

ON THE POLYCHROMY OF ANGKOR VAT RESULTS OF INITIAL PAINT COLOR INVESTIGATIONS

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1. Preliminary Remarks

For years Germany has been actively engaged in the preservation of the temple complex of Angkor through the German Apsara Conservation Project of the Cologne Fachhochschule under the direction of Prof. Dr. Hans Leisen and Prof. Jaroslav Poncar. The German project is concentrated on guiding and financing conservation measures for Angkor Vat. With its emphasis on methods directed toward extensive documentation of the existing situation and conservation of the historic fabric on the basis of scientific investigation, this project is unique in Angkor. Cambodian specialists, trained on-site, carry out stabilization and conservation work, sometimes together with German students.

Extensive paint remnants have survived on Angkor Vat, which was built between 1113 and 1150 by the powerful Khmer king Suryavarman II.¹ Systematic investigation of the pigments has yet to be carried out. It is not clear from which epoch these pigments date or how the temple appeared at the time of its construction. Although there is no doubt to the value of historic information paint and color analyses would provide, priority must be given to urgent conservation. Without such measures, extreme climatic conditions will only continue to cause deterioration. Often only the smallest traces of former polychromy can be identified microscopically, and these too may soon be lost. Many polychrome findings have already been destroyed through ignorance or negligence of their presence during earlier renovations.

The following observations are the result of initial restoration-oriented paint investigations in February 2000 in Angkor Vat. These observations do not bring us any definitive conclusions, but are rather offered as instigation to further investigation. In particular, we hope that these results will stimulate interdisciplinary discussion, as only thus can historically convincing interpretations ultimately be developed. At the same time, attention should be brought through these results to a scientific desideratum which deserves more attention. Information on the original polychromy of the temple complex enriches our knowledge of the temple creation, influence and use, thus providing an important contribution to cultural-historical research.² We are perhaps the last generation that will be able to convey this information.

*Translated from the German by Margaret Will.

¹ For the history and significance of Angkor Vat see: C. Jacques, *Angkor*, Bordas, Paris 1990; M. Freeman and C. Jacques, *Ancient Angkor*, River Books, Bangkok 1999; Ang Chouléan, E. Prenowitz and A. Thompson, *Angkor: A Manual for the Past, Present and Future*, APSARA Authority / UNESCO 1995.

² For the German-speaking lands extensive findings and publications on the polychromy of stone sculpture and architecture document that, in the majority of cases, stone was painted.

2. Position of the Findings / Tasks for the Investigation

Larger areas with polychrome layers are plainly visible particularly in the cruciform gallery, in the corner pavilions of the second enclosure and in the galleries of the central shrine on the uppermost platform (Figure 1). There are red pigment tones and occasionally also traces of gold on the bas reliefs of the outer gallery (running around the third enclosure), in addition to unimportant graffiti. Particularly striking are highly polished sandstone surfaces on the bas reliefs with black discoloration, these areas raise provoking questions. On the outside of the temple, pigments can be detected on only a few apsara.

A Third enclosure
B Second enclosure
C First enclosure (central tower)
D Cross-shaped gallery

Areas with partial or extensive pigment layers
Areas that were sculpturally unfinished in 1150

