

SECTION II

**ARCHAEOLOGY**

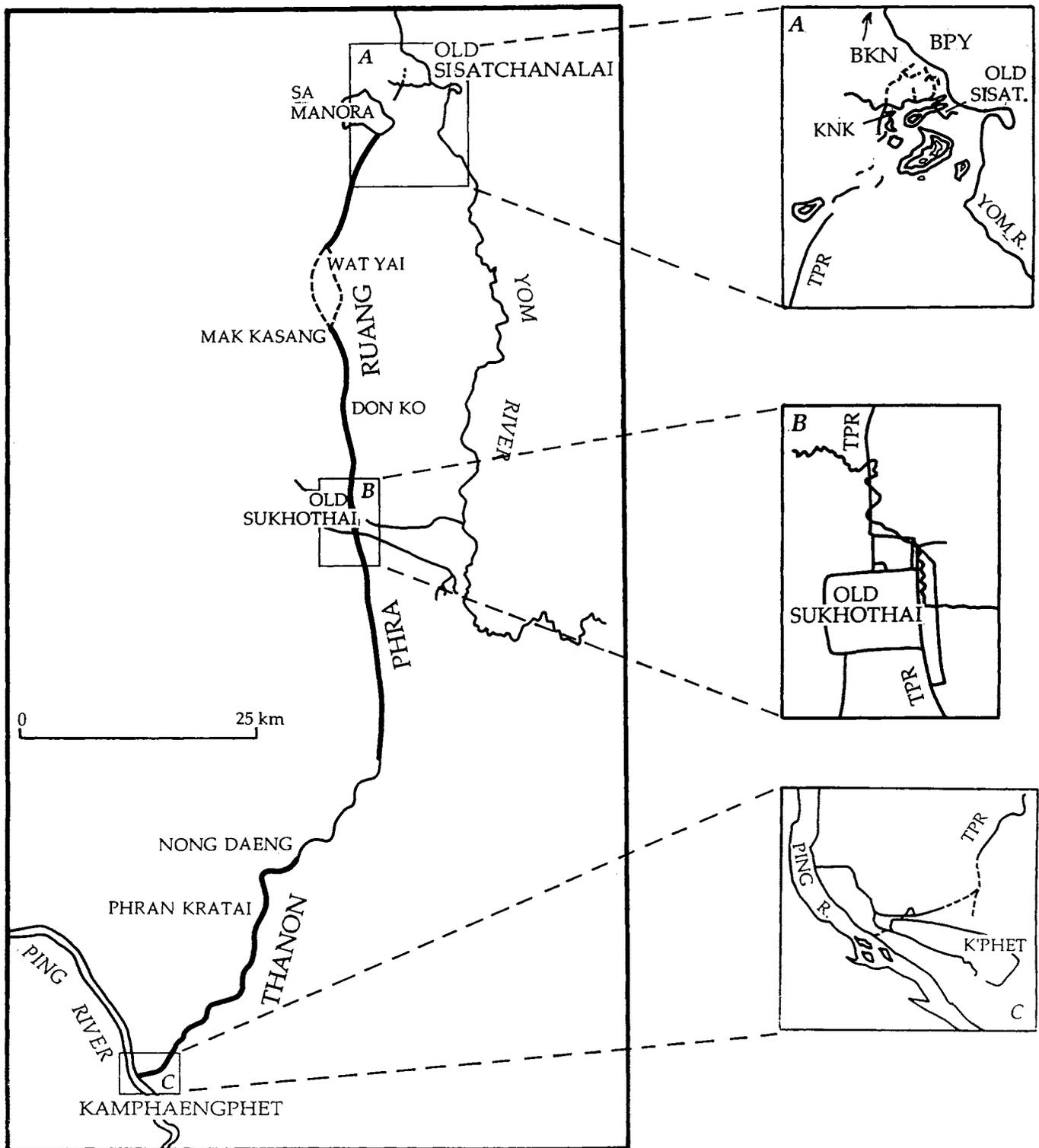


Figure 1. General map of the route of Thanon Phra Ruang (TPR) between Kamphaeng Phet and Si Satchanalai. Abbreviations: BKN: Ban Ko Noi; BPY: Ban Pa Yang; KNK: Khlong Nong Kham.

# RECENT DATA ON THANON PHRA RUANG BETWEEN SUKHO THAI AND SI SATCHANALAI: ROAD OR CANAL?

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## ABSTRACT

Thanon Phra Ruang is a discontinuous embankment and canal that runs from Kamphaeng Phet via old Sukhothai to Si Satchanalai. It has traditionally been treated as the road (Thanon) that its name implies, but we bring together here a range of field evidence from ground surveys and drilling of the northern section between Sukhothai and Si Satchanalai that shows that the structure is more sensibly interpreted as a canal with an adjacent embankment. The function(s) of the canal remain(s) to be fully clarified, but we suggest that these functions may have included water harvesting (with perhaps an ancillary irrigation function), drainage, transport and/or communication. The attractive hypothesis that Thanon Phra Ruang was an important means of transporting ceramics south from the production sites north of old Si Satchanalai is difficult to support from field evidence.

## INTRODUCTION

Thanon Phra Ruang (TPR) is a discontinuous structure, generally consisting of a canal and adjacent embankment(s), that runs for approximately 120 kilometres between Kamphaeng Phet and old Si Satchanalai, via old Sukhothai (fig. 1)<sup>1</sup>. It has been the subject of investigation since a 1907 survey by Prince Vajiravudh (later King Rama VI), but no consensus has emerged on the nature and function(s) of the structure. Indeed, the opinions of those who live along its length sum up nicely the range of current interpretations of TPR. The people in Ban Ko Noi (fig. 1) joke that "During the time of King Phra Ruang there were no attractive women in the city of Sukhothai. As a result, all of the men of the city got together and built a road to Si

Satchanalai so that they could visit the far more attractive women of that city." On the other hand, the residents of Ban Na Phae, a few kilometres south (figs. 1 and 2), speak of the ghosts that they hear on occasion, and of other sounds late in the night, beyond the village in the direction of TPR. They mention hearing the sounds of boats being dragged down the canal, the clinking of pottery and men talking of, among other things, a journey of one week's duration. They also report seeing, the following morning, the traces of drag marks where boats have scraped along the bottom of the canal.

In this article we briefly review the history of research on TPR before presenting data from a short field reconnaissance over the length of TPR, concentrating on the northern part, between Sukhothai and Si Satchanalai. This reconnaissance was aimed at describing some of the morphological character-

istics of TPR with a view to interpreting the function(s) of the feature. A particular aim was to elucidate whether the northern TPR is the remains of a road or a canal.<sup>2</sup>

## PREVIOUS WORK ON TPR

Prior to the turn of this century and Prince Vajiravudh's survey, there had only been one work of any significance on the question of TPR. In 1884 a translation of an inscription found at Wat Pamamuang was published. This inscription is said to mention the circumstances surrounding the digging of a canal for the construction of a highway between Sukhothai and Si Satchanalai during the reign of Thammikarat (Supajanya 1980). The inscription states that TPR terminated at Sukhothai, whereas the current consensus is that it terminated at Kamphaeng Phet (Vajiravudh 1907; Phinitphuwadon 1972; Supajanya 1980; Shiranan 1989; Supajanya and Pongsripiyan 1993).

