, in preparation for the ultimate reconstruction of that temple.
Finally, I assisted on the 24 September [1930] in the first operations of reconnaissance excavations for an unpublished candi brought to notice by a native of Desa Malang, Sleman district, a little west of north from Jogjakarta.

This excavation discovered in the subsoil a wall-facing in andesite, completely covered in volcanic lava.

Not being able to pursue the work of completely clearing this remnant, notes, sketches and photographs were taken by M. de Vink to be sent to the Head of the Archaeological Service.

The preparatory work for the reconstruction of an ancient temple after its study consists, as in Indochina, in cleaning out and clearing the site of all vegetation and the masses of earth or loose stones which block the standing parts.

Then one puts to the side, near the monument, all the fallen stones, scattered here and there, taking care to start new rows where possible, by stages or facades.

Naturally, in the course of these works and those which follow it, a numbered and dated series of photographs will fix the different phases and multiple aspects of the clearing and reconstruction.

Then, one unearths by excavation the buried parts of the building until one reaches the level of the lower base.

One then takes a very exact plot, at 1 in 10, with plan, section and elevation, of the four faces, of that which remains in place in the building.

Then, guided by the walls still standing, because it is rare for a building to be reduced to a flat level, one searches among the fallen blocks and puts to one side those which complete the upper parts still in place.

This work is based on careful observation of the profile or the design of mouldings, on the height of courses, the interior redent of the courses which most often fit together one inside the other.

One begins by bringing together all the stones with the same moulding, the same design and which visibly belong to the same level, or to the same decorative ensemble (stupa, pedestal, pediment of a doorway etc). That done, one searches among the stones for those which can be joined one to the other.

One begins to thus reconstruct on the ground the various levels of the structure, by pieces naturally, because most of the stones are missing or will only be found later.

The missing stones, or those remaining in place on the structure are replaced in this provisional reassembly by artificial stones of a very weak nature which one makes smaller or larger in response to the gap to fill.

When one has used up all the stones recovered and able to be replaced in their former position on the monument, after reconstitution of the levels on the ground,
one completes the drawings of the plots already taken making stand out the levels on the facades and giving the successive plan views of the higher levels.

The parts of the drawing which correspond to the stones which have not been able to be retrieved are marked with cross-hatching, and the parts simply assumed are marked in dots. These very exact drawings give on ground plan, section and façade the position of the courses and the joints.

That done, after having taken the photographs mentioned above, one takes down one by one each of the stones after having marked them on the inside with distinctive carved signs and corresponding to the blocks which immediately surround them.

These stones are lowered by a winch and pulley fixed to a scaffold; a worker receives them at the bottom and immediately puts them on the ground after carefully cleaning and washing them, reconstituting exactly the courses brought down. Depending on the state and the type of architecture of the monument, one reconstructs the levels on the ground by sections, varying from 3 to 6 courses in height, but the result from the way in which the courses are brought down (highest first) is that they are placed upside down, and the highest are at the lowest level.

It should be noted that the interior stones of the structure, usually of limestone, and not in andesite like the exterior cladding, are equally, and with the same care, marked, removed and reconstituted on the ground. Sometimes however one substitutes them after reconstruction with blocks of some rubble or other.

Thus, lowered course by course, the monument is finally pulled apart into horizontal sections and placed at the side of its former location.

The Javanese temples all seem to be as much lacking in foundations in the subsoil as the Khmer temples; when there is only the first lower course, and the base level to be taken up, one proceeds to the outlining by means of stakes and ropes which fix the location of the monument, delimiting the perimeter on the ground; then one records the height, and when one is thus assured of the location and level of the structure, one lifts the lower courses, below which one smooths the earth well watered and duly rammed, unless one recognizes the benefit of putting an area of concrete under the masses of stonework.

One then replaces all the removed courses, surrounding them with all precautions to assure their balance, the verticality of the facings and the horizontality of the courses, using the plans, sketches and photos taken on the spot.

Stones which are missing or in too poor a condition to be put back are replaced by new stones in andesite cut to the same dimensions, but the profile of the moulding is left plain and the design is only indicated by a line. In this fashion the general outline is respected. Sometimes, to avoid leading future archaeologists into error, all the new stones are marked with a small lead seal to identify them.

When it turns out that too many stones are missing, it is been recognized as more wise, after some reconstructions which had been too reckless and are now criticized, to break off this work.
It is thus that the Candis of Badut, Mendut, Kalasan, apart from other examples were left incomplete in their upper parts.

Candi Pawon, completely reassembled, gives rise to criticism but uncertainty about some aspect of the higher parts.

No mortar is used in the assembly of the stones of the facings, but the interior filling of the walls and terraces with blocks of stone is carefully joined with a cement mortar which is poured after the placement of each course: the joints of the exterior wall are initially closed up by a mastic of well mixed clay to prevent a smudge or leakage of the cement which would make it visible.

When the mortar is quite dry, one removes this earth mastic, washing the walls of the façade with acid water.

Stones spanning a gap or which could slip are held with iron clamps fixed on the inside: the cantilevered parts, like the gargoyles at the corners are placed on U shaped irons placed in a groove and lodged in the interior stonework.

The monument thus restored, more or less exactly in accordance with the number of recovered stones, one carefully arranges at a certain distance the carved stones which have not been able to be put back, for lack of being able to know their exact location, or because the level to which they belong has not been restored. The ground is well leveled, cleared all round the monuments and a fence of steel uprights topped with barbed wire prevents the approach of animals or people.

A door fitted with a padlock gives access to the interior, a native whose house is near the temple holds the keys.

He has the task of guarding the temple, to assure good behaviour and to supervise the visitors who must apply to him for access.

Inspectors of the Archaeological Service visit from time to time to satisfy themselves that this service is well executed and to check the register of visitors kept by the guard.

At Borobudur, a team of six natives works constantly clear away the grass and detritus and to clean the bas-reliefs of dust, insects or vegetation which could reduce their cleanliness. These locals, who are thus ceaselessly in the monument during opening hours (because at Borobudur, Prambanan and Mendut visiting hours are defined and right of entry exists at the door) are equally tasked with the supervision of visitors. Always going round the galleries, busy it seems with removing the wild grasses, they have the task of supervising the people who are in the temple and to assure themselves that they are not taking or breaking anything. These teams are all under the orders of a European who cooperates himself in the supervision of the monument.

I do not want to terminate this report without very sincerely thanking etc ...
Possibility of Adapting the Procedures of the Archaeological Service of the Dutch Indies to Khmer Monuments

The reconstruction processes which I have just outlined cannot be currently taken to Indochina, particularly to the Angkor Group, without modification.

It is necessary to not forget that the magnificent works of reconstruction of which I have been able to see the results in Java, completed or in progress, are the fruit of long preparation, of successive gropings, of trials and study of work methods over nearly twenty years.

During this period of time a group of people, as many natives as Europeans, has been formed, organized and trained; an important skill level has been gained, so that only now the reconstruction of a temple can take place without conflict, delay or hesitation, I could almost say automatically, by the workers and foremen (mandurs) very up to the mark with their tasks, knowing exactly what they have to do and knowing the contribution of their part to the whole.

It is thus, in the absence of direction of the Chief, M. de Haan, that I assisted on the work sites in organized work, admirably shared, where all the skills found their exact utilization.

Further, the Khmer monuments are very different from the old monuments in Java: this difference turns on the following three essential points:

1 The composition of the ground plan of the Khmer monuments is more complicated, more encumbered with enclosures, basins, cloisters, galleries, causeways etc. than the equally important temples in Java which one could compare them to. From where there is more difficulty in the installation of worksites, and to find the space necessary for workshops, stores, offices, supplies and areas on the ground for the different levels.

2 The sandstone which comprises the essential part of the monuments is much more crumbly, weak and more given to attack by humidity and vegetation than the andesite of the Javanese temples, which makes its handling more delicate. The outlines of the fallen stones, seen the same as the stones in place, are often eroded, degraded, sometimes even unreadable, the design is eaten into and has often disappeared, that which adds to the difficulty of finding stones which fit together to rebuild a course.

Finally, repositioning of the Angkor sandstone stones where the corners are often broken, the surfaces more or less worn away or irregular is no longer as easy as with the hard stones of Java which have more often kept their surfaces quite clean and flat.

Not counting that, to replace the absent stones with new ones, Cambodia does not offer the facilities of the Island of Java, where there is lots of stone in the soil near the temples.
The Javanese monuments do not present the numerous imperfections, blunders or faults which one encounters in the Khmer monuments (above all those of the last era): in Cambodia, it is rare for the courses to be of constant height, the stones are often treated like pieces of a wooden framework and the result is that they are broken, cracked or fissured.

The massy interior of the stonework does not make a single entity with the sandstone facing, it having been sized and fixed after assembly, showing a quite defective separation of the joints and of insufficient thickness. Finally, one does not find in Java an architrave crossing a space between two pillars and supporting a vault, that which constitutes a grave fault in construction obliging the stone to work in flexion [in tension] and leading to the frequent failure of these stones.

These three differences, added to the lack of competent and skilled personnel in the Angkor Conservation, suffice to show that right now one could not generally apply these methods in the Angkor group.

However, there is not room in my opinion to reject them completely, and one can even now profit from them by making the transpositions and modifications required.

There are some Khmer temples where the differences noted above are greatly reduced.

Some prasats, above all in the first part of the classical era, show a quite simple ground plan and are of more careful construction than the later temples: I list as examples in the Angkor Group: Banteay Srei, Banteay Samre, Cau Say and Thommanon, and, outside Angkor, several Prasats of early Khmer art.

These temples, by their quite restricted dimensions, lend themselves to a trial of the methods used in Java. In certain of the more important monuments, even of the last era, on can foresee works of partial reconstruction, porticos of gopuras, fragments of galleries or of prasats, etc., which would complete an ensemble. Certain lintels could be raised, certain masses of string walls or of foundations completed with the fallen stones at the foot of the structure, certain tops of towers rearranged.

Finally, the great lesson to be learnt from the methods put into practice in Java is to use cement with the greatest discretion. Many stays and props in reinforced concrete, indispensable to support the less sure parts at the start of clearing, could in the end disappear and give way in the process to a less rudimentary technique, for example by lodging in the interior of the blocks U shaped irons forming armatures, hidden in a cavity and resting on solid supports; as well in holding these blocks by clamps or chains, indeed even by new blocks cut to size and mounted in places required to supply that which is missing.

The ideal aim to be achieved must be like Java to avoid any trace of cement appearing for the visitor, an ideal more difficult to realise in Cambodia, with the stones so roughened by vegetation and the imperfections of construction, but which one must nevertheless approach.
As well, one can be inspired by the way in which the ancient structures are isolated and preserved against the possible depredations of visitors or straying animals.

The enclosure by barbed wire with an access gate closed with a padlock is not applicable to the monuments in the Angkor Park for which special legislation has been foreseen: but in certain small temples in the interior where pieces of sculpture, statues and bas-reliefs are susceptible to theft or breakage, a system of closed barriers like that used in Java could be tried.

Finally, in the important monuments, I will advocate, at all times as far as possible, to establish supervision by a European, and a permanent presence of teams cleaning the temples and at the same time supervising the visitors, as practiced at Borobudur.

* * *

24 Appendix 2
Appendix 3

Banteay Srei

By Henri Marchal

(Published as a Brochure by the EFEO in 1934)

(Translation by the candidate)

The charming little monument known to the people and the public under the name Banteay Srei, and to experts as Isvarapura, merits attention by the richness of the carved decoration and the good state of conservation of the decoration.