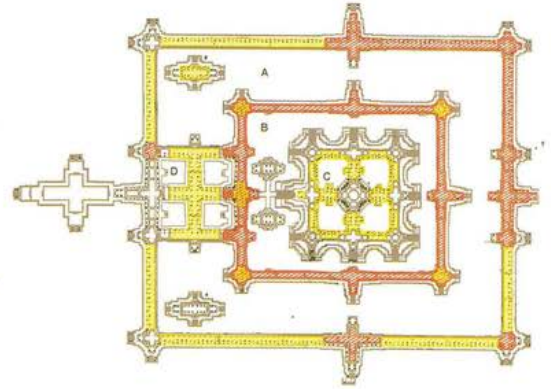


Figure 1. Plan of Angkor Vat

One of the most important contemporary sources on life in Angkor is the account of the travels of the Chinese emissary Zhou Daguan, who stayed at the court of the Khmer king in 1296-97.³ Impressed by what he saw, the Chinese guest described the golden towers of the Bayon temple, golden bridges and Buddha figures, all bearing witness to the wealth and nobility of the Khmer.⁴ Angkor Vat is mentioned only briefly in the travel report as a mighty building with hundreds of stone rooms.⁵ However at that time, the temple, erected some 150 years earlier, was overshadowed by other state interests. The zenith of power of the old Khmer kingdom was already past. Repeated conquest by the Siamese finally sealed the decline of the old capital after 1430. Angkor lost much of its population, the city was overgrown by jungle and the temples decayed. Not until the middle of the 16th century did Angkor Vat, as the largest temple complex, again become a focus of interest. Remembering the once mighty Khmer kingdom under Suryavarman II, King Ang Chan had Angkor Vat restored in 1546. The bas reliefs in the northeast corner, which had not been finished after the death of Suryavarman II in 1150, were completed at this time.⁶ At this point at the latest the temple was converted into a Buddhist shrine and henceforth developed as an important pilgrimage center.⁷ Thus Angkor Vat is among the few temple complexes in the region that has an almost unbroken tradition of religious use.

Undoubtedly most of the pigments that are visible today can be traced to use of the temple since the 16th century as a Buddhist shrine. Whether or not the temple was painted at the time of its construction

³ *The Customs of Cambodia*, Translation into English from the French version of the Chinese original from Paul Pelliot by Gilman d'Arcy Paul, Bangkok 1993.

⁴ Zhou Daguan: 2.

⁵ Zhou Daguan: 2-3. Zhou Daguan refers to Angkor Vat as Lu Pan's grave.

⁶ The region had previously been liberated from the Siamese. The beginning and end of the "restoration," or completion of the work which had been broken off in 1150, are documented by an inscription (1546-1564). (Jacques 1990.)

⁷ Presumably up until this time there was a figure of Vishnu in the central shrine which was then removed and replaced by a figure of Buddha.

still remains completely unclear. Even if Indian prototypes and traces of pigments in other temples in Angkor make such an assumption likely, it must be kept in mind that Angkor Vat remained unfinished.⁸ The goal of our investigations was thus an initial documentation of the findings, paying particular attention to the following questions:

Did Angkor Vat have painted surfaces in the 12th century?

Did the pigments cover the entire surface of natural stone, or did the design concept call for only partial painting?

Were there monochrome painted surfaces or was there a polychrome design?

What color tones were preferred?

Is it possible to differentiate several paint layers?

Does the polychromy make it possible to more precisely describe the history of the building?

3. Methods of Investigation

A thorough study of the surfaces, with magnifying glasses, made the most important discoveries possible. However, lengthy training was necessary in order to be able to chronologically order the paint layers, which are frequently juxtaposed. To support the in situ investigations, more than 30 paint samples were taken for microchemical analysis or for preparation of cross sections.⁹ The primary concentration on optical, in situ investigations was mostly an outcome of the special situation in which the paint remnants are found. On the bas reliefs and the apsara the very thin pigments often lie directly on the stone or in its pores, practically precluding the removal of samples without causing damage to the historic fabric. As layers on top of one another could only rarely be identified, the value of pigment analysis in terms of clarifying chronological order was limited. To support the findings from Angkor Vat, comparative probes were carried out in other temples of the Angkorian period. Because these probes involve sites that had been abandoned at least since the 14th-15th centuries and are thus largely unchanged, these supplementary investigations proved very important for providing basic evidence on the polychromy of temples of this period.

4. Results of the Investigation

Cruciform gallery

The interior of the cruciform gallery is still characterized today by extensive remnants of different polychrome coatings. From the 16th to the 19th centuries this gallery, known as the "Hall of the 1000 Buddhas," was a central focus of Buddhist pilgrimage activity.

Sequence of pigment layers on the walls and columns up to the cornice:

⁸ The Shiva shrine in Tanjore (southern India), built around 1000, can be taken as one example of a Hindu temple with well preserved polychromy and wall paintings. In Angkor clear indications of polychrome schemes have been found on the interior and exterior of the temples of Prah Ko, Ta Prohm and Preah Khan.

⁹ All of the microchemical analyses and cross sections of the pigment samples were carried out by Prof. Dr. H.-P. Schramm and M. Schramm (Hochschule für Bildende Künste, Dresden, restoration department). We would like to express our special thanks for their selfless efforts in the service of this project.

