

TECHNO-TYOLOGY IN THAILAND: A CASE STUDY OF THAM KHAO KHI CHAN

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INTRODUCTION AND THEORETICAL PERSPECTIVES

Thai prehistory is facing both a difficult and an exciting time, difficult because old terminology and concepts are proving confused and exciting because new forms of sites and industries have recently been discovered (Bronson and Natapintu 1988; Prishanchit 1988; Anderson 1988). The new finds only serve to underline the difficulties of the existing framework. It is with this challenging time in mind that I describe here a 'Hoabinhian' assemblage excavated in 1985 from Tham Khao Khi Chan, Surat Thani Province. In entering into this confused field I bring with me experience both in lithic technology (I have been a knapper for ten years) and in the typologies of Europe (Reynolds 1988). This experience has proven valuable in tackling the Thai material because many of the problems faced are common to the study of all lithic industries – the recognition of useful units of information, their description and their interpretation.

Historically, two main approaches to the study of lithic assemblages have been employed by prehistorians. The first is the culture-historic method which relies on the concept of 'style'. Similarities in artefacts and assemblages are interpreted as reflecting social proximities – contact, trade, and migrations – and assemblages are regarded as the material representations of ethnic groups. Suffice it to say that this approach has a number of limitations. The second approach to the classification of lithic assemblages revolves around the identification and discussion of past behaviour. This generally leads to a concentration upon function – either through assumed functional types (e.g. Bordes 1961), or by examination of use-wear (Semenov 1964). The former can lead to a focus upon only part of the assemblage while the latter is very time-consuming and can also result in a focus upon small samples.

Assumed functional types, like discussions of style, face the drawback that there are no necessary linkages between artefacts and their interpretations. Pieces can overlap considerably in morphology yet can be used in different ways for a variety of purposes, and a single piece can have more than one use. Factors such as raw material availability, variations in economy, manipulability, and nature of the raw material all need consideration. A functional classification based upon experiment and the analysis of damage patterns can be informative

of behaviour, but existing methods and results, particularly of the so-called 'high-power approach', have recently been questioned (Newcomer *et al.* 1986). The time and resources necessary for such studies ruled out their use in the analysis reported here.

A variant approach within the behavioural 'school', however, does have utility. This is based on technology, and when applied to classification it may be termed techno-typology. It concentrates upon how things were made and also has the advantage of being applicable to whole assemblages, to different raw materials, and to different times. Studies of technology can illustrate the constraints of stone raw materials and also the preferential selection of raw materials and tool blanks even within generally 'amorphous' industries. The techniques are widely applicable and need not preclude more problem-orientated studies and further classification by those interested in either style or function.

It should be stressed that the system of techno-typology used here is necessarily general and provisional. I cannot claim any great originality for the scheme, and most if not all of the categories have been used before. Further refinement of the system with its wider use is not only possible, but likely. The system uses the term 'class', not 'type', to emphasise the variability within groups of generally similar pieces and so avoids problems of stereotyping pieces with 'mental templates'. There is no single correct typology, and choices must be made according to research interests.

THE TECHNO-TYPOLOGICAL SYSTEM (TABLE 1)

The first basic distinction occurs between natural stones and artefacts. Natural stones are unmodified pieces and there are two classes; *manuports* which are non-local unmodified pieces assumed to have been introduced by human agency, and *natural stones* which are local pieces without modification. Artefacts are defined as pieces with modification and again two classes exist; pieces modified by percussive use only, and pieces modified by deliberate shaping or reduction. Within the former class those with battering and pitting on the periphery are termed *hammers*, and those with such damage and possible hollowing centrally located are known as *anvil-hammers*.

The deliberately reduced or shaped class is subdivided into four subclasses; edge-ground pieces, flaked pieces, flakes and debris. The first of these contains three further subclasses; *edge-ground pieces*, *flaked and edge-ground pieces*, and *polished pieces*. The second class, flaked pieces, should show only negative flake scarring and consists of two further subclasses; *cores* and *core-tools*. Cores are pieces flaked to produce blanks for use; these should not show any utilisation damage but may exhibit platform preparation. Cores can be further classified by the numbers of platforms, the directions of flaking, and also by size. Core-tools are flaked pieces that exhibit use damage and may be further subdivided according to the location and form of the damage.