It is often annoying to state that certain temples, which if the quality of the stone had been better would be at the same time models of architecture and masterpieces of sculpture, are diminished by the erosion of the stone and the state of ruin where one finds them in, shapeless masses which scarcely allow guessing at the vague profiles of the mouldings and scarce examples of the decoration, half erased. I give as the most typical example the monument located at Phnom Kom, south of Siem Reap; the ornamentation has almost totally disappeared, because this temple raised on a hillock is exposed in this way to the wind and the gusts which blow from the Great Lake [Tonle Sap]; the silhouette even scarcely allows recognition of the elegant architecture of the three towers whose gnawed and worn stones seem to have lost all shape. And even the period of this monument, contemporaneous with the temple of the Bakheng and very close to the beautiful groups of Lolei and Prah Ko, must make us regret no longer having this specimen of the beginnings of stone architecture of the Classical Khmer period.

The Bakheng is best conserved; the richness of the sculpture of the ground level of the central temple shows what an important monument it had to be in the time of its splendour, when it raised its high tower above the perspective of the first city of Angkor, unfortunately it appears to us nowadays brutally truncated and razed to the level of its cornice, which removes all of its character. The four pavilions which surrounded it have been completely demolished by monks who, in a quite low period, wanted to use this structure to heap up the stones in a colossal Buddha of which only the base has been built.

The temple of Banteay Srei of which all the central part has just been completely rebuilt by procedures similar to those currently in use in the Archaeological Service of the Dutch Indies, offers today, with an exquisite decoration, almost intact, a complete architectural silhouette unique to Cambodia of an ancient Khmer temple which had triumphed over the depredations of vandals and the injuries of time. Less powerful in aspect than the two temples of the Bakheng and Phnom Krom just mentioned, if these two had remained intact, it has the advantage of letting us see all of its decoration and its architectural completeness.

The temple of Banteay Srei is located twenty-five kilometers to the northeast of Angkor in a fully wooded area and near the river which coming down from Phnom Kulen, passes the Angkor Group and the centre of Siem Reap before discharging into
the Great Lake; a track allows access by car in the dry season. It is composed of a first court before the principal monument to the East, this court is bounded by buildings and galleries in laterite with sandstone pillars (fig 19). Moving to the West, one meets three concentric walls at the centre of which there is raised the temple proper, made up of three sanctuary towers aligned North-South and open on the east side (fig 18). The central sanctuary is preceded by a fore-body and by a little chamber to which it is linked by a corridor (fig 12).

This assembly is raised on a richly moulded foundation 90 cm high.

One of the particular points of this temple is the smallness of its proportions; the lateral towers measure 8.34 metres in height and the main sanctuary 9.8 metres. These towers are of the stepped type current in all Khmer architecture with false doors and false bays in the three blind faces. Accent stones, acroters and models of the prasat decorate the cornices of the different stages and relieve at the same time the dryness of contour which the sight of the stages stepped back one from the other would present to the eye. The peak of the towers passing from a square to a round plan is decorated by a Kalasa or symbolic water vase (fig. 5).

In the central court two small structures at the ground level flank on each side the fore-body which precedes the central sanctuary. These are edifices which are generally called libraries but which in reality themselves take part in the cult, because one often finds in them placements of altars and sometimes lingas; in the present case the removal of the earth which obstructed these buildings allowed the discovery of two slabs of sandstone, rectangular for the North one and round for the South one. These slabs are decorated on the edge with a little group in relief and must have served as a support either for an offertory table or as a pedestal for a divinity.

Outside the surrounding wall of this central part are found other buildings in laterite set within a second wall surrounded by a ditch.

This temple of Banteay Srei is not like the fortunate people because it has a history. In the period where it was only known by a few experts and archaeologists of the Ecole Française d'Extrême-Orient who were busy with it, it was revealed to the general public by a process which had a certain repercussion following the theft of some important bas-reliefs. Two Europeans had thought they could cut out and remove undetected three corner-pieces decorated with thevadas in the niches of the South sanctuary, but the bas-reliefs were able to be recovered. After having been used as prosecution evidence in the trial they were stored at the Albert Saurrat Museum in Phnom Penh until their return to their proper position after the restoration of the temple (fig 8).

The date of Banteay Srei is given definitively by M. Coedès, Director of the EFEO (BEFEO-XXIX-1929 p 289). Earlier M. Parmentier had thought to class the monument in the period in which had appeared the art of Indravarman (BEFEO-
XIX-1919-I), which would later have been good enough from the point of view of style if not from the chronological point of view. Later on the strength of inscriptions found in this temple and commemorating the erection of statues, one could be led to establish the period of construction of the central group, that which has just been reconstructed, as being fourteenth century. Given that the last Khmer monuments dating to the Bayon period, that is at the start of the thirteenth century, show faults and carelessnesses of construction all giving evidence of an intensive haste in execution, one would be astonished to meet one hundred years later a work so carefully done, so delicate and whose resemblance with the first monuments of the classic Khmer era is immediately obvious. There was there something abnormal which one believe could be explained by adding to the history of Khmer construction a last period called archaism, where one reverted to the oldest formulas of classic art. M. Coedes, taking the closest thing and bringing together the deciphered texts to those of the two temples constructed under the name of Jayavarman V (969-1001), where the name of the same personage appears, allows one to conclude that the whole Banteay Srei ensemble belongs to the period of this king and one could thus classify it definitely towards the end of the tenth century of our era.

That puts an end to explanations, a little diffuse, it is best to declare, which spoke of archaisms and of a return to earlier forms; Banteay Srei would have been a sort of pastiche of the art of Lolei, that which was reconcilable with difficulty with the temperament and the habits of the Khmers.

It remains to explain why this temple coming after other monuments, of a colder art, less profuse in decoration, dare I say, recalling in certain ways the art of Lolei and of Prah Ko, earlier by a century.

This time it was M. Phillipe Stern, Conservator of the Indochinese Museum of the Trocadero, whose work on Khmer art had already produced interesting results, who provided an answer; in his research on the evolution of Khmer art he thought he could see that Banteay Srei marks an intermediate period which, on certain sides, comes from the art of the end of the ninth century and on others, announces a new artistic period. To enter into detail would take too long and above all oblige one to use technical details which could occupy me for a long time, but it is evident to the visitor who has admired the superb lintels of Lolei, Prah Ko or Bakong, seeing those of Banteay Srei could not prevent themselves from establishing a relationship which imposes itself. Extreme richness of decoration, elegance of the curves, of the volutes and of the foliage which is mixed in the two arts, not without a certain exaggeration in the minutiae of the detail, of little figures astride garlands and monsters.

I will draw particular attention to a decorative motif which occurs frequently in the ornamentation of Banteay Srei and which appears in the first period of classic Khmer art, for one sees it equally at Prah Ko near Lolei (northeast tower, north lintel) and at the East Mebon (tower of the southeast corner, north lintel), it is the lion’s or Kala head biting the head of an elephant seen full face (fig 22). What is the exact symbolic meaning of this motif? I leave to the specialists the task of giving an explanation for it, but I simply point out its disappearance in the following periods.

Moreover, if the beginnings of Khmer art present in its decoration a very great variety of images, figurines or animals summarizing without doubt religious myths, it seems that the symbolic sense of these representations had finished by being more or
less forgotten and that the artists following had taken up several of the motifs without
knowing their esoteric sense. I find a proof of it in the head of Kala which, already
in the period of Banteay Srei occurs frequently in the mural surfaces, on pilasters, in
the moulding ornaments, repeated in profusion in a simple decorative motif. The
place which this head, symbolic at the start and without doubt playing a prophylactic
role above doors and entrances to the temple, occupies at Banteay Srei proves well
that it no longer keeps this character; one sees this not only placed on the pilasters of
doors, where it alternates with a Garuda head (fig 21) but appears in the lower band
of the moulded body of the base of the walls of the central sanctuary. It would be
difficult to allow this inferior situation if the decorator had considered it as the image
of a terrible Divinity.

It is in effect a general rule in the history of art: a motif which, in the early period,
appears as a symbolic emblem, with a very marked occult sense, ends up later by
transforming itself into a purely decorative motif deprived of all symbolic sense.

The Kala head in the last period of Khmer art came equally to repeat itself
intermixed on the decoration of wall surfaces and even sometimes employed in *semis*
as on the walls of the West façade of the eastern entrances of the temple of Angkor
Wat.

One can note as belonging to the period following the Baphuon, the not very happy
discovery of placing balks of wood in the stonework above openings.

Finally, one of the curiosities which singles out this temple of Banteay Srei is the
replacement, on the plinths of stairways, of the usual lion by fantastic personages
with monster heads; one of them on the West façade shows a Negroid human head of
great beauty (fig 23). The squatting pose of these guardians of the entrance is not
without recall in the dvarapalas of certain Javanese temples, Candi Sewu or Candi
Plaosan, but the Cambodian temperament, which rejects macabre, obscene or
ferocious expressions, has softened the expression.

M. Goloubew and Mme. Countess de Coral-Rémusat have earlier pointed out
several borrowings made by Khmer art from Javanese decorative motifs; the
anthropomorphic guardians of Banteay Srei may be added to the list of these
borrowings.

It is not only the figured scenes on the pediments which, by their workmanship, do
not equally approach the beautiful bas-reliefs of Borobudur or Prambanan.

It is even singular to note that in this period sculptural Khmer art which started, one
might say, in bas-relief scenes, because one only sees them quite rarely in the
preceding periods, attains a beauty and a perfection which it loses more and more in
the following periods; the bas-reliefs of the Bayon or Angkor Wat, whatever may be
the interest which they present from an iconographic and unitary point of view, often
show carelessness and clumsiness and above all a prolixity, a cumbersomeness and a
confusion that one does not meet on those of Banteay Srei. I will cite quite
particularly, as differing clearly from the ordinary Khmer bas-reliefs, the two superb
representative scenes, on the East pediment of Gopura 2 West and on the West
pediment of Gopura 3 East (see *BEFEO* XXXII-1932- article of M. Coedès p 81); this
last unfortunately has not been able to be put back in its place has been placed on

28 Appendix 3
the ground at the north of the causeway crossing the moat. There is a knowledge of composition, a naturalness of movement at the same time as a clarity in the interpretation of the subjects represented which will no longer be found in the period at the end of Khmer art.

Another peculiarity of the decorative art of Banteay Srei is the little female dancer with a long skirt which one sees on the decoration of the corners of the walls of the central sanctuary above standing personages armed with a lance. This skirted dancer, replacing the apsaras with short loincloths which one sees on the walls of Angkor Wat or the Bayon, will only make a quite brief appearance in Khmer art.

On the other hand, one can note as already belonging to the following period the presence of a chamber with a porch to the east of the main temple and linked to it by a corridor, an innovation which will be pursued up until the end of Khmer art, only the temple of Angkor Wat makes an exception to this relationship.

One sees equally appear in the decoration of the walls in the middle of motifs placed in squares (fig 12) such as one will later find on the walls of Chau Say Tevada and the higher level of Angkor Wat.

Such briefly summarized are the characteristics by which this temple of Banteay Srei takes a small place in Khmer art.

This temple equally deserves the attention of the public for another reason: it will inaugurate in the sites of the Conservation of Angkor the process of anastylosis, already practiced in various parts of the world. It is at Java that, thanks to the extreme kindness of M. Dr Bosch, Chief of the Oudheidkundige Dienst, I was able to put into use these new methods in assisting in the reconstruction of the little south temple of Prambanan.