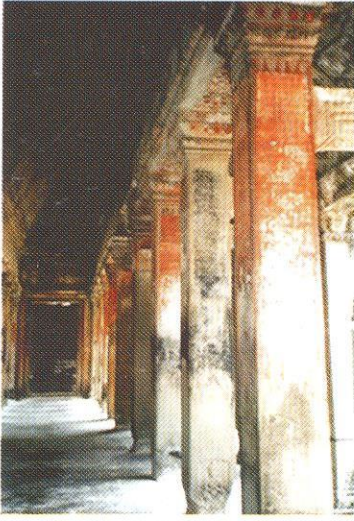


Figure 2. Cruciform gallery. Traces of red paint, repairs, soot and inscriptions produce a heterogeneous picture. The inscriptions mostly have a black, lacquer-like background layer to improve their "legibility."

polychrome scheme with white, ocher, red and black applied directly to the stone of the decor and the apsara;

2. red iron oxide and white, applied with a wide brush, mostly only retouchings;
3. thin pink coating.

Tympanum reliefs

Two schema can be detected on the tympanum reliefs above the door openings to the interior corridor (from lowest to uppermost layers):

1. red iron oxide/white (?), not over the entire surface, perhaps with the figures painted white or light ocher and the background partially a deep red;
2. gilding of the figures and door frames on red and black, lacquer-like ground.

It can be concluded from the number of paint layers that the earliest polychrome scheme, which definitely can be dated to the 12th

Differentiated red and orange tones, often set off with white, predominate on the columns and wall surfaces. Numerous inscriptions, graffiti, crude paint repairs from different epochs, black discoloration, spots of soot, and oily surfaces merge with remnants of polychromy to present a very heterogeneous picture, suggesting long, intensive religious use (Figure 2).

Two paint layers which largely cover the whole surface can be identified on the walls up to the upper cornice. However, as both layers overlay damage to and repairs of the stone surfaces, and are on unfinished low reliefs, they cannot be dated to the 12th century.

Sequence of paint from lowest to uppermost layers:

1. on the smooth stone wall surfaces: luminous orange (red lead);¹⁰ on the dancing apsara and base decor: red (red iron oxide) / white(?);¹¹
2. thin pink coating over the entire surface.

Cornice and above

Three pigment layers are recognizable above the cornice and on the cornice itself:

1. a finely differentiated,



Figure 3. Cruciform gallery, above the string course. Initial paint scheme (12th century), polychrome painting with a pointed brush in red, white and black on sculpted ornamentation. The stone surface is not completely covered by the painting.

¹⁰ According to the report on the chemical analysis the red lead had converted in places into lead sulfate or lead chloride and had changed in color (blackening and fading).

¹¹ The white was not analyzed. Presumably it is lime.



Figure 4. Cruciform gallery, central corridor, cornice.

- 1: Gilding above the tympanum relief
- 2: Sporadic red coloration from a renovation phase
- 3: Older paint findings (12th century?)

was intentional, or if the work was simply unfinished.

The red/white scheme can be interpreted as part of the first general renovation phase, which can most convincingly be dated to the middle of the 16th century.¹³ The use of different red and white tones indicate an intentional and organized design. The inconsistent, cursory character of the scheme, which breaks off abruptly in some places on the upper decor and tympanum reliefs, is however striking¹⁴ (Figure 4). The apsara on the base are depicted lightly on a red background and red-white decorative frame. Red ocher (red iron oxide) was used as the pigment (Figure 5).

It is not clear whether the luminous orange-red coating of red lead on the smooth wall surfaces between the base and the cornice also belongs to this color scheme. The appearance of two different red pigments on one wall surface suggests that this is not the case.

The most recent layer, covering the whole surface, is a thin, pale pink whitewash.¹⁵

Gilding, dating perhaps from the same time or somewhat earlier, is still clearly discernible on the tympanum reliefs and the ornamental door frames. A black natural lacquer, weakly toned with

century, existed only above the cornice. It is extremely delicate and has a graphic-ornamental character (Figure 3). The details and the small-scale ornamentation on these reliefs were highlighted and accentuated with a pointed brush and strong colors — often without covering the forms entirely with paint. The apsara above the cornice are outlined in red on a white (?) background.¹² Individual strands of hair and details of the adornments were painted with a pointed brush on the background surface to complete the image.

So far this early scheme has not been detected on the large tympanum reliefs. As this polychrome layer is also absent on the wall surfaces below the cornice, it can be assumed that in the 12th century there was only partial polychromy in the upper area. We do not know whether this design



Figure 5. Second enclosure, western gallery toward the cruciform gallery, socle zone: unfinished apsaras laid out in red and white.