Twenty-three years after the publication of this inscription, the first survey of TPR was carried out by Prince Vajiravudh during his trip from Kamphaeng Phet to Si Satchanalai. The account of the trip was later published in 1927, with a commentary by Prince Damrong. Although the Prince focused on the mound or embankment of TPR and assumed that it was a road, he did report use of the water in the adjacent canal, as well as noting that his suggestion that TPR was a road was a "tentative assumption paving the way for researchers and historians to reconstruct a more accurate picture" (quoted by Supajanya and Pongsripiyan 1993, 13).

Nonetheless, the opinion that TPR was a major road or highway has been dominant (Krom Silpakorn 1967; Phinitphuwadon 1972; Van Liere 1989), but recently there has been something of a shift away from this interpretation, towards the view that TPR was part of a major canal system (Bruneau 1973; Supajanya 1980; Supajanya and Pongsripiyan 1993; Shiranan 1989; Hein and Barbetti 1988).

## SETTING AND METHODS

The course of TPR from Kamphaeng Phet to Si Satchanalai, via old Sukhothai, is largely across old high flood plain surfaces (alluvial terraces) of the Kamphaeng Phet and Sukhothai alluvial fans. These fans are low angle alluvial deposits of the Ping and Yom, laid down where these rivers flow from their upland valleys onto the northern Central Plain. A complex interlocking network of ancient abandoned channels is found along parts of the course of TPR, particularly at its northern end (Stewart et al. 1987; Bishop and Godley 1993).

The field reconnaissance survey of TPR was carried out over a six-week period in December and January, 1991–92. During this period, the length of TPR was reconnoitred on foot and motorcycle. Sites for detailed description along the length of TPR were chosen on the basis of their apparent degree of

preservation. The aim was to take measurements at least every three to five kilometres, depending on access. Once a suitable site had been located, a cross-sectional survey and, depending on conditions, hand augering for sub-surface investigation, were carried out. The cross-sectional shape of TPR was determined at each location after the identification of a suitable local datum. A taut cord, checked against the local horizon, was then used. Measurements of the height below this datum were taken against this cord at fifty centimetre intervals with readings rounded to the nearest five centimetres.

Drilling into TPR was carried out manually using a soil auger. Depending on the degree of preservation, several holes were drilled across the width of TPR so as to identify any sub-surface structure in either the embankment or the canal. A stratigraphic log of each hole was compiled and related to the local site datum. A total of eighty holes were drilled into the embankment and canal.

## GENERAL DESCRIPTION OF THE NORTHERN TPR

The TPR canal and embankment run parallel with each other in a relatively straight line between the ancient cities of Si Satchanalai, Sukhothai and Kamphaeng Phet. The degree of preservation varies considerably along the length of the structure, but a number of generalizations can be made about the dimensions of TPR. The canal is typically eight metres wide although some sections are as much as ten metres in width. The embankment tends to be slightly wider, being generally between fifteen and twenty metres in width. The depth of the canal varies considerably along its length, although the trend is apparently for the channel to shallow towards the south.

Ancient occupation sites are found at various points along TPR, especially at Wat Yai, the area that Vickery (1991) has argued is the true site of the old city of Si Satchanalai (rather than at Kaeng Luang—see note 1). Remains of a former occupation at this site include temple ruins and ancient wells. Significantly, there is apparently a general lack of ceramic remains associated with TPR, except for a marked concentration of earthenware shards in the area of Ban Don Ko. Virtually no shards were encountered in auger holes in TPR.

## THE NORTHERN TPR

### Si Satchanalai–Ban Tha Wiset (Wat Yai)

The TPR structure is clearly identifiable at Sa Manora, approximately five kilometres from Si Satchanalai (figs. 1 and 2). The embankment is distinct in this area (cross sections 1–4, fig. 2), but north of Ban Sam Lum it is more discontinuous, becoming only poorly preserved as scattered mounds between one and two metres high in the northernmost area. The canal, on the

other hand, can be traced northwards to Khlong Nong Kham via ancient natural river channel remnants that have been connected by artificial channels (fig. 1; Bishop and Godley 1993). The meandering course of Khlong Nong Kham has been integrated into the moat system on the northern edge of the city wall of Si Satchanalai (fig. 1). Parts of the Khlong's course have also been enlarged and modified so as apparently to connect with an extensive *baray* and possible "kiln-and-quay" system at Ban Pa Yang, just outside the northern wall of the city (see below). At its extreme northern limit, TPR can also be traced to a canal that runs to Ban Ko Noi, the major tenth to sixteenth century A. D. ceramics production site (fig. 1; Hein 1986; Hein and Barbetti 1988; Barbetti and Hein 1989; Supajanya and Pongsripian 1993).

Prince Vajiravudh's (1907) map of old Si Satchanalai indicates that he would not have agreed with this reconstruction of TPR because he clearly shows TPR approaching the southern wall of old Si Satchanalai and entering the city via the great southern gate (the Ramnarong Gate). It is noteworthy that this route is meaningful only if TPR is a road; there are no canals along the route which ends at the city gate (crossing a moat, incidentally). The validity of the Prince's reconstruction is doubtful, however, because his map does not indicate the path of TPR between Sa Manora and Si Satchanalai, and we have found no signs of an appropriate course for this.

At Sa Manora the embankment and canal are adjacent, and they essentially parallel each other to Sukhothai. Initially, both embankment and canal are quite clear (cross sections 5 and 6), but as TPR continues south through Ban Na Phae, the embankment loses its definition, although the canal remains clearly visible and is generally between one and two metres deep (figs. 2 and 3). From a point approximately five kilometres south of Ban Na Phae, the TPR embankment has been graded in modern times and covered with laterite for use as a road. The canal has also been clearly modified by dredging to make it deeper and wider. In areas where excavation has not occurred, the canal tends to be shallower than it is through Ban Na Phae.

TPR retains this modified character as far as Ban Thanon Phra Ruang. Beyond this village it is even more modified, until it is eventually impossible to recognise. Since there is no sign of TPR diverging from the line of the modern road, we assume that this road continues to follow the track of TPR, as it does north of Ban Thanon Phra Ruang. This interpretation is supported by the fact that where the gravel road diverges from the expected straight course of TPR, there is no sign of either the embankment or the canal along a projection of the original alignment; the road must therefore be following a divergence in TPR from its general alignment.