"Anastylosis consists in the re-establishment or re-erection of a monument with its own material and in accordance with construction methods specific to each monument. Anastylosis allows the discreet and justified use of new materials replacing missing stones without which one could not put back in place the ancient parts". Thus M. Balanos, Engineer-Conservator of the Acropolis of Athens expressed it in a conference held in Athens at the International Institute of Intellectual Cooperation in October 1931.

The application of this process would not be able to be practiced in a current fashion in the Khmer temples which had a too long stay in the middle of a forest which had invaded all its parts and pulled it apart and cracked it everywhere. The very weak sandstone was flaked and the fallen stones had sometimes lost all exact shape; it would thus most often very extremely difficult to hope to reconstitute all the lost parts of the temples such as Ta Prohm, Prah Khan or Banteay Kdei; but certain temples of less grand dimensions and whose more durable sandstone has better resisted bad weather and the combined dissolving actions of the moisture and vegetation are able to be taken and reconstructed totally. Banteay Srei is in this last category, it is with this temple that, after my return from Java, the anastylosis process was inaugurated in the sites of the Conservation [of Angkor].
After the theft of the bas-reliefs mentioned above, M. Parmentier carried out a first provisional clearing in January 1924, classifying the stones found in the debris and rebuilding on the ground certain parts of the towers and Gopuras whose elements he had retrieved.

Drawings, plans and elevations drawn by M. Parmentier in conjunction with the historic and iconographic papers of Messrs Finot, Director of the Ecole Française d'Extrême-Orient, and Goloubew, were put together in one volume which forms the first Archeological Memorial published by the Ecole Française with van Oest in 1926.

For seven years, the temple returned to sleep in the bush until, at the beginning of 1931, a first team came to prepare for the reconstruction of the South tower; it is by this action that began the anastylosis of this temple whose first operation had consisted of the reconstruction on the ground of the different stages of the towers (fig 3.4 & 5).

Then a very exact record of the parts still in situ had been made with photos to support the reconstruction, first on paper with the drawings, plans, cross sections and elevations of all the towers to be rebuilt (fig 9).

It is only after these preliminary operations that one could hope to pull apart, stone by stone and course by course the upper level and foundations that the compression of the ground, slippages, and fissures produced by the trees which had penetrated into the stonework had left in a piteous state. One can see in plates 1 to 8 of the Archeological Memorial Volume 1, (1926) the condition in which the temple found itself in 1924. Figures 1 and 2 show the view of the buildings which had to be rebuilt in 1931.

Figure 6 gives a view of the site during the dismantling of the stones of the south sanctuary and figure 7 the preparation of an area rammed for the pouring of concrete foundations before the reconstruction of the monument.

The same operations took place successively for the three towers, then for the porch and the chamber preceding the central sanctuary (figs 10 to 14).

Finally the two buildings called libraries were in their turn, gathered, demolished then rebuilt (fig 15). Figures 16 to 18 which may be compared with figs 1 and 2 show the end of the work. It then remains to return to complete state the gopuras of the first two walls to achieve the complete assembly whose appearance generally seduces the tourists who did not believe they would endure the several bumps which the track and the wooden bridges inflict on the cars which cross the 25 kilometres separating this temple from the ancient town of Angkor.

We have taken away provisionally the sandstone boundary stones and pillars of the first outside court to the East (fig 19), which gave access to the temple. It would be wrong to believe that the carved detail in this part is less rich than in the reconstructed central part, and one can see in figure 20 a curious flat stone at the entrance of the porches of the lateral laterite buildings whose decoration does not yield in richness and elegance to those of which I have spoken in relation to the main sanctuaries.
Now, how can one explain the presence of this joyous architecture in an isolated site a little outside the great Khmer roads of the past? No satisfactory answer can be given to this question. The closest sanctuary, that which is at the summit of Phnom Dei, possesses an inscription dating from Yasovarman and telling of a foundation at Hari-Hara; it delimits a religious area consecrated to this divinity, but it is impossible to establish any relationship between the Prasat Phnom Dei in brick, of mediocre workmanship, with the Shivaite temple of Banteay Srei.

Siem Reap, 25 July 1935

Chief of the Archaeological Service of
The Ecole Française d'Étrême-Orient

H. MARCHAL

Figures

Fig 1. Central towers before start of work

Fig 2. South tower before start of work

Fig 3. First level of South sanctuary

Fig 4. Second level of central sanctuary
Fig. 5. Fourth level and top of tower reassembled on ground

Fig. 6. Demolition of South sanctuary

Fig. 7 Repair of foundations of South sanctuary

Fig. 8. Return to position of one of the stolen pieces
Fig. 9 Front view and section of a sanctuary to detail the positioning of re-assembled stones (from later version of Marchal's paper).

Fig. 10. Repair of foundations of forecourt.

Fig. 11. Reconstruction of forecourt libraries.
Fig. 12. Façade of the rebuilt forecourt

Fig. 13. Forecourt interior before rebuilding. [Note cross-tie block and fallen corbels]

Fig. 14. Forecourt interior after rebuilding. Fig. 15. Rebuilding of the South library
Fig. 16. Central towers and South library  
Fig. 17. North tower and forecourt  
[Both photographs after reconstruction]  

Fig. 18. Group of reassembled parts, viewed from Southwest
Fig 19. Group taken from E outside gopura

Fig 20. Threshold stone from South porch of lateral edicule of 1st east court

Fig 21. Decoration detail E. Gopura.

Fig 22. Decoration detail of N. sanctuary
Fig. 23. Entrance guardian W. façade
This temple, which is situated twenty kilometres directly north and a little east of the royal city of Angkor, was discovered in 1914 by an official of the Geographical Service. It was visited a first time by G. Demasur, a pensioner architect of the Ecole Française, and it has since been the subject of several studies; the first being included in L'Art d'Indravarman, an important contribution by M. Parmentier, head of the Archaeological Service, in the Bulletin de l'Ecole Française d'Extrême Orient, XIX., i (1919), and the second, larger and fuller, the work of M. Finot, Parmentier, and Goloubew, forms the first volume of Archaeologica Memoirs, brought out by Van Oest in 1926 under the title The Temple of Icvarapura. I shall therefore not undertake now a new description of this temple, which seems to occupy in Khmer architecture a place apart, owing to the smallness of its dimensions, and especially the perfection of its sculptures, which are admired by all visitors.

It belongs to a transition period which carried on the art of the opening of the classical period up to the end of the tenth century A.D., and was making ready for the fine art of the eleventh and twelfth centuries, of which the most representative types are, to begin with, the Baphuon and then Angkor Vat.

This period of art belongs to the reign of Jayavarman V: in this epoch the balustrade of nagas did not yet adorn the causeways crossing the corridors, as it was to do later on; on the other hand, there is to be seen the marking of the approach roads by boundary posts, which occurs also at Ta Keo and Pre Rup.

Laterite and sandstone appear to have been used together in this period, which uses even brick in certain places. The central sanctuary is no longer detached, and is enlarged in front of its principal entrance by a long room unknown before, but destined to become frequent after this period.

In the pattern and well-marked profile of the mouldings and decoration, the rather simple composition of the ornaments, and the very free nudes between the ring mouldings on the door pillars, this art of Jayavarman V clearly recalls that of the preceding period. From some of the details, Countess G. de Coral-Rémusat showed that it was connected with the art of Lolei and Prah Ko.

The temple of Bantay Srei had been visited in December, 1923, by pillagers, who had taken down and carried off several panels adorned with bas-reliefs. After this theft, a preliminary clearing was undertaken by M. Parmentier, which brought to light some sculptured pieces and some inscriptions which were deciphered by M.
Finot. M. Goloubew at that time took there the beautiful series of photographs which illustrate Volume 1 of the *Archaeological Memoirs*.

Following on a mission on which I was sent to Java to study on the spot the methods of reconstruction used by the architects of the Archaeological Service of the Netherlands Indies, the Director of the Ecole Française d’Extrême-orient decided to make a first trial of these methods, and the choice fell on the temple of Bantay Srei, which offered the chief conditions for success in this work.

But before summarizing the various stages of the reconstruction of the southern sanctuary, and to make clear the novelty of this task, I may here refer to the methods that were used earlier. The work of the conservation department at Angkor up to 1931 was restricted to the simple clearing of the ancient monuments buried in the jungle, which literally submerged all the Khmer temples when left to themselves. This clearing consisted in the removal of the vegetation, earth, and fallen blocks of stone which had accumulated in the courts and galleries and sanctuaries. Strengthening measures with shores and spurs of reinforced concrete, finished this task in those portions that were too dilapidated or were threatening to collapse. It was in this way that the Bayon, Angkor Vat, the Baphuon, Bantay Kdei were dealt with, to mention only the chief temples already cleared. After this clearing work, the monument appeared in its actual ruinous state, parts of it fallen in or wanting, towers without summits, galleries more or less without their vaulting, and so on. All this gives to most of the Khmer monuments a truncated appearance and a low outline.

Acting, on what I had observed at Java, I adopted at Bantay Srei the methods used at the Archaeological Service of the Netherlands Indies - methods which, I hasten to say, could not be applied to the entirety of Khmer monuments, most of which are far too important and too complex in mass to be so treated with advantage.

Candis Kalasan, Sari, Pringapu, Sewu, where our Dutch colleagues effected some admirable reconstructions, cannot rival in importance such temples as the Bayon, Anakor Vat, TaProhin, or Prah Khan; even in the Khmer temples of less extensive area, their restoration is made impossible by their more ruined condition, and especially by the condition of the stones, perished and split by tree roots growing about them and ruining them. The quality of the sandstone in the temples at Angkor being much less resistant than that of the andesite in the Javanese temples, a fallen stone is nearly always split, notched, or reduced to fragments. At Bantay Srei the sandstone is somewhat harder than elsewhere; this, and the small size of the sanctuaries, has allowed the working out of the reconstruction of the southern sanctuary, followed by that of the northern sanctuary. The first task was to gather together the fallen stones scattered about the three central sanctuaries, in order to reconstruct the fallen parts of these buildings in their several storeys. It is important, in fact, before beginning reconstruction, to ascertain exactly, what materials one has at disposal, in order to know whether there are stones enough to avoid having to put too much new material into the building that is to be reconstructed. Some series of photographs of the southern sanctuary were taken, and plans, reliefs, and front elevations prepared, compiling in this way a record intended to aid the reconstruction by fixing the exact place of each stone. Plate
XLIII shows the appearance of the southern sanctuary before the beginning of the operations, with the displacements and fissures caused by soil subsidences and vegetation. Then followed the taking down, course by course, of the parts still standing, taking care to note exactly, by interior markings the place of each of the stones; Plate XLIV shows this work going on. The basement [foundation plinth] was likewise taken out with the same precautions. As is usual in Khmer monuments, the inner structure of this temple is in laterite with an outer facing of sandstone carrying the mouldings and decoration. But as soon as the outer walling of the basement was removed, I came upon an inner filling of very rough laterite blocks with the interspaces filled in with soil, which accounts for the sinking in the pavements and the fall of the walls of the temple. When the ground was cleared of all the building material, I had this free area levelled, and topped with a concrete bed of cement mortar, meant to distribute the pressure and avoid subsidence. We know that among the Khmers, their monuments rest simply on one or two courses of rough stone blocks, which carry the walls and are set on a conglomerate of rubble. The level for the first course (Plate XLV) having been arranged, the basement was replaced, being built within of blocks of dressed laterite set in cement mortar in successive courses. On the foundation of the basement thus solidly reset were replaced the sandstone pavements and the walls of the ground floor of the sanctuary; the three reliefs removed in 1923 were put back, closing the empty gaps which since that time had disfigured the temple. During these various operations, of course, some inside fixings with iron bars and clamps were put in to strengthen weak places, but every care was taken that the bonding work should not show outside, and that the masonry should retain its former appearance of stones set with live joints. Some blocks which could not be found were replaced by fresh stone, especially on the east front; but the mouldings were left blank and no ornament even outlined, thus allowing easy recognition of the places where new material is introduced among the old. This process, which is in agreement with the methods used by the Archaeological Service of the Netherlands Indies, likewise agrees with the conclusions arrived at by the International Conference of experts for the protection and preservation of monuments of art and history, which met at Athens in October, 1931. The work was completed by putting back such of the plinth flats, and the corner decorations of miniature prasats, as could be recovered from the rubbish; the missing ones were not replaced. These stones, which are simply placed in position and fixed by bolts to the terraces of the different storeys, give a special character to the outline of Khmer towers; they take away the stiffness of the profile and restore the enclosing line to a cylindrical shell-like shape (Plates XLVI and XLVII).