- 1: Red iron oxide
- 2: Red lead

¹² The background coloration could not be clearly identified because of severe efflorescence and changes in the pigment.

¹³ It is unlikely that there was a comprehensive new color scheme between 1150 and 1546; with the exception of Yasovarman II (ruled 1150-1165), the successors of Suryavarman had little interest in the Hindu temple since the state religion had meanwhile become Mahayana Buddhism and the region was soon occupied by the Thais. However, little is known of the period from the 14th to the middle of the 16th centuries.

¹⁴ In places one gets the impression that things were painted as far as the ladder reached. On the cornice of the north wall there is a polychrome scheme with green as well as red and white for a length of c. 10 m. This scheme breaks off abruptly and is unique in the whole temple.

¹⁵ In the microscopic cross section the uppermost layer appears only white.



Figure 6. Third enclosure, bas relief from the 12th century (northwest side). Background laid out in places in light red, with dark red "repairs" (?) on top. The figure exhibits remnants of a partial paint scheme.

both cases the pigment is a red ocher (red iron oxide). The dark red, which is related to the red/white scheme in the cruciform gallery in coloration and stroke, is on top of the lighter red. It was only partially applied (in places as retouchings), using a wide brush. Sometimes it was used together with white as a color accentuation of details such as parasols, jewelry, crowns, eyes and lips.

A third chronologically definable polychrome treatment can be characterized as multi-layered. On top of a cool red tone (cinnabar) is a black lacquer with gilding.¹⁶ The gilding is limited to selected scenes (Figure 7).

The 16th-century reliefs in the northeastern part of the outer gallery reveal very different findings.¹⁸ Whereas the scheme with partial gilding can be detected, the two earlier red tones with red iron oxide are totally absent. Instead the reliefs exhibit extensive remnants of a detailed preliminary drawing in red (red iron oxide) and black on the flat, uncarved upper section of the former wall surface (Figure 8). In places, entire surfaces were laid out in red or black. It is obvious that initially a complete drawing of the relief depiction was made on the flat stone wall, according to which the relief was later carved. This supports the thesis to the same effect by Vittorio Roveda, although he relies purely on the iconographic

cinnabar, served as the ground for the gilding.¹⁶

Between the red/white paint layer and the more recent pink coating are extensive areas of soot and black discoloration (oily surfaces or pigment discoloration) that suggest a long interval between the two.

The bas reliefs on the outer gallery

On the bas reliefs from the 12th century, distinct areas with red color tones are initially noticeable. Closer observation reveals two different red tones: an orange-red which is mostly found on the background of the reliefs and a somewhat darker red which can be found on the background as well as on the reliefs themselves (Figure 6). In



Figure 7. Third enclosure, bas relief from the 12th century, sun god Surya. The bluish red (1) is the remains of the ground for gilding which was still clearly visible around 1900.

- 2: Light red from an older period
- 3: Partial lacquering of the surface

¹⁶ Schramm (see footnote 9) assumes that this is ubushi. An exact identification was not possible.

¹⁷ In a sample from the relief of the sun god Surya the gold lies directly on the cinnabar and the black resin is on the gold. In the analysis the gold exhibits strikingly high portions of silver.

¹⁸ Inscriptions date the beginning of sculptural transformation to the year 1546. In 1564 efforts were still being made to finish the reliefs.

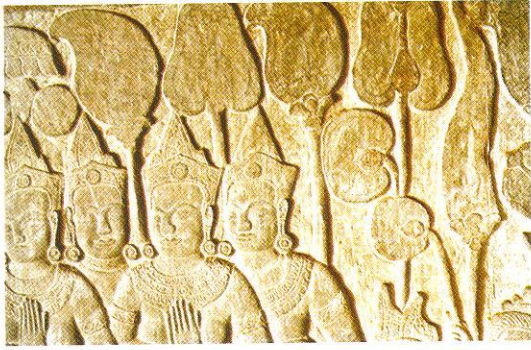


Figure 8. Third enclosure, bas reliefs from the 16th century (northeast side). The figures and details are only roughly carved. The highly refined preliminary drawing is visible on the wall surfaces that were left uncarved. Some of the details of these painted models were laid out in red.

are perhaps remnants of additional drawings which were never transformed into sculpture. Signs of picking and scraping to remove the paintings are clearly discernible. Roveda's assertion that the eastern corner pavilions never had preliminary drawings and therefore remained undecorated in the 16th century is thus questionable.