An embankment on this general alignment can be discerned again on the northern bank of the Fakradan River as a broad low mound, of roughly the same width as that of TPR elsewhere, and about fifty metres long; but no canal can be identified (fig. 4). We interpret this as a small remnant of TPR which has been preserved because of its proximity to the bank of the Fakradan River. This proximity means that the embankment has presumably not been cultivated because of the poten-

tial for damage to, or loss of, agricultural machinery in the river. The mound is clearly cut by the Fakradan River (fig. 4), indicating that the current course of the river post-dates the construction of TPR<sup>3</sup>. TPR is found as an embankment from the southern bank of the Fakradan to Wat Yai. As on the northern bank, there is no clear sign of a canal. According to locals interviewed at the time of the reconnaissance, the embankment had only recently been graded and capped with laterite.

### Ban Tha Wiset (Wat Yai)–Ban Don Ko

A complex of embankments at the Wat Yai temple ruins resolves itself into three distinct mounds that head south towards Wat Bot from the general area of Ban Tha Wiset (fig. 4), and a fourth which vanishes before it leaves the Wat Yai area. The embankments are quite different from those found elsewhere, tending to be very wide with gently sloping sides. Only the central of the three mounds that extend beyond the Wat Yai area has a canal associated with it. Neither this middle embankment, nor the adjacent canal, actually enters the ruins of Wat Yai. Rather, the canal runs beside, but outside of, the temple wall. West of this central mound are two other mounds, one of which begins at the entrance to the old temple, passes through the modern Wat Yai temple grounds, and vanishes after a short distance. The second begins within the grounds of the Wat Yai primary school and continues to the south, vanishing as it enters land used for sugarcane.

While the locals strongly believe that at least one of these mounds extended south towards Wat Bot, there is no consensus as to which one represents TPR. One of these mounds is clearly identified by Prince Vajiravudh as part of TPR because he mentions following the TPR embankment between Wat Bot and the Wat Yai ruins. While discussing TPR during our reconnaissance, the Ban Tha Wiset village head indicated that prior to the construction of the western road (fig. 4), the remnant of TPR found on the southern bank of the Fakradan River continued south towards Wat Yai, under what is now the road. It might therefore have connected to the point of cross section C on the far western embankment. Based on this, it seems that this far western embankment is the most likely course of TPR. The function(s) of the other embankments remain(s) unclear.

On the eastern edge of the canal is a large rectangular enclosure formed by four broad and gently sloping embankments (cross sections A–A' and B–B', fig. 4). Several decades ago, a large, partially-buried, hollow tree trunk, about eight metres long, was discovered during cultivation in the northwest corner of this enclosed depression. No one remembers the exact location of the find but the local consensus is that it lay perpendicular to the embankment when it was exhumed. It seems likely therefore that this hollow trunk was a pipe between the depression and the canal. The depression must therefore be the remnant of a small reservoir which was used either to store water transferred from the canal, or to hold and store water for transfer into the canal.

The TPR is virtually impossible to recognise on the ground from the sugarcane fields at Wat Yai to Ban Mak Kasang (fig. 5),