The change in plan from square to round at the top of Cambodian prasats is generally made by putting in one or two crowns of lotus petals. At Bantay Srei the plan continues square up to the level of the terminal design, which is in the shape of a vase. No doubt this tower ended in a bronze design of the kind seen in some reliefs, but it is not possible to be precise on this point, since the art of Bantay Srei is somewhat different from that of other Khmer buildings.

The reconstruction of this temple, which starts a new way of conservation at Angkor, has enabled us to form a very exact idea of the constituent parts of a prasat; in fact, the work of taking down the portions still standing, as well as the preliminary putting together of the different storeys on the ground, have clearly
shown the building principles that were in use among the Khmers. It is known that, generally, in the ancient monuments of Cambodia, the whole constructive part, properly speaking, is subordinated, if not sacrificed, to the decorative effect got by the facing which is applied outside. I have already pointed out the unsuitability of the filling in of the rough laterite blocks in the basement of the tower; I had to replace these irregular blocks by levelled courses in order to settle the foundations of the tower on a solid mass. When I had the stones raised which were still in place on the north pediment of the ground floor, I was able to judge the solidity that the method of fixing stones together by iron double T anchors, sealed with lead in a hollow on top of a vertical joint, might offer for binding two courses together at one level. The difficulty the coolies had in separating two blocks so tied proves that this method, which is so frequent among the Khmers, has very real solidity. Perhaps, indeed, that might explain the way in which some stones in several Khmer temples are suspended in space when it seems that they ought to have fallen long ago.

I shall conclude by stating some facts which will give an idea of this work and show its importance. The height of the temple is 8.34 metres (about 27 feet 6 inches), not including the 0.90 metres (3 feet) of the basement. The figures of the decreasing height of the storeys have no continuous proportion, and no general principle can be deduced from this particular instance. The preparatory work of searching out the stones to be replaced in situ lasted about two and a half months and the rebuilding three months. The work was completed by the total clearing of the gopuras and the paths leading to the temple, as well as the removal of some large trees which, in stormy seasons, are a serious and perpetual danger to monuments near them. During the removal of the blocks and trees which obstructed the central passage of the third gopura on the east, there were found a new inscription and two very beautiful pediments, one of which shows a very, simple and clear scene with figures, without that rather confused complication that often mars Khmer reliefs. M. Coedès was able to identify the subject represented.

When funds have allowed of the reconstruction of the three central towers and the adjoining buildings, the materials of which are in a large part put together on the ground, we may hope to see before us a completed work that will be unique in all Cambodia in the elegance of its proportions, the finish of its work, and the delicacy of its sculptures. This monument situated near the ruins of Angkor will be, when a motor road shall replace the present track, a great attraction offered to the travellers who each year come in increasing numbers to visit the Khmer monuments.
Plate XLIII. Southern sanctuary before commencement of operations
Plate XLIV. Work on southern sanctuary proceeding.

Plate XLV. Setting up levels for rebuilding basement
Plate XLVI. Reconstructed southern sanctuary from southeast
Plate XLVII. Reconstructed southern sanctuary from northwest.
Appendix 5

The Maha Rosei Ashram

By H. Mauger

(Published in BEFEO vol XXXVI 1936)

(Translation by the candidate)

(Extracts)

Introduction

The Maha Rosei Ashram is a Khmer edifice in the province of Takev [Cambodia], situated on the right bank of the Chau-doc river, at about the same latitude as the chief town of the region. Its exact coordinates are 12 grads 182 north and 114 grads 049 east, according to the 1:100000 chart of the Geographic Service of Indochina. It is interesting to note that this sanctuary is located 3.5 km to the southeast of the village of Angkor Borei, which was one of the main cities of ancient Cambodia, perhaps even of Fou-nan.

It is in this vicinity that the chain of heights of Angkor Borei stretches, the only eminence in the country within a radius of 30 km. This little mountain, of 164 m height, reaches to the northeast by Phnom Da, only 44 m high, close to that of the groups of Phnom Baken and Phnom Bakon, which scarcely merit the qualifier of "mountainettes". In the season of the rising of the Mekong, the whole plain is just a massive sheet of water, and these weak projections of the earth, rocky and bare, appear gigantic in the flatness of the surroundings. This would explain the religious importance which the ancients gave to these eminences, of which the attraction no doubt was emphasized by the natural grottoes which abound there, and constitute - in our days still - sure hermitages, quiet and cheap.

The sanctuary we are concerned with is built on a narrow rocky platform, attached to the flanks of Phnom Baken, at a height of about 20 m above the level of the plain; it is oriented to the north, perhaps to face the capital, perhaps also to obey the general law of the orientation of grottoes. On its southern façade, it is nearly leaning against the rock face of the hill, from which it is separated by a narrow corridor, where one can scarcely move. On the eastern side, a little spur limits the platform to 2 or 3 metres of the monument. To the west, the ground is a little less constrained: about 30 m square, fairly level, it is like a rest landing on the flank of this chaotic pile. To the north, finally, the building dominates from on high, by its main face, a quite steep rocky slope, however, relatively easy to climb.

Such is the imposing group where the Maha Rosei Ashram is built.

In the course of our campaign of 1935, we were charged with the restoration of this building: here we give an account of our work, and present various
conclusions to which we were led by the descriptive and critical study of the Maha Rosei Ashram.

Chapter I
Description of the Monument

(Parts 1 and 2 Not translated)

3. Construction

a). Nature of the materials

The stone used for the construction of the edifice has a porous aspect, recalling very closely that of laterite or Bien-Hoa stone, called bay kriem by the Cambodians; but they are marked by a relatively sombre sandstone colour, and above all by their exceptional hardness, while that of laterite is of pinkish tones and quite soft. The rock which we refer to is a basalt, and comes most likely from the region bordering the Mekong between Kompon Cam and Kratie; this interesting fact will be of great use to us in our chapter on hypotheses. Only the door frames are different, and are made of a beautiful dark sandstone, with a dense texture.

The foundation blocks are cut from a slatey chist, placed not on the ground but on a thickness of lime mortar. All the central structure which supports the cella is otherwise made of a conglomerate of coarse rubble and mortar of the same type.

b) The stone blocks and their assembly

The base and the walls of the edifice are made of stone blocks of an average height 30 to 35 cm (certain even reach to 50 cm) while on all the upper parts, from cornice to crown, are made of slabs not exceeding 22 cm in thickness but sometimes reaching 1.5 m. a side. The assemblies are different for each of these two categories:

A block with two free faces (facing) and four faces in contact with adjacent stones (fig 14). The lower face is always fitted with a tenon whose depth varies between 2 and 5 cm. and which engages in a mortise arranged in the lower level. Both lateral faces carry, depending on the situation, both tenons, or both mortises or finally, one tenon and one mortise.
The projection sometimes reaches 8 cm. in length, and is exactly adapted to the corresponding hollow of the neighbouring block.

The upper face, finally, presents apart from the usual mortise, two cavities with rounded ends which serve as the lodgement of a moveable piece, in the shape of a small violin, crossing the space of the joint: these double-headed tenons are generally held with mortar.

All these details strike one with the minute and impeccable way in which the blocks are assembled. One can see that there is no question of their adjustment, by the process of rubbing used later in such an ingenious fashion and carefully described in a Bayon bas-relief. Each course, each joint, had to be sized by successive approximations to perfect adherence, and one can imagine at leisure the number of pullings apart and reassemblies necessary to be assured of the correct shape of the blocks before their final placement.

The slabs show a quite different process of assembly. It is the principle of our tiles with tongues and groves fitting one into the other: this arrangement has the advantage of stopping the infiltration of rain-water, which are removed to the exterior along the grooves (fig 15). We must add that the delicate work was only executed for the slabs making up the ceiling of the vestibule; all the others are simply positioned with free joints with a single lower tenon to stop slippage of the base.

Fig. 14. Assembly of blocks

Fig. 15. Assembly of slabs
These refinements of detail are evidence of the care given to the construction. The building of such a sanctuary itself needs more work and patience than most of the architectural structures later built in Cambodia.

c) The work tools

Apart from the tools necessary in our time for the working of any stone – cold chisel and hammer – we have been given proof that the artisans of Maha Rosei Ashram had used the saw. This proof consists in a discarded stone which is a third cut in a perfectly straight line, 35 cm. long, 15 cm. deep and 2 to 3 mm. wide. It is not visibly a natural fissure of the stone, and no tool – if its is not a saw – would be able to execute a cut as fine and as regular. We can thus explain better to ourselves how the joints are so well made, because the simple chisel inevitably has faulty places, grooving certain parts more than one would have wished.

Finally, we seem to be able to state that the foundations were arranged by a line, and not with the aid of a precision level; in fact after having set up our foundations, we began the placement of the first courses, the joints, which were touching at the base of the stones, widened approaching the upper face (fig 16b). As for the stones which touched perfectly, we would have had to lift their ends more and more, stretching from the centre of the façade; and we would have thus obtained a crescent curve, 16a, which is the natural position of a line (this curve is a "chain" [catenary]). Practically, when the base had been entirely repositioned, the effect was too disgraceful if we absolutely respected horizontality: the first course of the wall was built up with a thin filling of cement which lifted the corners from 10 to 12 mm.

![Figure 16](image)

A. Curvature of string (exag.)  
B. Perfectly horizontal  
Fig. 16. Curvature of foundations

Chapter II  
Critical Study of Maha Rosei

(Not translated)

Chapter III  
Anastylosis

1. The state of the ruins before the works.

When we visited the building for the first time in October 1934, it was about in the same precarious state as in 1920, when the photographs reproduced in
Primitive Khmer Art of M. Parmentier (Vol 1 p. 124). All the main façade was collapsed, as well as two-thirds of the west lateral face. The stones adjoining the point of rupture were in a dangerous state of balance, and their collapse seemed imminent. The slabs which made up the ceiling of the passageway remained suspended by a miracle above the void, thanks to the structures which made them part of the dome – which rested in all its steadfast mass on the walls of the cella. This, in its turn, was visibly subsiding, in particular on the north side, and the slabs of the passageway (on which it rested) were in their turn lifted up in a cantilever way. The foundations, in lime mortar, diluted by floodwaters, were dug out in each rainy season, and the undercutting of the building could be foreseen in the very near future.

Further, the sanctuary had been wrecked by vandals, who had left in the interior of the cella an excavation of a cubic metre, and had thrown down the crown and the first slabs of the dome, in the hope of finding minute fragments of gold which were customarily lodged there.