The two colors found on the preliminary drawings in the northeastern area support the assumption that the red background on some parts of the reliefs from the 12th century are part of an original design. The "legibility" of individual scenes is greatly improved through this use of color. Because a subsequent red coloration of the background of the 16th century reliefs is not to be found, it can be assumed that the red on the reliefs from the 12th century at least predates the 16th century. There is much to indicate a dating in the 12th century. The partial nature of the color scheme is striking. Apparently certain elements of the images were to be emphasized by means of the red accents.

The much later gilding of certain scenes served,

and overall design context of the reliefs in his convincing argumentation.¹⁹ The preliminary drawing that Roveda surmises is in fact still discernible in remnants today. Remarkably, the artistic quality of the model, a two-color painting mostly with black lines and red backgrounds, greatly exceeds that of the sculptural execution. The quality of the work suggests that this is the painted preliminary model from the 12th century, first transformed into sculpture in the 16th century.²⁰ Apparently after 400 years the preliminary drawings were not easily discernible everywhere and the sculptors of the 16th century had to freely design some details, which appear much less convincing. This is the only plausible explanation for the enormous differences in quality in the sculptural work in this area (Figure 9). On some completely plain walls in the northeastern gallery there are red and black traces of pigment which

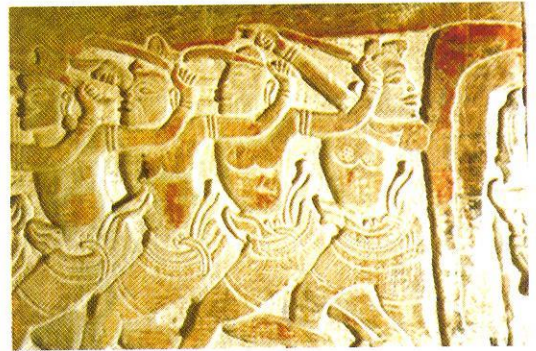


Figure 9. Third enclosure, bas reliefs from the 16th century (northeast side). Red and black remnants of the preliminary drawing on the uncarved wall surface. The sculptural transformation is misunderstood artistically in some places (right-hand warrior).

¹⁹ Roveda, Vittorio, "The use of drawings for the making of the reliefs from Angkor Vat," in W. Lobo, S. Reimann, eds., *Proceedings of the 7th International Conference of the European Association of Southeast Asian Archaeologists, Berlin, 1998*, Centre for Southeast Asian Studies, University of Hull, 2000, 169-175. See also G. Cœdès, "La date d'exécution des deux bas-reliefs tardifs d'Angkor Vat", *Journal Asiatique*, 2, 1962, p. 235-48 (avec "Note sur les bas-reliefs tardifs d'Angkor Vat" par J. Boisselier).

²⁰ The pigment investigations thus support the assumption by Albert le Bonheur in interpreting two inscriptions on the relief (see le Bonheur, Albert and Jaroslav Poncar, *Von Göttern, Königen und Menschen. Flachreliefs von Angkor Vat und dem Bayon*, Peter Hammer Verlag, Wuppertal, 1995, p. 54). The fact that the painting (preliminary drawings) can be documented on the entire surface that was reworked in the 16th century refutes earlier hypotheses that only a few scenes were laid out in the 12th century.

in a similar manner, as special accentuation. Since the gilding was still easily discernible in the late 19th century, it can be dated to the 18th or 19th centuries.²¹ Questions concerning the black shiny parts of the bas reliefs remain unanswered. The theory that this is due to pilgrims touching the relief cannot be confirmed analytically. The primary cause is lacquer treatment of selected places.²² Similar partial lacquering was also found between the paint schemes from the 16th and 19th centuries in the cruciform gallery. This probably served a religious purpose.

First and second enclosures

Probes could only be carried out on the lower parts of the galleries of the first enclosure and the corner pavilions of the second enclosure. The findings here are similar to those on the lower half of the cruciform gallery. The first paint layer on the stone is again the red/white scheme, which probably can be dated to the middle of the 16th century. In the galleries of the first enclosure subsequent partial gilding (of the door frames) and the pale pink coating are also to be found, obviously indicating a sequence of schemes similar to that documented in the cruciform gallery. Further investigations will be needed to clarify whether remnants of the scheme from the 12th century are present on the upper walls.