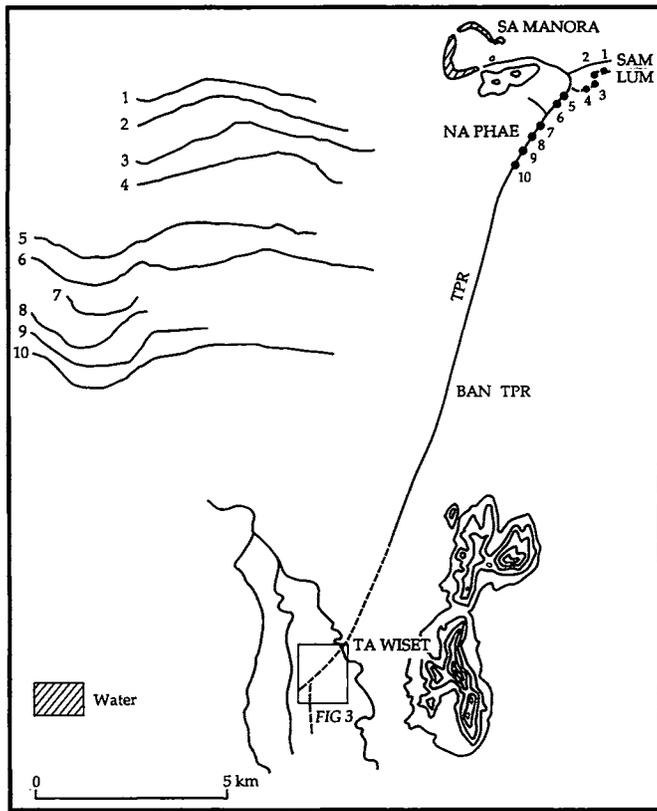
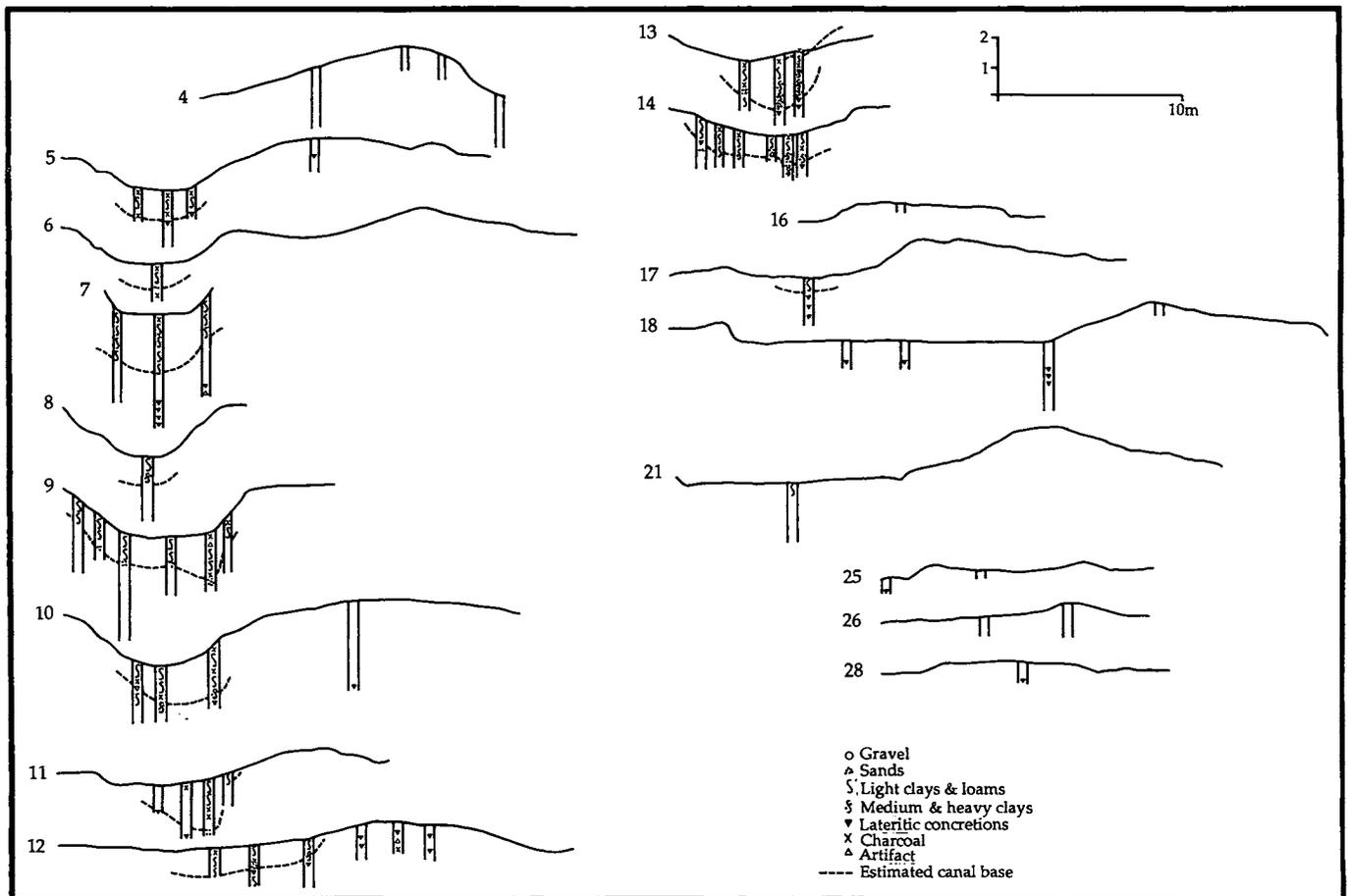
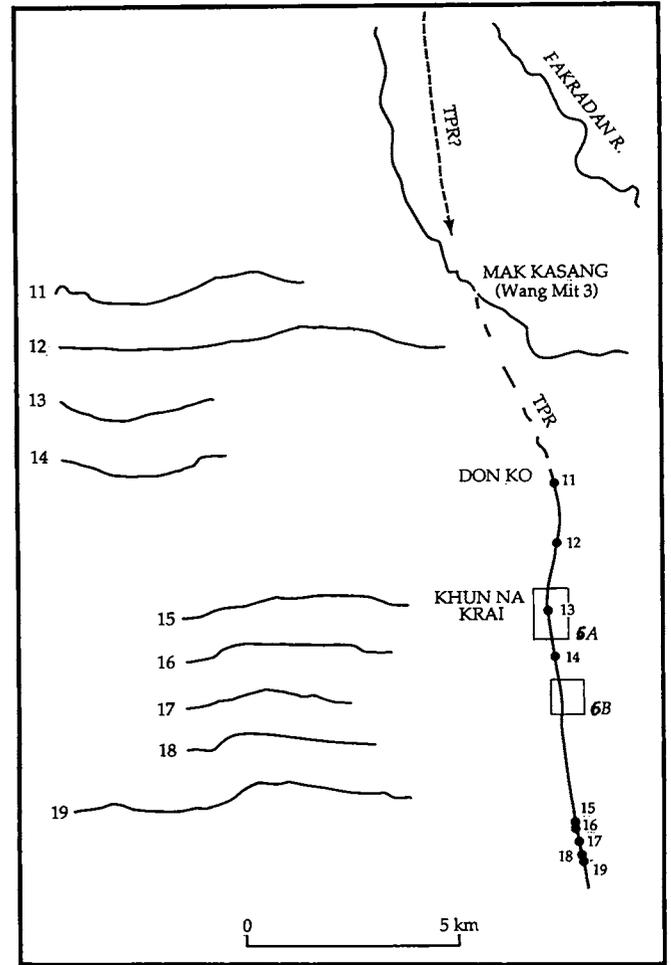
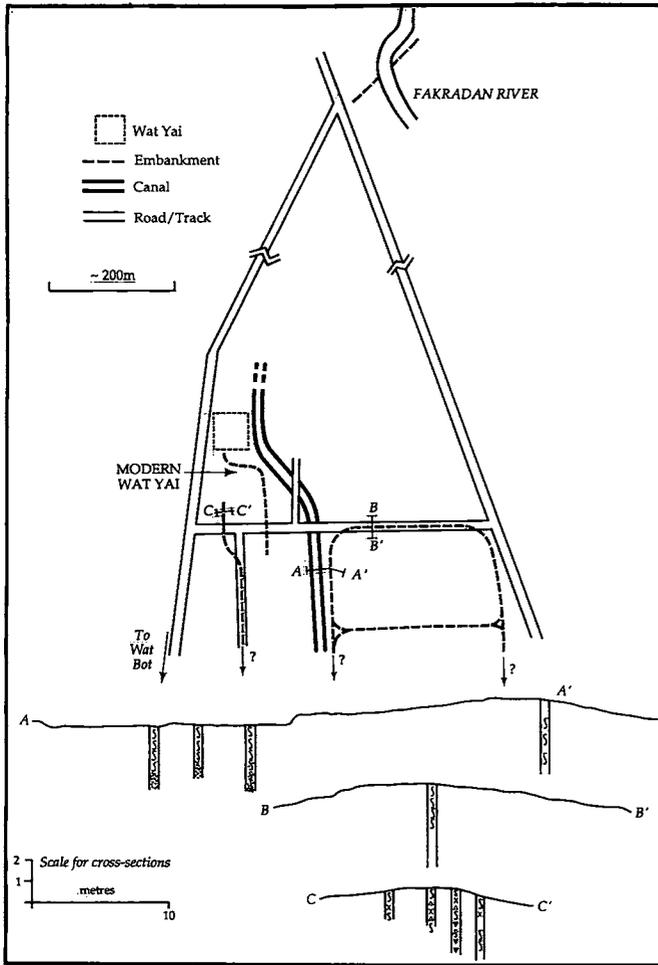


Figure 2. TPR and surveyed cross sections between Sam Lum and Ta Wiset. See Figure 3 for dimensions of cross sections and for sub-surface details.

Figure 3. Stratigraphic detail on surveyed and augered cross sections.