It is easy to work out the causes of the ruin: the builders had not taken the care to sink their foundations to the natural rock of the hill, which - in the deeper parts - is 1.85 m below the sub-soil. They placed their footings directly on the ground where there were several areas of large rocks which inspired their confidence. But the nature of the soil is essentially weak, because the earth is very broken up and under the action of dryness it breaks up into a dust mixed with stones, that the comings and goings progressively drag towards the base of the cliff. The first storms each year pursue their work of erosion, and it is thus that – little by little – the foundations sink, occasioning the first cracks in the stonework. The cracks were thus carefully filled by means of crushed brick, and driven in by force; but nature pursued its task, enlarged the fissures, undercut the foundations and the rock, one fine day, rapidly sank, bringing with it all the northeast corner of the sanctuary.

This first accident occurred a long time ago, for we have found certain blocks of stone in the rotten stump of a tree of good size, which had had the time to be born, to grow and to die. Much more recently the eastern part of the façade fell in the same way and it is thus that the Maha Rosei Ashram took up the appearance in plate XXVI A, taken in March 1935, before the start of work.

2. The search for the stones

Before laying a hand on the building, our first care was to find all along the slope the stones which had – for the most part – rolled quite to the bottom. In several points where the earth had visibly built up over the years, we had to excavate quite deeply to dig out the stones which found themselves buried there. Then, all the blocks were numbered (from 1 to 128), and their place recorded on an overall sketch plan; further a general table was drawn up in which we noted (in relation to each number) the specific description of the stone, then (as one goes along with the identification) all the information necessary to its correct repositioning: the number of the course in roman numerals, the orientation, by the letters N, S, E and O [W], and finally the rank in each course in Arabic numerals. This systematic work procedure avoided for us many trials and errors and
manipulations of the stones which – without counting the loss of time which they always entailed – we were forbidden in the circumstances, given the exigencies of the terrain at our disposal and the difficulty of manoeuvring the blocks along the slope.

For the provisional assembly of our façades, we set up several tiers at the base of the edifice, which may be seen in the cross-section in plate XX. Access of the stones to these emplacements was effected by beam ramps along which the blocks were successively slid with the aid of a hoist. Thanks to the preliminary work of identification, each stone was taken up according to its needs, and taken to its definite place.

In spite of all the care given to our searching, certain blocks remained unfound, either they had been broken up in their fall or the inhabitants of the neighbourhood had taken them away for their personal needs: it is thus that one of the top stones of the edifice - essential because it contributes in a large part to the make the silhouette distinctive - was brought back from Phum Prei Phdau, a village about 20 km from Maha Rosei, and quite luckily the people of the countryside had been able to identify it.

Finally we had proceeded to a detailed plot of the building: the plan of each course was drawn to a scale of 5 cm to the metre (1:20), so that there is not a stone which does not appear on the set of plates thus set up. The necessary façades and cross-sections completed this document. All these operations being completed, we then attacked the systematic disassembly of the building.

3. Disassembly of the building

When one is led to work in a terrain as demanding, as broken up as that of Maha Rosei, the first question which appears to the mind is the following: where is it possible to store the removed stones, and how to get them to their temporary places? At first sight two places immediately presented themselves, to the east of the prasat we had available a platform 5 to 6 m long, but 2 to 3 m at the widest, to the west the flat area is a bit wider and is nearly 30 m square. But one like the other is below the level of the sanctuary we had to dismiss the hope of there rebuilding by entire courses the stones which we had to put aside. Searching to other possibilities we noticed a among the rocky escarpments two platforms ... which are far from level, but on which it would be possible to set up a floor of beams, heaping up several piers of stonework to complete the natural point of support. As well as difficult access, these places presented a great advantage, their height avoided for us lowering the top stones to the ground, which saved time. Another lucky detail, the smallest platform is exactly the higher and it is up there that we perched the top stones, whose surface is the least, while the intermediate stones (up to the approaches of the ceiling of the passageway) found a site at the less elevated level. Finally on the ground, to the left and right of the sanctuary we placed the slabs of the ceiling, which served as solid foundations for the provisionally reassembled walls, cornice below and feet in the air.

Our determination of the assembly being well firmed up, it remained to know by what means we would move the stones to their provisional places. It would be
easy to set up sufficiently strong walkways to roll the slabs on rollers; but
returning them from the slopes would be delicate and very slow. A crane, on the
other hand, would make us lose a precious space, by the encumbrance of its base,
of its counterpoise, of its beam and its rigging. But a crane which took up no
space, that is really what we needed. Because precisely the four storage places
were effectively on the same circumference which passed, it also, nearly in the
axis of the sanctuary, we could thus achieve the disassembly and reassembly of
the prasat, pivoting on a single centre, to service five workplaces. It is to respond
to this basic advantage that we created the machine visible in plate XXV B,
whose pivot is seated in a crack in the rock, its moving arm is made from four
channel beams, this “load mast” may be allowed to rotate around the axis, and on
the other hand to raise and lower according to need, by means of a hoist with six
strands whose upper pulley is fixed on the top of the vertical of the centre of
rotation. It is by the use of a multiplying block and tackle, suspended from the
end of the load mast, that one could lift blocks to a convenient level.

We were thus equipped to attack the job: but we will not be too impatient, and
will reflect a bit further; we have seen before the strange encorbelment which
supported the ceiling slabs; that only adhered in a way thanks to the mass of the
superstructure which – of its 30 tonnes – totally weighed down their end. But, as
much as we unloaded the upper parts, the counterweight would lift, and soon the
bottom slabs would carry it away, causing in their fall irreparable damage. It was
thus necessary before all else to proceed with the staying of the slabs; the pieces
of wood which we had provisionally placed as “candles” were taken away as
insufficient and replaced by two “easels” resting on blocks of concrete each one
wide enough to withstand a pressure of 50 tonnes (plates XX, section, and
XXVIII A). Two I beams of 200mm were directly wedged under the slabs,
carrying their weight to the easels.

Being thus prepared for any eventuality, the disassembly was carried out without
difficulty, but not without danger or worry, because of the instability of the
tottering stones which had to be stayed in their turn before proceeding with their
removal.

On emplacement I were placed the courses from the last stage, on emplacement
II was stored the intermediate stage, then on the ground, were placed to the east
and west of the sanctuary the ceiling slabs and the course immediately above it.

We thus arrived at the walls proper; those to the east were stored at emplacement
III in two stacks on above the other; those to the west at emplacement IV. As for
the south face, it gave rise to a new problem, because all the available area was
already occupied. We had to build, parallel to the wall, a shelf of beams, resting
on three solid easels based on the rock wall: it is there that the last blocks of the
sanctuary were provisionally stored. The last blocks? It would be more exact to
say the second last because the cella was still standing; but it was necessary to
keep it – for lack of space – and we were constrained to here interrupt the
disassembly, to first set up the foundations of the exterior walls.

4. The foundations
We do not insist upon the technical details of all this work, about which information is given on plate XXVIII B. However, it is to be noted that the slope of the natural rock presented an important declivity, we had adopted the method of a foundation on shafts, which saved an important volume of earth and stonework; six piles of rubble were based evenly on the rock and supporting the reinforced concrete beams on which the walls of the sanctuary rested directly. On the northeast corner, not finding rock until after 2.5 m down, we had to carry half the pile on the extrados of a buttress vault arch which sprang in the base, from another rock shelf, situated some distance away. The south face of the sanctuary was simply based on the a filling of concrete, without reinforcing, because the rock was at the level of the ground; in this part, the rock is at 0.35 m below the soil of the other façades and the builder – sooner than lift the whole structure – preferred purely and simply to leave out the first course of the substructure.

Our beams once set, all the base of the building was able to be put back, and only then were the four walls of the cella – temporarily stored on the foundation stones that we would put back.

We then proceeded to the reinforced foundations of the cella proper, which are at a level 0.9 m higher than those of the perimeter, and joined these last by means of pillars whose armatures had been deeply buried in the piles of stonework, before their construction.

We had thus finally put together a monolithic system, made up of piles, beams and pieces of reinforcement, whose assembly was practically unable to be deformed, and able to carry a load of 83 tonnes which we were soon going to place on it.

5. The reassembly

This part of the work was more than one of extreme simplicity; each stone having been duly numbered, found its original position without hesitation; the irretrievably lost blocks, which were mainly located on the west face, near the north corner, were replaced by laterite which is soft and easy to cut to size, and which resents outside the same porous appearance as our grey basalt. Only the colour differs, and we were forced to remedy this problem by covering the outside faces of the laterite with a wash of diluted Chinese ink [Indian ink].

The double headed pieces which originally assured the solidity of the blocks were removed from their lodgements and replaced by a slurry of concrete mortar whose reinforcing was flat iron made into figure 8 shapes.

The vertical slab forming the door frame, west side, having been fractured in its fall, we replaced it with a slab of concrete of the same section, reinforced with four 16mm iron rods.

Finally – for the good appearance of the building – we built around the sanctuary an embankment in partially cemented rubble, which accommodated a narrow platform in front and to the west of the building; this embankment was hidden under a layer of grass of the sort that maintained the impression that surrounding
the Maha Rosei Ashram, neither nature nor the hand of man had ever in the past added to its solidity.

Chapter IV
Attempt at Historical Reconstruction

1 Documents

In the course of the work which we are to lay out, it has been given to us to reveal certain quite troubling particulars, which it is our duty to recount with all impartiality.

In the first place, we have met in the building the presence of two stones being reused; one of these is the slab stone of the passageway situated immediately to the east of the door (see plate XXIX A); it was originally cut to size for the cornice, of which it offers the same capital projection; nevertheless, it is not impossible that this stone had fallen down from the cornice and rested as a slab at the same time as the work of analysis. The other is a base stone of the Southwest corner (third from the corner), this presents equally on its internal face the same profile as the cornice of the building (sketch 21), but, such a stone could not be adapted to the base - after having been built into the cornice - if we allow for at least a partial but important demolition in the course of the building; or as well - that which appears more likely - a complete disassembly and reassembly of the building.

We know in fact, according to information from the Geology Service of Indochina that the basalt used in the construction of the Maha Borei Ashram very likely came from the region of Kraceh on the Mekong, where we tend exactly to locate the grouping of Khmer power, before it extended to the northern parts of the kingdom. One is thus entitled to ask why the builders made their material come from so far away, when sandstone, much nicer in appearance and easier to work, was available in much closer quarries. We may suggest - without reserve - that it is not necessarily raw stones which they brought, but sooner blocks already sized and moulded: we could say a complete sanctuary in separate pieces.

But here are a few new details to help convince us: on the east façade, in the base, let us examine the third median stone from the northeast corner; this is broken, but broken since the time of construction of the monument; it was in effect repaired by means of two stone tenons analogous to those which we have already described above (sketch 22). And this new question occurs to our mind: Why did the builders use a broken stone when it would have been so easy to use an intact one, or use the fragments in the superstructure if it was felt needful. It does not appear logical to answer that this stone was broken in the course of building or transport; and if it had to be used at any cost, is it not because it had already been quite carved?
An observation of another order supports our hypothesis: we refer here to a stone which has a double filet under its cornice. In the "original" Maha Rosei Ashram they had hurriedly cut it in a too small block, which did not fit in the interior facing of the wall; from the ancient anastylosis this block was rejected as unstable, because today we can no longer find a use for it. But where do thus come the replacement stones one asks? In place of getting new material, the builders borrowed from the south façade, then replacing underneath the stones thus held up by this enormous block, visible in plate XXIII A the nature of whose grain is quite different, and that they had to put to use in the new building because they estimated it would take too long to get raw stones from Kraceh.