Observations made in the western gallery of the second enclosure, which simultaneously constitutes a passage to the cruciform gallery, are of particular interest. Finely sculpted bands of decor and dancing apsara on the base stop abruptly, remaining unfinished. Vestiges of tracings for the decor with freely drawn black lines of detail are discernible in several places. Roveda has already made reference to the interesting preliminary drawing in the door jamb of the northwestern corner pavilion of the second enclosure.²³ Here too only the basic scheme of the repeating pattern is traced, whereas the inner drawing is done free hand (Figure 10).

The red/white polychromy appears on parts of the wall surfaces that were not sculpturally treated, completing the image (apsara) in a simple manner, by means of paint. This proves the chronological classification of the polychromy as a later renovation phase (16th century).

Findings on the outer facade

Technical reasons preclude any investigation of the exterior stone. Because of the exposed nature of the site, and cleanings carried out in the 1980s, it is unlikely that much polychromy would at any rate be detected. Remnants of older color schemes have only been found on several apsara and behind two blind windows. Traces of red pigment are found repeatedly in the niche-like backgrounds beside the apsara. Remnants of gilding, applied directly to the stone, have only been found on one apsara on the central tower of the first enclosure. Eyes and eyebrows were drawn with a pointed brush. This



Figure 10. Second enclosure, western gallery toward the cruciform gallery, base area. Preliminary drawing from the 12th century, sketched freehand with a brush and black paint on the smooth wall surface.

²¹ According to a description by Etienne Aymonier from 1904 the partial gilding on some areas was still clearly visible at that time. (See le Bonheur 1995: 60).

²² According to Schramm (note 9) this is a black natural resin, but not shellac.

²³ Roveda 2000: 173, n. 20.

finding resembles in sensitivity the first scheme in the upper part of the cruciform gallery. However the many partial applications of gilding along with nuances caused by religious pilgrims of later times render a clear statement impossible.

The apsara also bears repeated red and white remnants of a scheme which can probably be dated to the period between the 16th and the 19th centuries.

5. Summary and Initial Conclusions

1. The investigations provide more precise knowledge of the degree of completion of the temple complex in the 12th century and of supplementary work done in the 16th century. As is generally known, the fine sculptural treatment was left unfinished in 1150. Largely completed were the central shrine with its inner gallery (first enclosure) and the outer gallery (running around the third enclosure) on the south and west sides.²⁴ Except for a few details of the base area, the cruciform gallery was also finished. Apparently, work on the western gallery of the second enclosure was in progress at the time that work at Angkor Vat was interrupted. Only in this gallery are tracings and preliminary drawings for the ornamental low reliefs to be found on the smooth wall surfaces.

2. The extensive bas reliefs of the outer gallery in its northeastern corner, measuring c. 110 m in length, were not finished until the 16th century. Investigations of the polychromy prove, however, that the sculptors of the 16th century worked according to a complete painted model of great artistic quality. Apparently, the complete design for the bas reliefs, running fully around the gallery, was painted in one 12th century campaign, using black and red pigment on the stone surface, before the sculptural work was begun.²⁵ In the northeastern corner the relief was not executed until the 16th century.²⁶ That the detailed overall design is an achievement of the 12th century rates as an important discovery.²⁷

3. The sculptural completions from a later period are not limited to the bas reliefs in the northeastern corner. In other parts of the temple complex there were also efforts to complete the sculptural decoration. The outlines of decorative patterns and dancing apsara, often artistically misunderstood, were traced on free wall surfaces and incised on the stone in an amateur manner.²⁸ In their greatly oversimplified or falsified form these incisions also cover surfaces that were originally not intended for decorative treatment (for instance, on the stairway to the cruciform gallery).

4. It goes without saying that a color scheme from the 12th century can only be anticipated in the areas that were finished sculpturally at that time. As the temple's sculpture was left unfinished, so was the color scheme, along with any intended color effect. For this reason, it is difficult to draw any definitive conclusions about color use in Khmer temples in general from the particular example of Angkor Vat. Nonetheless, remnants of polychrome schemes which can be dated with certainty to the 12th century are found in the upper parts of the cruciform gallery and on the bas reliefs. In reference to the goal of the

²⁴ According to Hindu ideas Mount Meru, as the seat of the gods, is the center of a mythical geography. From its center, axes run in the four cardinal directions, dividing the universe into quadrants. Each quadrant is ruled by a god. Surya, the god of the sun, rules in the southwest. Is the preferential completion of the southwest part of the temple an expression of a special homage by Suryavarman to Surya?