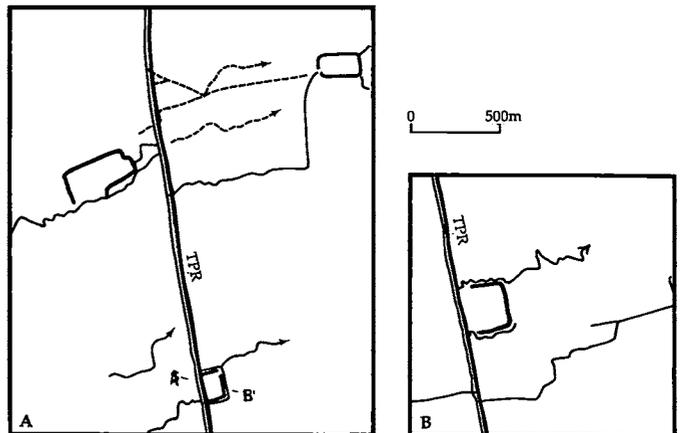




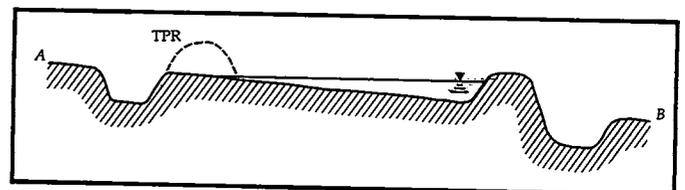
Above left  
Figure 4. Detail of TPR structures in the vicinity of Wat Yai.

Above right  
Figure 5. TPR and surveyed cross sections between Mak Kasang and Khlong Sa Wa. The dotted section of TPR is based on Supajanya's (1980) mapping from aerial photographs (see Figure 3 also). Labelled boxes refer to Figure 6.

Mid-right  
Figure 6. Detailed maps of sections of TPR showing reservoirs and small drainage channels in relation to the main structure (see Figure 5 for locations). Section along line A-B is shown in Figure 7.



Lower right  
Figure 7. Diagrammatic cross section of the reservoirs shown in Figure 6.



although it is remembered by locals. Indeed, some of the elderly recall being told of the visit of Prince Vajiravudh to the area. Others affirm that TPR passed through the area, but do not remember its exact position. At Ban Mak Kasang, there are scattered remnants of a low embankment that may represent TPR but poor preservation and extensive vegetation cover mean that we simply report here (fig. 5) the general location of TPR as mapped from aerial photographs (Supajanya 1980; Supajanya and Pongsripian 1993). TPR has been virtually completely destroyed between Ban Mak Kasang and Ban Don Ko, having been graded into the fields to allow easy tractor access. While both the embankment and the canal exist in living memory, there is no longer any visible sign of TPR once having passed through this area. Those who remember TPR say that it once headed in a relatively straight line from Ban Mak Kasang to the point now occupied by the sale yards at Ban Don Ko. It is also noteworthy (cf. Vickery 1991) that there are a number of old laterite and brick-lined wells in the Ban Mak Kasang vicinity.

### Ban Don Ko—old Sukhothai

Between Ban Don Ko and old Sukhothai, TPR was, until recently, quite well preserved as an embankment between one and two metres high, paired with a broad, one metre deep channel (figs. 5 and 3). This canal is somewhat infilled, with the base of the sedimentary infill being marked by an abundance of organic matter and, in a few localities, earthenware shards. Unfortunately, the quantity of organic matter recovered from any one auger hole in the canal was not sufficient for radiocarbon dating. It is also noteworthy that earthenware shards are generally abundant on the surface of TPR and the adjacent ground surface throughout much of the section immediately to the south of Ban Don Ko, but no stoneware shards were found during the reconnaissance.

In this section, TPR is not straight but somewhat sinuous. This sinuosity has a wavelength of 100–200 metres and an amplitude of fifteen to twenty-five metres, gently swinging from one side of the modern road to the other. Where the embankment has been graded or cut in modern times, the sections show it to be homogeneous and comprising very compact, dry heavy clays. This material is generally consistent with (and therefore presumably derived from) the surface material of the surrounding fields.

There are a number of other interesting features associated with TPR in this section. In particular there are a number of what appear to be small, shallow reservoirs that were apparently constructed by the building up of low embankments to trap water (figs. 5 and 6). They are of two types: type A abuts TPR whereas type B is found adjacent to, but somewhat removed from, TPR. The type A reservoir tends to be smaller, more regular in shape, with clear right-angled corners and its long axis parallel to TPR (fig. 6). The outflows of both types of reservoir seem to have been controlled by a single gap (a sluice gate?) in the embankment on the down-slope side. The deterioration of the reservoirs has resulted in the escape of water into

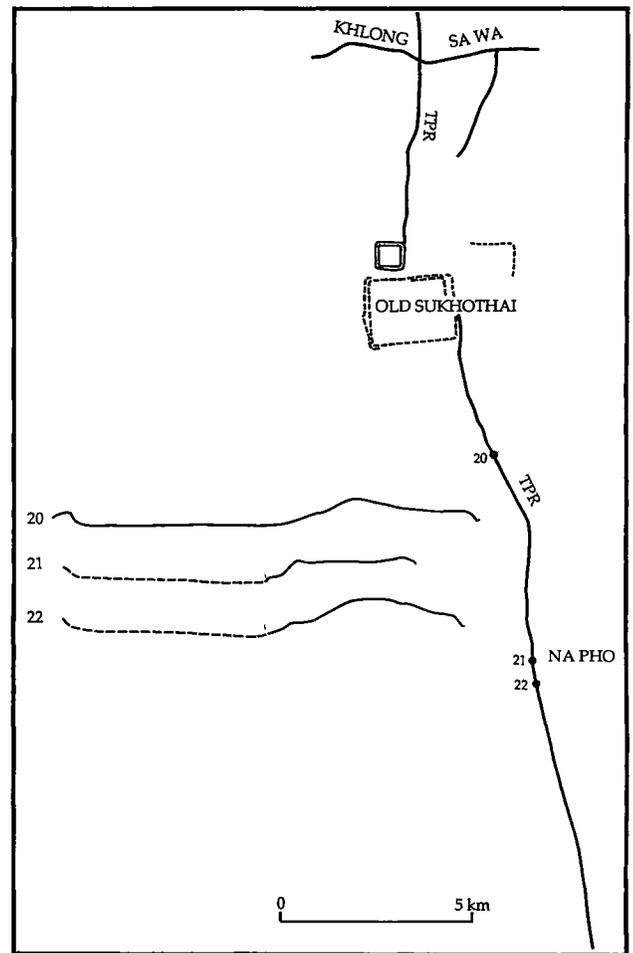


Figure 8. TPR and surveyed cross sections between Khlong Sa Wa and Ban Na Pho (see Figure 3 also).

the encircling ditches from which the material to form the walls of the reservoir embankments was excavated (fig. 7).

The displacement of small drainage lines as they cross TPR may indicate that the reservoirs that abut TPR predate its construction. Although it is also possible that the reservoirs which are adjacent to TPR may also be older, it seems more likely that they are either contemporaneous with, or post-date the construction of TPR.