2 Conclusions

Basing our view on all considerations, it is tempting to suppose that the Maha Rosei Ashram first saw the light of day north of Phnom Da, in the vicinity of the other edifice which is its close relation in material and form, the Kuk rah That. Now the geological map of Indochina shows a belt of basalt which stretches towards the north much higher than Kuk Prah That, and nearly up to the latitude of Kraceh (sketch 23); on the other hand, M. Coedès tells us that the most southern inscription of this former country is found at Thma Kre (about 12 km north of Kraceh). Lower it stretches to Fou-nan, and the approximate delimitation between the two territories seems most likely to be at the latitude of Kraceh. From this it is not impossible that the Maha Rosei Ashram was built on the soil of Chen-la, at a time when their rulers lived in the peace necessary for craftsmen. This would put the first founding of the Maha Rosei Ashram at the start of the sixth century.
Then to overview the troubled period of the conquest: Mahendravarman grabbed Vyadapura (Ba Phnom, capital of Fou-nan) and drove back his enemies to the south, where the court set itself up in the village of Na-fou-na (not yet identified). Içanavarman, his son and successor, achieved in 627 his conquest of Fou-nan, and perhaps then – the better to stamp his hold on the recently enslaved southern country – he dreamt of transporting there the sanctuary formerly had seen the light on the soil of his fathers. Himself, having set his capital at Sambor at Sturn Sen, had no further interest in keeping near Kraceh the divinities which his soldiers had led to victory; those they thus kept with them in the newly occupied territory. Than in that era, an important city with walls 8 km around, was raised on the site of the current village of Angkor Borei - thus the evidence on an inscribed block, dated 533 saka (611 AD), found last year near the centre of the village. Phnom Da, located less than 2 km to the south of its ramparts, was quite naturally chosen as a hermitage: it is there that was clustered, around the newly rebuild sanctuary, the famous artists’ studio which gave rise – among other masterworks – to the stone of Hari-hara (today in the Guimet Museum), the triad of the Phnom Da prasat, and the Krishna of the grottoes (Stoclet collection).

It is true that this basaltic belt stretches towards the southeast and nothing proves that the Maha Rosei Ashram had not been built on Founanese territory. Thus our hypothesis would be destroyed ... But on the contrary, no other is viable: on the one hand it would be unlikely to suppose that the transfer had been able to be effected by the conquerors, because these would care little for the idols of their vanquished; must we thus conclude that the Founanese themselves pulled apart the temple to put it under the shelter of the invaders? It is improbable since the attack of Chen-la was rapid and further, a people – even in rout – keep to the end the hope of regaining their former possessions. On the other hand, one could say that, the conquest achieved, conquerors and conquered ended up be forgetting in the long term their mutual resentments; unity was formed for the care of the new
nation, arts and customs were assimilated (that would not be difficult, since the two rivals had lived under the stamp of the same civilisation). Later they may have forgotten the origins of the Maha Rosei Ashram ... but we do not know what psychological reasons settled on the transfer of this temple to the southern confines of the kingdom, when the centre of Khmer activity was moving definitely to the west. We prefer to stick to our first supposition and to believe – until better informed – that the Maha Rosei Ashram was a Chen-la and not a Fou-nan building.

Let us hasten to add that this historical restoration does not only rest on such fragile hypotheses: the vicissitudes of Fou-nan are not hers – even if imperfectly known, and we would be presumptuous to attach to our sayings the slightest certainty. But at least may we be permitted to note – if not the likelihood – at least the possibility of the facts we put forward.

The results of our reflections remain subject to discussion: in presenting them in this study we have had no other ambition than that of having suggested certain new hypotheses, which will catch the attention of researchers and contribute to inform the historians of Khmer art.
Plate XX. Plan and cross-section of structure (appearance of ruin)
Plate XXII Maha Rosei Ashram. Main façade
Plate XXIII. A. West face  B. East face.
Plate XXV. A. Ramp to NE of sanctuary. B. Stacking of blocks to SE.
Plate XXVI. Maha Rosei Ashram A. View of stay assembly  B. Main face of cella
Plate XXVII. Maha Rosei Ashram A. West façade  B. East façade (ruins)
Plate XXVIII Maha Rosei Ashram A. View of supports on façade
B. Foundations
Plate XXIX Maha Rosei Ashram A. State of site at start of reassembly
B. Sanctuary in course of reassembly
Appendix 6

The Restoration of the Angkor Monuments and its Problems

By Louis Malleret


(Translation by the candidate)

(Extracts)

Figure 1. Angkor Wat, South Tower in the second stage court

The methods of restoration of the [Angkor] monuments varied depending on the reigning ideas. To the period of the discovery and exploration was succeeded that of clearing, consisting of delivering the structures from the grip of the forest and from the enormous accumulations of debris, facilitating access, proceeding with an analysis of fallen pieces and to class them by their position of fall, and finally take care of some organisation in the chaos of fallen blocks to allow their study and later operations. This preliminary phase was accompanied by indispensable works of consolidation. But the French archaeologists were then haunted by the abuses to which the restoration methods of their compatriot Viollet-le-Duc had given rise in the nineteenth century and, careful before all else to not renew these errors, they pushed respect for the ruin to undertaking nothing which would re-establish the overall entity. Further they consented to maintain in their tottering position blocks in false doors by supporting them with crutches, posts, stays, beams, frames, hooks or hoops of iron bars. These artifices were obvious, they sometimes surprised visitors disagreeably, letting remain the risk of collapses and of accidents, and finally denying a deeper study of the edifices.
In 1930, M. Henri Marchal, then Conservator of the Angkor Group, was sent on a mission to Java, with the aim of studying the methods which the Dutch had been applying with success for twenty years to the restoration of the ancient temples of the East Indies. He brought back the conviction that these could be perfectly suitable to the monuments of Cambodia. A first experiment was tried in 1931, in the small group of buildings of Banteay Srei, situated about 30 kilometers to the north of Angkor Thom. This group of tenth century constructions presented the advantage of consisting of materials in hard sandstone, well set up in their remaining lower parts and not much broken up in their fallen upper parts. It was made up of little temples composed of elements of reduced dimensions, which facilitated their handling by teams of workmen who were still inexperienced. Finally, the richness of the decoration proliferating over the surfaces of the walls facilitated the recognition and replacement of the fallen stone blocks. The operation was a success and the method called anastylosis, which had had its proof in Greece and Java, was introduced into Cambodia where it was to produce surprising results, thanks to the adaptations and improvements sometimes imposed by different problems.

In fact, the term anastylosis is improper here, since the column holds only a limited place and only plays an accessory role in Khmer architecture. Reconstruction of edifices is not subjected to the threat of earth tremors, as in the Mediterranean Basin and the Islands of the Sound. The materials have not systematically given rise to a useful exploitation like the marble of the Greek temples of which the Tholos in the "quarry" of Marmaria at Delphi is a prime example. Finally, although serious wrongdoings had been committed, notably by the Buddhist clergy in recent times, the architectural elements were rarely transported to great distances and it is often possible to recover most of the basic parts. In reality, the problems which confronted the archaeologist at Angkor related primarily to the art of the engineer. They owed little to the effect of wartime destruction, not much to the effects of climate, something to the vigorous action of the vegetation, but above all to mechanical causes aggravated most often by the faulty techniques traceable to the ancient builders.

Before analyzing the interrelated action of these various agents, it is necessary to outline some of the characteristics of Khmer construction. These are generally erected on a stable base made up of clayey sand. But the part which has been drawn from the earth has varied over time, in some types of edifices the conception is itself modified. The whole history of architecture in Cambodia is that of an evolution towards more and more complex assemblies which developed at the start from isolated buildings, then groups on a common terrace, then joined by galleries and divided into masses balanced on sometimes grandiose expanses, finally climbing the steps of a pyramid in daring conceptions, associating multiple combinations of horizontal perspectives and vertical flights. False stages, false doors, false windows, patterns of fading away or of accentuation, distant views, little courts full of mystery, steps, causeways, balustrades, water surfaces, shadows and lights, all give evidence of a science which excludes neither calculation nor artifice, but tends to create overall impressions, effects of synthesis, of symbolic figures thanks to a prodigious sense of the balanced distribution of figures in space. Even in its repetitions, its repentances, its accumulations of close constructions almost running one into the
other, this art retains a powerful attraction which results from the diversity of its ideas from one building to another and from the richness of its inventions, like that of the tower with faces. Pushing these considerations to the extreme, one could say that there are no two Khmer temples which require the application of the same remedies to their ruinous state and that the ingenuity of the technician requires here infinite resources.

This variety of solutions is imposed as a function of the nature of the materials employed by the builders. Brick construction predominated in the earlier periods and was maintained up until the tenth and eleventh centuries, the use of stone was then limited to the lintels of doors, their colonettes and to false doors. Generally well burnt and conveniently sized, brick finally gave way to sandstone, together in association with laterite, without excluding the use of wood in the lining beams, door leaves, ceilings or framework. The wood has almost entirely disappeared under the gnawing of termites, insects whose devouring power forbids any permanent repair. An attempt at restoration of one of the ceilings was however undertaken by the architect Jacques Lagisquet, but in cement tiles made to order with their rosaces carved, the effect obtained was striking.

For these materials a problem of supply was posed. Laterite in particular has a place in filling rubble [rough stonework] in some buildings where it has a role as interior filling, while the skin is made up of plates or blocks of sandstone moulded or sculpted. The Khmer had thus already been led to an economy with stone, not that they lacked it nor was suitable transport unavailable, but without doubt because it was of unequal quality and strength in the quarries to which they had access. Whether it is covered by a revetment or whether it appears in the open air in surrounding walls or slabs, laterite alters its nature by deterioration in contact with permanent moisture or by erosion in the fallen rocks. It is thus necessary to replace it, and the only means to obtain it would be by exploitation of subterranean deposits which are made up by concentration of iron in the sheets of clay in quaternary terrains in tropical regions. It is easily cut out from the ground, in blocks which dry in the sun. But this method of supply is tedious and the problem of overcoming the shortage of laterite is not yet overcome.

In certain monuments it seems that to the lack of sandstone may be attributed the use of rubble of different tones, going from yellow to brown, though all the shades of grey, and this absence of homogeneity results in inequalities in the strength of the materials. The sandstone of Angkor presents in effect several varieties of different hardness and it has been subjected by the artisans of other times to an erroneous use which consisted of submitting it to forces of flexion or tension, in accordance with a behaviour which could only be obtained from wood. It is thus for example that the lintels of an excessive span have experienced rupturing forces which they could not resist. The constructors believed to reinforce their strength in the tenth and eleventh centuries, adding to them a wooden beam as backup on their internal face, a remedy which could only have limited effectiveness in a country where insects are terrible destructive agents. Generally the Khmers did not know how to separate the procedures of the framer and the carpenter. They have combined lintels and pilasters in vertical or grooved assemblies and made the stone work in accordance with the modalities of strength of wood. This error is responsible for much damage.
However, the process of ruin is not tied to these mistakes alone. Stereotomy seems to have been completely ignored by the ancient builders. The blocks have not been sized to provide carefully aligned courses of an equal height. The are badly squared and the masonry generally lacks cohesion. The absence of overlapping of the blocks to ensure the alternation of joints has set up planes of rupture or of detachment, such that the face towers of the Bayon for example opened before restoration into slices whose opening increased from bottom to top according to the lines of weakness of the vertical joints (see fig 2).