²⁵ There are also indications of preliminary drawings with red and black on the upper parts of the bas reliefs from the 12th century.

²⁶ One inscription says that the reliefs were still being worked on in 1564. In other words the work took a long time and apparently was again not finished in some areas.

²⁷ Freeman and Jacques, p. 64, should be challenged for their overall deprecatory assessment of the relief. The highly refined design is among the great achievements of the 12th century.

²⁸ In some parts of the base area of the first enclosure there are even primitive incisions of squatting apsara.

investigation as described above, it can thus be confirmed that the temple originally had a color scheme. This is also corroborated by findings of predominately red pigments on other temples.²⁹ So far the investigations in Angkor Vat suggest a partial polychromy on selected areas. Red (red iron oxide) dominates, differentiated with white, ocher and black.³⁰ The polychromy of the 12th century is distinguished by the subtle filigree-like work with which small-scale ornaments and details of the figures are painted. Partial polychromy probably also existed on the exterior of the building, at least on apsara, but it is certain that the intended design also remained unfinished here. So far, indications of extensive gilding have not been found.³¹

5. Overpaintings have been detected but their chronological classification is difficult. The first and presumably the only extensive new color scheme with red and white was probably carried out in connection with restoration of the temple in the middle of the 16th century. There was an attempt to take up the color tone of the original scheme - to the extent that it had survived - and to extend it to areas where the stone had remained visible. This polychrome scheme, limited to different red tones and white, is much cruder in its execution than the original scheme. Between the 16th and the 19th centuries there were repeated repairs and partial new schemes.³² On the wall surfaces of the cruciform gallery the most recent color layer is a pale pink coating which apparently was intended to cover discoloration and soot resulting from religious use. At this point we can not determine whether the gilding of the door frames, tympana and selected scenes of the bas reliefs was carried out at the same time. It is certain only that the gilding is relatively recent and that natural resin was mostly used as the ground. A natural black lacquer was also identified on the black shining parts of the bas reliefs. The purpose of this partial lacquer treatment is not yet clear. The early red tones are red iron oxide. After the 16th century red lead (in the cruciform gallery) and cinnabar (always in connection with gilding) were used. Proteins could be identified as a binding medium in the early paint layers.

Further investigations should concentrate on the galleries and outer walls of the first enclosure along with the central towers, where chances of finding further traces of pigment from the 12th century are the greatest. The findings of gold and red on an apsara, with delicate drawings on the eye, indicate an early date, but the singular nature of this example renders interpretation difficult. Extensive original polychromy is probably also still to be found in the upper parts of the bas reliefs up to the cornice.

These results are to be understood as initial documentation of the existing situation. Further investigations promise to shed light on unanswered questions regarding the polychromy of the bas reliefs and of the cruciform gallery, and could refine or perhaps correct existent interpretations which are as yet mostly hypothetical. In addition, parallel investigations in other temple complexes are very important. Only the sum of information and comparative examples will allow us to make general statements on the nature of the polychromy and its meaning in older Khmer architecture. The findings so far promise that much further knowledge could be gained.

²⁹ A homogenizing red scheme is found on the bricks of Preah Ko (9th century). The stucco decoration, applied later, was painted with yellow ocher (ocher iron oxide) and the stone-carved niches for figures were red ocher (analysis by Schramm). In Preah Khan (end of the 12th century), painted red and decorated with bands and circular decor in yellow ocher and black has survived on a large base surface in the inner sanctum. In its coloration and execution these findings very much resemble the initial scheme in the upper part of the cruciform gallery of Angkor Vat!

³⁰ According to Hindu ideas the colors red, white and black formed the *guna* as a symbiosis of the three existential basic characteristics: white as the symbol of spiritualization, purification, pleasure and luminosity; red for dynamism, passion and pain, black for rest, constancy and darkness. (See Albanese, Mailia, Indien, *Zeugnisse großer Kulturen im Norden des Landes*, Erlangen 1999, 21.)

³¹ Zhou Daguan's description of Angkor Vat as a building with stone rooms (see note 3 above) perhaps should be given special significance. If a lot of gilding had been visible, Zhou Daguan would have mentioned it.

³² It is possible that in the 17th century there was another renovation phase in some areas, in particular in the cruciform gallery.