### Old Sukhothai—Phran Kratai

The characteristics of TPR change quite dramatically south of old Sukhothai. When it is initially re-encountered, after leaving the walls of the city, the canal morphology has changed from narrow and relatively deep to wide and shallow (sections 20–23, figs. 8 and 3). Auger holes drilled across the width of the canal encounter lateritic concretionary gravel about half a metre below the current ground surface (fig. 3). These concretionary deposits overlie the heavy clays that are found throughout the

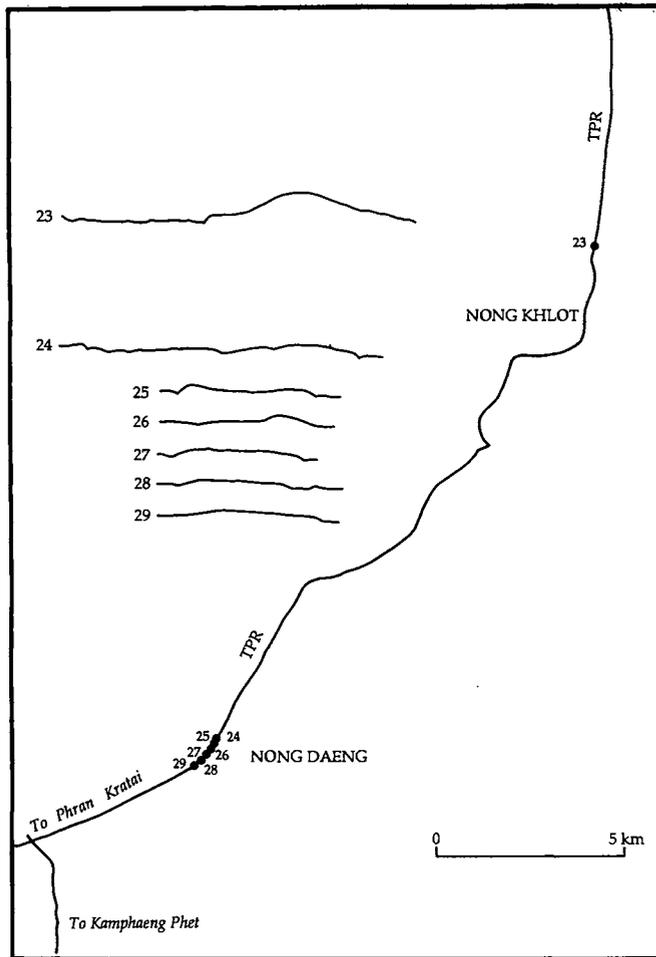


Figure 9. TPR and surveyed cross sections between Nong Khlot and Nong Daeng (see Figure 3 also).

region, suggesting that the current form of the canal (namely, wide and shallow) is indicative of its original form and does not represent the effects of the infilling of a previously much deeper channel. This section of the embankment is also noteworthy for being rather more pronounced than elsewhere, with the exception of the Ban Sam Lum area in the north (cross sections 1–4, fig. 2). In particular, it is higher than elsewhere and exhibits steeper and more clearly defined edges. Sections cut through the embankment show that, as elsewhere, it consists of a rather homogenous and massive (structureless) mix of dry and compact heavy clays.

Both the embankment and the canal survive discontinuously in this state to just south of Ban Na Pho. From Ban Na Pho south to Nong Klot, a road has been constructed on top of the TPR embankment, as is the case north of old Sukhothai, and the TPR embankment has been covered by material dug from both sides in order to elevate the road above the surrounding ground level. These works have obliterated the shape and form of both embankment and canal for nearly all of its length between Ban Na Pho and Nong Klot.

The next point at which TPR is clearly identifiable on the ground is at Nong Daeng, on Highway 101 between Kamphaeng Phet and Sukhothai (cross sections 24–29, fig. 9). Although it is clear from aerial photograph surveys (Supajanya 1980; Supajanya and Pongsripiyan 1993) that this is part of TPR, it is very difficult to find visible surface signs of a canal at Nong Daeng. The TPR is preserved therefore as a broad low embankment that rises approximately forty centimetres above the surrounding ground surface (fig. 9) and is covered by a loose scattering of lateritic concretionary gravel. Deflation of the embankment to its present shape by water and wind action is consistent with both the surface concentration of lateritic gravel and the embankment's low elevation, implying that the embankment at Nong Daeng has lost nearly all of its original height. The embankment width at Nong Daeng is similar to the width of TPR elsewhere. It is impossible to follow TPR with any confidence beyond Nong Daeng towards Phran Kratai because the embankment becomes indistinguishable from other undulations found in the fields.

### Phran Kratai–Kamphaeng Phet

Immediately south of Phran Kratai, as at many other locations, TPR has been recapped with gravel and lateritic concretions dug from either side of the road, rendering it difficult to distinguish any of the features of either the old road or its adjoining canal. TPR near Kamphaeng Phet was not examined because of irrigation works under the auspices of the King's Project of Khlong Tatongdang, undertaken by the Royal Irrigation Department (RID) between 1981 and 1985. These works exploited Khlong Tatongdang and Khlong Houywai, the courses of which apparently represent the course of TPR (Supajanya 1980). These areas were not examined as part of this survey because it seems likely that the work undertaken by RID would have disturbed or changed features of TPR associated with these creeks.

## CAN THANON PHRA RUANG HAVE BEEN A ROAD ?

Despite the tradition of its name, the presence of an embankment along its route, and the assertion by many (e.g. Van Liere 1989) that TPR is a highway, several aspects of its character and immediate environment seem to contradict its having been used principally as a road, particularly to the north of old Sukhothai. The first is that in pre- and proto-historic times in Thailand, lines of communication for wheeled or foot traffic were not built up as elevated roads, as they are now (Supajanya and Pongsripiyan 1993). Even in the unlikely case that TPR was a road built up in this way, it would be expected that material to build up the road surface would have been dug from either side of the course of the road, as is the common modern practice. Excavating in this manner would serve several purposes. Firstly, it would be less demanding to obtain the material for road construction from the two sides because the ditches would need

to be only half as deep. The physical manifestation of this would therefore be a relatively shallow canal or ditch on either side of the embankment on which the road was located. Yet along the length of TPR there are no signs of there ever having been two ditches forming an integral part of the TPR structure.

Secondly, a ditch on either side of the road would aid drainage and therefore minimise the potential for flood damage. While the directness of the route taken by TPR between Sukhothai and Si Satchanalai minimises the distance covered, and therefore makes some sense for a road, it also makes equal sense for a canal. Moreover, the landscape setting of TPR between Sukhothai and Si Satchanalai appears to be inconsistent with its having been a road. For much of its length, the embankment of TPR passes through low-lying ground, often running along the banks of streams. During the heavy rains of the wet season these rivers often overflow their banks, thereby rendering an adjacent road liable to flood damage by erosion. And even if the rivers did not damage the embankment, water would drain to the low ground during the wet season. Either could subject a road to inundation and possibly damage its structural integrity.