Figure 2. The Bayon of Angkor Thom, Tower 33, before and after restoration

But, in most cases, it is the effects of overloading which prepared and set in motion the collapse of the temples. The Khmers seem to have ignored the principle of the arched vault and they preferred in all cases that of corbelling. This is only in fact the [vertical] prolongation of the walls by successive projection of their constituent elements until they rejoin themselves like the shape of a broken arch. Theoretically, this system does not involve lateral forces, if the ground which supports it is everywhere of the same level. But it needs only weak compressions [of the ground] for the effects of reversal to manifest themselves or for cracks to appear in certain elements of the structure. It is that which is produced sometimes for demi-vaults placed side-by-side on one side of a wall and resting on the other on pillars, with the use of "cross-ties" of sandstone to join the first to the second. [See figure 13 Appendix 2 for an example]. It has needed a light subsidence of the foundation which supports the pillars to bring about a rupture of all these cross-ties in a very remarkable way in the same place. It is by a reverse movement that collapsed the wall of bas-reliefs

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1 Craft of cutting and dressing complicated bocks of masonry such as those for an arch, vault or spiral staircase (Oxford Dictionary of Architecture, OUP 1999)
of heaven and hell at Angkor Wat, in a way that it was necessary to put batons on all of the carved walls of the gallery of this edifice, with the aim of watching the movement of the masonry.

The corbelled vault results in creating enormous overloads whose mechanical action is very apparent in monuments of the type of Prah Khan. Nearly everywhere in the galleries these stone cross-ties have collapsed, blocking the passages in an indescribable chaos. One notes, on certain pillars, curious torsion effects having brought about the beginning of a rotation of the blocks on themselves. Further, nearly all the pillars have crumbled at the base. We were embarrassed for a long time to determine the cause of the phenomenon in which it seems at first sight that the stones were gnawed by an unknown agent. In fact, these pillars were likened to prisms supporting excessive loads, one easily recognizes in their suffering the shapes of crushing, such as is described in specialist studies. The interplay between different materials in the same structure also provokes inequalities of resistance to pressure and differences of behaviour in the case of compression of the soil. By the totality of these causes may be explained the detachment of walls, the ruptures of the corners at the steps of the pyramids, vertical fractures in monolithic blocks or even the “exfoliation” [loss of skin] of the sandstone in superficial sheets which detach and pull down in their fall large panels of the decoration.

The action of temperature and of heavy rains operates without doubt on the surface of sandstone when ceases to be protected by debris or a mantle of forest vegetation. The growth of lichens or of mysterious mushrooms as at Banteay Srei causes considerable damage to the carving which it dulls or blackens. One has often blamed the mechanical effect of the giant roots which grow in the interstices of the masonry blocks, finally dislodging them (fig. 3). The power of re-growth of the tropical vegetation is such that it is necessary to organise at Angkor a brush-removal flying squad which, all year long, moves from one monument to the other, often passing the same place several times. But the forest mantle also exercises a protective effect, we always know that excessive deforestation accelerates the process of ruin. Certainly it is unavoidable to knock down certain giant trees whose fall during storms sometimes leads to immense damage, but a middle-of-the-road solution consists of keeping shade useful to the sensible conservation of the old stones. These offer additionally the advantage of keeping around themselves a certain mystery which pleases dreamy souls, romantic spirits, to all those who remain faithful to the “feeling of the ruins” made fashionable in the nineteenth century in France by the painter Hubert Robert and the writer Volney, but who also respond to the intentions of the great artists of all times who did not conceive that human constructions could be arbitrarily separated from the spontaneous creations of nature.
In the most general case, the acceleration of ruin results from compression or subsidence of the earth (see fig 4 top). There is then no other remedy than to proceed with the reconstruction of the edifice with its own materials, which brings into play the principle of anastylosis. This leads to a jigsaw puzzle on a sometime colossal scale. A first operation becomes an analysis of the fallen stones which allows the guarantee that one has available sufficient elements, among the stones which are detached from the masonry. A second phase consists of the dismantling of the material remaining in place, and numbering each of the blocks and reassembling on the ground beds of stones as complete as to allow the hope of finding absent elements. The ground being free of the structure which it carried, it is necessary to re-establish at a constant level the soil consolidated and capable of carrying the load of a new building. For that one generally counts on a slab of concrete fitted with suitable ironwork [as reinforcement]. A delicate task consists of setting up at a level carefully aligned the first courses which one gets in reassembling the numbered blocks in the inverse order of their removal. All that remains is the thus pursue the reassembly up to the summit, replacing by blank stones, without moulding or carving, the blocks which could not be found or leaving unfinished the parts whose elements are too mutilated (fig 4 bottom).
This technique used sincerely excludes any conjectural initiative and also, in principle, the use of cement, except for internal masonry and then with discretion. The problem of vertical joints which reappear on their later placement may be corrected by chains or hooks, the Khmers not having hesitated themselves to use anchorages, but these artifices must be carefully copied. A difficulty consists of reserving around the monument storage areas sufficiently big for the classification of the blocks. The absence of decline or the configuration of the ground sometimes brings about a considerable cluttering, so much that that it has been necessary to separate the waiting material on staged platforms.
It is here that the ingenuity of the conservator comes in, sometimes because of unforeseen situations of technical difficulties for which the technique of anastylosis only provides general principles. The rupture of lintels or architraves sometimes leads to hide in a groove in the stone a U shaped iron serving to support the broken parts. But a clever system of hooks with covering on the outside face of the lintels sometimes gives the impression that these are suspended or only rest on a single column. Later the shortage of laterite forced M. Jean Alur, the current conservator, to replace the internal blocks of the structure by a tank constructed from a stone extracted from Phnom Krom, which is not sandstone but makes a good replacement material. The space thus left has been filled with an earth packing, and sometimes in a foundation for example covered by a slab of reinforced concrete. In other cases it has been enough to rejoint the blocks with the aid of a ram (fig 2 right). Moreover, the infiltration of water has led to the isolation of the worksite with the aid of a barricade and drying it with pumps, with the aim of laying when dry a cement slab, outside the work of recovery in the sub-structure. In a difficult case, access ramps must be provided for the use of cranes with relays of lifting machines on the steps of a pyramid.

But, all the operations of restoration of a monument do not lend themselves to the relatively simple cases of anastylosis. The repair of an enormous monument like the Baphuon which has suffered serious collapses at two of its corners and suffered at other times on one of its faces serious modifications on the part of the [Buddhist] monks, constitutes a gigantic undertaking which can only be carried out in terms of a programme of a dozen years. This edifice constructed on an artificial hillock, made mainly of sand, suffered internal fissuring due to the torrential rains. The pressure of the earth on the walls has caused rock falls and there are scarcely any means to fix it other than partitioning with internal walls, embankments and other containment procedures having failed up to the present. The dangers to which the access pavilions and the little tier temples with charming bas-reliefs were exposed have made necessary a complete dismantling, accompanied as in all cases of this type, by many drawings and photographs allowing its reassembly on stable foundations.

Works of this size have been completed by M. Maurice Glaize for the complete reconstruction of the Banteay Samre group. But the triumph of anastylosis has been the rebuilding, by the same architect, of the central temple of Bakeng in the Roluos group, entirely collapsed and reassembled by a prodigious [jigsaw] puzzle, thanks to a logical classification of its separate elements (fig. 5).
However there are cases where anastylosis meets its limits. Such a one is that of the rebuilding of brick monuments which do not lend themselves to disassembly and reconstruction. Up to the present, one is limited to partial reconstructions, to discrete repairs, to saddles of clamps or belts of flat iron. These methods are insufficient and inspired by the example of the repair of the underpinning of the great pillar of Strasbourg Cathedral thirty years ago, we have advocated the use of hydraulic jacks to lift the panels of the walls which local subsidence of the soil tends to stack them one on the other by the enlargement of their cracks. A general formwork of masonry to ensure its rigidity with a mask of wood to protect the workmen, then simultaneous efforts of lifting and traction would allow the reattachment of the fractured parts and works in the sub-structure comprising injections of cement.

These methods suppose the use of modern equipment whose potential can be combined with traditional man-power. The Cambodian workman is only at his ease when among wooden scaffolds tied with rattans which he prefers to metal tube scaffolding made boiling hot by the burning sun. But he ends up by adapting himself to the use of machines of great [power] output. He has taken time to accept substituting the use of wheelbarrows for baskets for the transport of earth and he has accepted with mistrust the mechanical chainsaw in place of the handsaw. However he moves with ease among the Decauville tracks and shows an extraordinary aptitude for the recognition and classification of carved blocks. It is finally in this alliance of modernism and tradition that is the originality of the methods of restoration at Angkor, an undertaking daunting at first by the size of the tasks to be fulfilled, but which gains for the archaeologist the highest satisfaction by the feeling which he gains as being the spiritual heir of the great masters of other times.

LOUIS MALLERET
Appendix 7

Anastylosis : An Alternative for Conservation of Stone Monuments

By Vasu Poshyanandana

(From Country Report of Thailand for Meeting of Experts for Formulating Guidelines for Archaeological Field Procedures and Techniques 1995(?)

What is Anastylosis?

In Thailand nowadays, whenever one refers to restoration of stone monuments, the word 'anastylosis' is always mentioned along. This is because professionals and staff concerning restoration of stone monuments have agreed that anastylosis is, at present, the most suitable technique for stone monuments conservation. However, apart from being an alternative in restoration of monuments, what, actually, is anastylosis? To this point, we may go back to the origin of the word 'anastylosis' that it was used formally for the time to call a new alternative for restoration in the International Conference [sic] of Archaeological Conservation of the Acropolis Monuments held in Athens in October 1931, by Greek engineer, Mr. Nikolaos Balanos. After the conference [sic] the word 'anastylosis' was internationally accepted and appeared in the Charter of Athens. The definition by Mr. Balanos says "The ‘Anastylose’ method consists in the rebuilding of a monument with its own original materials according to the system of construction peculiar to each" which implies the idea of a column replaced in its vertical position in Greek architecture. However, in practice, anastylosis began since 1834 by a Bavarian architect Lea Van Klenze at the Parthenon, Athens.

From Europe to Asia, anastylosis was applied for the first time in Java architecture by a Dutch architect which inspired Henri Marshal to apply this technique to Khmer architecture at Prasat Banteu Sreij, the pioneer project in 1931. The principle followed Balanos' definition with some additional condition: "restoration with the monument's original materials according to its specific construction system, however, anastylosis may accept addition of compatible and appropriate new materials to replace lost stones which are essential that, the restoration of original elements of great importance back to their original positions is impossible without these replacements".

Later on, anastylosis was applied for the first time in Thailand at Pimai for the restoration of the main Prang during 1964-1969, with financial and technical support from the UNESCO. Mr. Groslier and Mr. Pichard, 2 professional architects from France were sent as project consultants to cooperate with M.C. Yajai Chitrpongs, a Thai architect who was also graduated from France. Mr. Groslier had applied Henri Marshal's technique by adding modern structure to bear the load of the original structure for stability and damp-proofing. This was done by hiding reinforced concrete structure in load-bearing parts of the monument and adding a reinforced concrete spread foundation underneath the whole monument. Successful result at Pimai Main Prang made this technique well accepted and was applied to Prasat Phnom Rung. and Prasat Muang Tam
consecutively. The principle is to dismantle the whole monument and reassemble the stones in their original positions as pre-planned over the new reinforced concrete spread foundation, with additional supporting reinforced concrete structure hidden in parts of the superstructure.

While anastylosis at prasat Muang Tam is proceeding, many of the monumental sites especially those Khmer-influenced sites in Northeast Thailand have widely adopted the word anastylosis to their restoration projects including Phnom Wan Site which is French-Thai Joint Conservation Project. The project is intended to be a pioneer project in practicing anastylosis in a new approach by refusing the use of reinforced concrete and reduce the use of cement and structural steel by replacing it with lime concrete and stainless steel. Dismantling is necessary. In fact, the word ‘anastylosis’ only implies the restoration of the fallen original stones back to their original positions by original technique. We, therefore, may take Phnom Wan as an experimental project in anastylosis to be observed and evaluated further.

Objectives and General Principles

1. The initial objective of anastylosis is ‘authenticity’ for which the monument’s aesthetic and historical value is conserved, in other word, to return the original feature to the monument. We will only try to retrieve the original elements and restore them back to their original positions with as little addition as possible. All the work must stop at the point when hypothesis begins. It is noticeable that anastylosis was derived in time that, within the world of conservation, an opposition to restoration by reconstruction (to repair and reconstruct in complete form based on hypothesis of the original conditions of monuments) was growing. This was reasoned that complete reconstruction may be misleading to public when a hypothesis was realized as if it was the true original.

2. Anastylosis is a method of monument restoration which generally aims to protect the monument from various threatening factors causing deterioration by attempting to eliminate the origins of problems in each case. However, anastylosis is not a simple restoration method aiming only to extend the monument’s existence but, on the contrary, anastylosis can be compared to a total operation to the monument which results in alternation [sic] of the monument’s appearance from the time of discovery or excavation. Normally, we prefer the reassemble of original materials with techniques as originally applied when it was first built, however, in case that the original techniques are ineffective for the stability and durability of the monument, new techniques may be applied as necessary.

3. Anastylosis is a method of presentations of the ruins for the scattering bricks and stones cannot well convey the meanings to the visitors which is opposite [sic, apposite?] to the ruins after anastylosis when the stones are restored back to their original positions.

Although it is not the complete reconstruction which shows the complete image of the monument in the past, anastylosis is sufficient to indicate the characteristic of the original space of the collapsed monument. It is a middle point between complete authenticity or romantic concept which says that the ruins must not be
touched, and the concept for revitalization of the monument in a new body with a complete reconstruction.

Advantages-disadvantages

Anastylosis is an effective method of restoration which has returned many world famous monuments to their magnificent image of the past. Unfortunately, anastylosis cannot be applied to every case, that is to say, anastylosis application is limited to stone monuments with stones of reasonable size connected without mortar so that we can correctly categorize the stones and trace the original position of each stone.

It is not always easy to decide whether anastylosis is suitable. Restoration of ancient elements to their original positions, even partly can increase public understanding to the formerly almost meaningless heap of stones, on the contrary, anastylosis based on the information of only one period can be an obstacle to scientific studies in historical development of different periods as seen in layers of previous construction. An alarming aspect of anastylosis is the ability to erase a period of development whereas another period is presented, therefore, anastylosis will be less confusing when applying to the monument with only one outstanding period of construction.

Anastylosis is most suitable for enhancing the potential of the information perceivable from the monument by clarifying the monument's original space characteristic. This method of restoration will create a new appearance of the monument which is easier to interpret and also add durability for the monument to last. However, for the achievement of these objectives, the restorer must have a specialized knowledge, experience of a professional specialist, and creativity and sensitivity of an artist. Application of anastylosis without sufficient skills could lead to a distortion of facts without difficulty.

In every case of anastylosis which has been done exaggerately or without sufficient information from research or studies, there is a risk in transforming an archaeological site into a drama scene. We should admit that an attempt to restore with anastylosis principle each time could cause a mistake, therefore, it is vitally important that the opportunity for future revision or recorrection of the work should always be allowed, for instance, when new elements are found which could alter a previous interpretation of the monument, or the previous restoration is proved incorrect in certain aspects.

Stone Monuments Restoration by Anastylosis in Thailand Today

As we have seen in the original definition of anastylosis mentioned previously, what we are carrying out at many Khmer influenced monuments in Thailand could not be called anastylosis, but applied anastylosis which sometimes is mistaken to be the true anastylosis as referred to internationally. In fact, anastylosis can be applied in terms of concept but not in detailed applications because stone monuments all over the world may not have the same physical conditions, construction techniques, and environmental factors so there must be some differences in details of implementation which we have to consider and control.
particularly case by case. While many of the stone monuments have been restored in different approaches without a standpoint until problem occurred as at Prasat Puiy Noi [not specified], for instance, the Thai-French Joint Project at Prasat Phnom Wan is attempting to find a standard approach for anastylosis restoration based on past experience and problems previously encountered in Thailand i.e. at Phimai, Phnom Rung, and the true principles of anastylosis. Aspects of consideration can be categorized as follows:

1. Authenticity of the monument in materials, position, form, and construction techniques must be retained as much as possible. A good restoration must be true to the original conception of the monument so its shape must be respected. Any intervention must be legible and removable, it must also keep the effect produced by the outline of the monument.

1.1 We must realize that every block of stone which used to compose as the ancient monument is most important in terms of historical evidence. Every cut or carve is therefore damaging to such evidence. Moreover, working with stones need ultimate care from the dismantling and moving of stones that we must avoid using hard metal tools which can cause scrapes or chips, and moving should be done only in case of necessity. The storage of stones waiting for restoration must have a measure for protection of chipping, efflorescence, and moisture from the ground. The replacement of lost stones with new materials must have sufficient justification and the chosen materials might have to be hidden from sight. These materials must be suitable for their function (to replace the deteriorated old stones or to support the originals on top etc), for instance, the clearly visible parts of the monument should stone of same type as the original be used instead of using cement with artificial sandstone finish which lacks craftsmanship [sic] and awareness in preservation of the surrounding original stone.

1.2 The original stones must be returned to their original positions and level based on drawings and documentation of the monument's condition before excavation and, dismantling which is very important for consideration.

1.3 Forms, decorations, mouldings and proportion on the original monument must be preserve as historical and art evidences by investigation of primary information for restitution by specialists. This restitution must be reapproved by a board of committee. It is also very important to restore as planned with great care. To supervise the work closely and it is prohibited to add any part without enough supporting evidence including addition of new materials in large portion when compare to the original on site.

1.4 Ancient construction technique is also an important historical evidence. Addition of new structure such as reinforced concrete foundations or other hidden structure is not in the original principle of anastylosis as generally understood. In fact, it is indicated that if the original structure has no disadvantages, it must be completely, preserved, however, in practice for monuments in this part of the world, restoration with only the original techniques applied could not guarantee stability and durability of the monuments as Mr. Grolier had perceived. Nevertheless the alteration of original conditions and construction techniques must be done only in case of real necessity and the detailed report of these

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procedures must be made for future studies. The example we have seen at Phnom Wan is the decision to preserve the original laterite base of the monument without total dismantling and underpinning with reinforced concrete foundation as formerly done in most cases with reasons that we should not interfere or change the monument in parts which are not necessary. In this case, the decision was made specifically considering the characteristic and original condition of the monument. Therefore, anastylosis with total dismantling and reassemble should not be automatically applied without consideration any further.

2. Anastylosis is a method for protection of monuments from deterioration factors therefore, if necessary, new techniques can be applied as mentioned in 1.4 but there must be a measure for protection of side effects from the chosen materials i.e. cement, steel (further studies must be carried out for epoxy application).

3. The aspect of presentation of ruins as mentioned previously is only to enable visitors to perceive the original form and space of the monument on site as much as the original elements indicate, therefore, exaggerated addition is not appropriate. We are not obliged to rebuild a new Prang only to support the top finial found, for instance, we can be contented to preserve the finial or lintel in the museum in case that the original positions cannot be correctly proved.

Problem Solutions

1. Anastylosis which is the method we have chosen for stone monuments restoration is highly prone to alteration of history when practiced without understanding and expertise. It is also not easy to apply when there is a limited time, therefore, any rush must be avoided regarding the monument as the most important.

2. Working procedure must allow supervision and control properly by a group of experts and experienced professionals.

3. Restoration must be recorrectable, not be exceedingly durable. For instance, the use of mortar in repairing Khmer monuments which was originally constructed without mortar should be restricted in case of necessity only and the material used must be less hard than the original stones to prevent damages and enable future repair.

4. A recommendable material for restoration of stone monuments is lime mortar. Lime mortar is a material which can be used to reinstate the external appearance of a broken stone, or to complete a wall. Different possibilities exist to make readable the intervention on a stone or a wall. For instance, the colour of lime mortar can be slightly different from stone colour. It is also possible to set mortar back from the original surface in order to create distinction. Composition of lime mortar is lime: sandstone powder (or brick powder, or laterite gravel): black earth.
Appendix 8

Details of the 1999 proposal for the 2000 restoration of Prasat Phnom Wan, Nakhon Rachasima Province

This Appendix contains some detailed drawings from a proposal of 1999 for the continuing restoration of Prasat Phnom Wan in 2000.

The proposal put forward plans for the restoration of the main sanctuary, the small prang, and of parts of the gallery. The total estimated cost of the restoration was 10,208,000 baht, now about $A 365,000, including materials, labour, and overheads. The work involved was primarily to disassemble the sanctuary and small prang, lay concrete foundations, provide drainage for rainwater, and reassemble the buildings to their original state.

The attached drawings are reductions from A0 to A4 of drawings prepared by the Archaeology Division showing the current and proposed state of the temple. A site plan in the top right hand corner of the drawing shows the alignment of the view in the drawing. In relation to the drawings taken from the proposal prepared by the Fine Arts Department:

Drawing 8.1 shows the ground plan of the temple, with the areas to be worked on shown hatched. These are the main sanctuary, the small prang and the southeast and southwest sections of the gallery.

Drawing 8.2 shows the south elevation of the sanctuary before restoration.

Drawing 8.3 shows the sectioned floor plan of the sanctuary before restoration giving the location of all stones.

Drawing 8.4 shows a longitudinal cross section of the sanctuary before restoration.

Drawing 8.5 shows two lateral cross sections of the sanctuary before restoration.

Drawing 8.6 shows two other lateral cross sections of the sanctuary before restoration.

Drawing 8.7 shows the proposed drainage plan of the temple complex after restoration.

Drawing 8.8 shows the elevation of the sanctuary after restoration.

Drawing 8.9 shows the sectioned floor plan of the sanctuary after restoration.

Drawing 8.10 shows the longitudinal cross section of the sanctuary after restoration. Clearly shown are the reinforced concrete foundation (solid black) and the drainage works to remove rainwater.
Drawing 8.11 shows two lateral cross sections of the sanctuary after restoration, also showing the concrete foundations and the drainage arrangements. Drawing 8.5 shows similar sections before restoration.

Drawing 8.12 shows two other lateral cross sections of the sanctuary after restoration.
Ground plan of the temple showing work areas.  Drawing 8.1
Sanctuary: south elevation before restoration. Drawing 8.2
Sanctuary: Sectioned plan before restoration. Drawing 8.3
Sanctuary: longitudinal cross section before restoration. Drawing 8.4
Sanctuary: lateral sections before restoration. Drawing 8.5
Sanctuary: lateral sections before restoration. Drawing 8.6
Proposed drainage plan of the temple.  Drawing 8.7
Sanctuary: elevation after restoration. Drawing 8.8
Sanctuary: sectioned plan after restoration. Drawing 8.9
Sanctuary: sectioned elevation after restoration. Drawing 8.10
Sanctuary: lateral cross sections after restoration. Drawing 8.11
Sanctuary: lateral cross sections after restoration. Drawing 8.12