Accentuating this problem is the universal location of the embankment on the downslope side of the canal. Supajanya (1980) and Jumsai (1988) both noted that the embankment appears to have been placed so that runoff could be captured. That is, the embankment effectively acted as a dam, and in the event of a breach in the embankment, the body of water held behind the embankment would probably have caused significant damage to the embankment. This would have effectively closed a road until water levels had subsided and repairs to the damage could be carried out. Locating a road embankment on slightly higher ground would have greatly reduced the risk of such a breach, and the level of maintenance required to keep the TPR open as a road would have been similarly reduced. Such a diversion would have required the addition of only a few kilometres to the overall length of the TPR. In short, the siting of TPR north of Sukhothai is not optimal if the structure represents a road.

## CAN THANON PHRA RUANG HAVE BEEN A CANAL?

It is well known that major water works, including extensive *baray*, pond and water harvesting systems, are integral to old Sukhothai (Jumsai 1988) and they have been recently identified at old Si Satchanalai and its associated ceramics production centre (Hein 1986; Hein and Barbetti 1988). Moreover, TPR between these two centres clearly exhibits a dug canal. The maintenance of the Sukhothai and Si Satchanalai water works must have involved significant infrastructure, which Jumsai (1988) attributed to Khmer efforts before the Thai kingdom of Sukhothai was established. Siribhadra and Moore (1992) have recently reiterated the important role that water and its management played in Khmer culture. Jumsai (1988) described TPR

as "ancient ... bunds leading away from the city" and noted that it would have had a simple hydraulic diversionary function as part of the water harvesting infrastructure, whatever its other functions.

Canals are explicitly mentioned from the Sukhothai era in Inscription XI (1360s) in which King Luthai is reported as constructing a canal from Phitsanulok to Sukhothai over a distance of some sixty kilometres (Gosling 1991). Unfortunately, no trace of this canal remains, and it is also unclear whether the report of the canal construction is factual (Gosling 1991). Even if it is not, the mention in the inscription nonetheless implies that the construction of a canal of the dimensions of TPR (sixty kilometres from either Si Satchanalai or Kamphaeng Phet to Sukhothai) was not an unreasonable undertaking for the time.

If TPR north of Sukhothai was a canal, at least three explanations for its construction can be suggested: 1) a means to divert and collect water for domestic or possibly ritual use; 2) an irrigation system; and/or 3) a means of transportation and communication.

## Water Collection and Diversion

Sukhothai is not located on the banks of a major river, unlike Kamphaeng Phet and Si Satchanalai (as traditionally understood—Vickery 1991), and a reliable supply of water must surely have been an issue for the city, particularly during the dry season. This makes sense of Sukhothai's location at the topographically lowest point of a canal along TPR (Supajanya 1980; Supajanya and Pongsripian 1993), as the city must have been the ultimate destination of any water within the system. Ironically, while it seems unlikely that the lack of adequate water would have been a problem during the wet season, during the dry season, when an external supply of water would have been most needed to maintain the extensive complex of ponds and *baray* at Sukhothai, the TPR system would probably have been quite inefficient, given the high evaporation rates and the low rainfall that characterise the dry season (Meteorological Department 1987). Loss of water would have been accentuated by the large surface areas and shallowness (low capacity) of both the canal and the reservoirs.

Large quantities of water would therefore have been needed to ensure that more than a trickle arrived at Sukhothai. This apparent shortcoming of the canal interpretation makes sense of a range of features at the northern end of TPR. Recent reconnaissance by Don Hein (personal communication) in the Ban Ko Noi–Sarajit area at the northern end of TPR suggests that major water harvesting infrastructure was developed in this area to maintain the water levels in the system (see below). This remains to be demonstrated definitively by further field work, but without such water harvesting, it seems unlikely that TPR could have supplemented Sukhothai's water supply. That is, if TPR operated without augmentation, it would have supplied a steady and reliable source of water when it was least needed.

TPR may have been designed to do the reverse, namely, to deal with the problem of excess water during the wet season, rather than not enough during the dry. In this case, TPR could

have functioned quite efficiently, draining excess water towards Sukhothai where it is likely to have ended up in the large *baray* of the city. Overflow would have been allowed to drain into the streams that flow to the Yom from Sukhothai (fig. 1).

It is, of course, quite possible that it fulfilled different roles at different times of the year. One possible scenario is that TPR was used as a means to maintain a constant supply of water in Sukhothai during one season and to provide water for local use during the other. This water would have been stored in the large *baray* that surround Sukhothai and in the smaller local reservoirs along the length of TPR. This water management could have served several purposes. Through the wet season, water, surplus to the needs of those along the length of TPR, could be diverted downstream, eventually ending up in the *baray*. Any water in excess of that needed by the people of Sukhothai could be released to the Yom. This would considerably decrease the risk of local flooding along the length of TPR by acting as a drain for excess water, thereby minimising the potential damage to crops. This concern for agricultural productivity, and the potential for damage posed by excessive flooding of rice seedlings during the early stages of the wet season, could well have justified the considerable efforts expended on infrastructure such as TPR, particularly in the context of royal ceremonial cities of the size of Sukhothai and Si Satchanalai.

By the end of the wet season, the *baray* would have had the benefit of this greatly increased catchment area. They would have had a far greater chance of being full at the onset of the dry season, thus ensuring that there would be water remaining at the end of the dry season. Throughout the dry season, on the other hand, TPR could have acted both to collect and to direct the remaining water, particularly from the catchment areas to the north.

### Irrigation and/or Transport–Communication

Bruneau (1973) mapped ancient land use patterns in the Sukhothai–Si Satchanalai–Uttaradit area from aerial photographs and noted that extensive portions of the area show a pattern of small irrigated rice fields dating, he suggested, from the twelfth to fourteenth centuries (see also Van Liere 1989; Supajanya and Pongsripijan 1993). Bruneau (1973) explicitly interpreted parts of TPR as a canal and saw it as the key element of an irrigation system used to supply water to this "chequerboard" of small, ancient rice fields whose orientations were apparently determined by that of the canal. From aerial photographs, the pattern and tone of these small fields are clearly distinguishable from the pattern and tone of the present, much larger fields, which also have a completely different orientation from the older fields (Bruneau 1973; Supajanya and Pongsripijan 1993).

Siribhadra and Moore (1992) have recently argued that there is little evidence that the massive water management schemes associated with Khmer settlements, both in ancient Cambodia and ancient Thailand, were associated with irrigation. This would seem to indicate that if TPR were indeed originally a Khmer project, as Jumsai (1988) has suggested it

must be, it was not associated with irrigation. This is too simplistic an interpretation, however. Despite Jumsai's (1988) assertion that Thais could not have successfully administered TPR, we see no reason to conclude that Thai administration of TPR could not have succeeded its initial construction by Khmer authorities, with the Thais locally using it for irrigation. For example, an inscription at the base of a Shiva image found in Kamphaeng Phet, and dating from A. D. 1510 contains a brief account of the renovation of that city in the early sixteenth century A. D. Part of this so-called "Inscription XIII" reads:

One other thing ... Since the *thor* (ท่อ–canal) which had been built purposely by Pu Phraya Ruang (ปู่พรญา Ruang) to bring water to Bang Phan had become silted up, our people had to depend solely upon rain water for the rice fields. But now as the *thor* had been discovered and dredged up, they no longer practised rain-fed, but irrigated, rice cultivation (quoted by Supajanya and Pongsripijan 1993, 18).

In the Ban Ko Noi area, aerial photographs reveal old artificial channels that follow the contour, at one point using an aqueduct to cross a natural water course. The range of uses of these artificial channels awaits further work, but would appear to include water harvesting and transport (Hein 1986; Hein and Barbetti 1988, and unpublished data). The apparent lack of an irrigation distribution network in the Ban Ko Noi area, the extremely close connection between the canal and the "kiln-and-quay" system at the sixteenth century export ceramic production site of Ban Pa Yang, and the connection of TPR to a canal that runs through to the Ban Ko Noi ceramics production centre (Supajanya and Pongsripijan 1993), suggest that the water works at this locality may have constituted, almost exclusively, a water-harvesting and/or transport system and that the system did not have an irrigation function (Hein 1986; Hein and Barbetti 1988). The volume of ceramics that was transported from the Ban Ko Noi and Ban Pa Yang production sites to Sukhothai (especially large architectural pieces—Guy 1989) and beyond (especially to insular Southeast Asia, as well as to India and the Middle East), and the length of time for which this transport took place (Guy 1989), seem to demand an efficient transport system that was not subject to excessive interruption or disruption. It is tempting to suggest that TPR filled this function, particularly as there is apparently a clear connection from the Ban Pa Yang and Ban Ko Noi production sites via Khlong Nong Kham to TPR (Hein and Barbetti 1988). This could have been the main means of transporting the export ceramic wares to the south, thereby avoiding the rapids (Kaeng Luang) and laterite outcrops in the Yom River in the vicinity of the old city. Both of these would have made ceramics transport difficult at times of low flows, with times of high flows being also quite treacherous due to the river's high flow velocity and turbulence.

The general paucity of ceramic shards encountered during our reconnaissance poses difficulties for an interpretation of the TPR system as a transport canal. It would be expected that

accidents and general movement of goods and people along the canal would have resulted in the accumulation of significant amounts of waste material in and about the canal. Shards can certainly be found in some fields adjacent to the canal, but these are probably simply associated with general occupation along TPR. Moreover, we failed virtually completely to recover any in our auger drilling of TPR itself, and it has been recently observed (Don Hein, personal communication) that material being dredged from a very conspicuous remnant of the northern TPR canal between Khlong Nong Kham and Ban Saen To, close to the ceramics production sites, is also virtually free of shards.

In summary, therefore, it appears that the northern part of TPR can fruitfully be interpreted as a canal–water management system, but the balance between the uses of TPR for irrigation, for water collection and movement, and for communication and transport remains to be clarified. On the basis of the connections between the structure and other features in the Ban Ko Noi area, it would seem reasonable to suggest that the northern parts of the canal system were used to transport ceramics away from the Ban Ko Noi–Ban Pa Yang export ceramics production centre, but this is yet to be reconciled with the virtually complete lack of evidence for ceramic transport in the canal system

## CONCLUSION

The TPR feature is a major engineering structure that runs for more than 120 kilometres across the upper Central Plain of Thailand between Kamphaeng Phet and Si Satchanalai. It seems to be "focused" on old Sukhothai, in that it falls towards the town from both the north and the south, and old Sukhothai was an extremely important centre in the time that TPR was thought to

be operating (although this time remains to be established by independent dating).

A range of characteristics suggests to us that the northern TPR between Si Satchanalai and Sukhothai functioned as a canal. These include its overall form, including the relationships between its canal and embankment elements, its landscape setting (commonly crossing low-lying, flood-prone land and/or being located adjacent to rivers), and the presence of reservoirs and ponds along its length. Its relationship with ceramics production centres and probable water harvesting infrastructure at its northern extremity, and the apparent unlikelihood of river transport of large volumes of export ceramics across Kaeng Luang at old Si Satchanalai, are suggestive of a transport function for TPR, but the lack of associated shards seems to constitute a strong counter-argument. Our current interpretation is that the purposes of the northern TPR were probably communication, perhaps delivery of water to Sukhothai, and possibly drainage of water from along the length of the canal. Reservoirs and ponds along the system were apparently used to maintain levels of water which had been gathered from as wide an area as possible. On the basis of the apparent lack of distribution channels along the length of TPR, we do not, at this stage, envisage a major irrigation function for the canal system.

It is a great shame that highway construction has compromised the integrity of the best preserved section of TPR. We feel that the oral tradition of the villagers of Ban Na Phae, namely that voices can be heard in the night on the canal discussing a journey of one week's duration, accompanied by the sounds of boats being dragged along the canal, is closer to the reality of the function of TPR than is the tradition of the villagers of Ban Ko Noi. Unfortunately, damage to the structure means that it may never be possible to test more fully these alternative hypotheses concerning the nature and functions of TPR.

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## NOTES

1. Vickery (1991) has recently argued that the traditional location of the ruins of old Si Satchanalai, or simply Si Satchanalai in common current [and our] usage, on the west bank of the Yom River at Kaeng Luang (the "Royal Rapids") is incorrect. According to Vickery, these are the remains of the population centre of Chalieng-Sawankhalok, and the remains of the city of Si Satchanalai are to be found in the deserted habitation areas and ruined temples at Wat Yai on the Fakradan River, 20 km to the south of Chalieng-Sawankhalok (fig. 1). For convenience, we will continue the former usage, without judging the validity of Vickery's argument.
2. Unfortunately, while this field work was undertaken, a highway connecting old Sukhothai and Si Satchanalai was constructed by the Highways Department of Thailand. This new highway has been constructed along the length of the old TPR between Sukhothai and Ban Don Ko. While this highway will forever preserve the memory of Thanon Phra Ruang, it is a pity that this section of TPR has been destroyed, as it preserved better than any other section the original shape and form of TPR. We have now lost a remnant of an impressive engineering feat, no matter what its original function was. As Prince Vajiravudh (1907) wrote, "If we let people destroy this road stupidly, it will disappear soon. No one can tell where it was. And one of the evidences of ancient Thai civilisation will disappear."
3. Vickery (1991) also reports on changes in the course of the Fakradan River in relation to the founding of habitation in the vicinity of Wat Yai (his location for Si Satchanalai).

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