Four specific subclasses of core-tools are recognised, the first three because they already exist in the literature, and the fourth because it is a form that appears frequently in Southeast Asian industries. These subclasses are *choppers* – unifacial pebble tools with trimming restricted to one side or end; *chopping tools* – bifacial versions of choppers; *unifaces* – unifacial pebble tools trimmed around most or all of their margins, and *steep-edged pieces* –

pieces which exhibit steep unifacial flaking often with many step-terminated flake scars (Figure 1). The platforms of steep-edged pieces from which the flakes have been removed are battered and often the origins for the scars are obscured. Platform edges are very steep, but I avoid using specific measurements because they are extremely difficult to record consistently (Dibble and Bernard 1980; Reynolds 1988), and it is also debatable how useful such measurements are. Additionally, it might be argued that edge angles vary greatly along a piece, so single edge measures are not very representative. The case for pragmatism here is strong and a steep-edged piece may be recognised by a series of features of which an edge angle over 75° is only one.

Flakes are pieces that have been struck off other pieces. Ideally, they should possess platforms, bulbs, concentric ripples and a bulbar scar, but these features vary according to the force of the blow, raw material, hammer weight, nucleus size and shape, and platform preparation. There are three main classes of flakes; *retouched* – these are flaked flakes, *utilised* – flakes which show wear features such as edge smoothing, worn arrêtes, irregular micro-flaking etc., and *plain flakes* which are unmodified. Within the flake classes subdivisions may be made according to the presence and amount of dorsal cortex. Flakes with the dorsal surface entirely covered with cortex are *primary flakes*, pieces with some dorsal cortex are *secondary flakes*, and pieces lacking cortex are termed *tertiary flakes*. Consistent morphologies within these classes should be looked for. Further pieces of technological interest within the flake class as a whole are *core-edge trimming flakes* removed to refresh a worn platform edge; *core tablets* which removed an entire old platform; *crested pieces* which show flaked main arrêtes on their dorsal surfaces (this flaking can be bi-directional), and *plunged flakes* that ‘overshot’ the core base when they were removed and so took a part of the core base with them. Such plunged flakes appear to make up Anderson’s category of ‘gouge-like pieces’ at the site of Lang Rongrien (Anderson 1988).

The final modified class is *debris*, which includes shatter fragments which will exhibit shear and shatter facets, and broken pieces. Amongst the broken pieces are *broken cores*, *broken pebbles*, and *broken flakes*. The broken flakes may be subdivided into *proximal fragments* which have platforms, *distal fragments* which have flake terminations but no platform, and *indeterminate fragments*, being those pieces on which the flaking direction cannot be determined.

The proportions of each techno-typological category within an assemblage should indicate the nature of the reduction strategy, show whether certain pieces were selected for use elsewhere, and give a general indication of activities carried out on the site. The classification presented is deliberately general so it can be widely applied. It provides basic behavioural information and is a system that can supply the starting point for more problem-orientated studies. In the following example the system is applied to excavated material from the site of Tham Khao Khi Chan in southern Thailand.

THE SITE

Tham Khao Khi Chan is a cave site in Surat Thani Province, southern Thailand. It was excavated by Tharapong Srisuchat and members of the Thai Fine Arts Department as part of a

salvage project for a period of two months in early 1985. The cave is situated at 70m above sea level overlooking a valley floor at 45-50m above sea level. It has two openings, both facing east, and the excavations took place in an alcove of the more northerly one. A trench of 2x3m (TP-1) was initially opened and excavated in spits of 10-15cms. This was subsequently expanded to the wall of the alcove and the new area was dug by stratigraphic layers and labelled NTP-1. In area, NTP-1 was about the same as TP-1. The depth of deposit was approximately 2.60m, at which depth a dripstone pan was reached. Radiocarbon dates were processed by the Thai Office of Atomic Energy for Peace, and are listed by Srisuchat (1987:106). No details of materials dated are known (i.e. whether bone or charcoal), but laboratory dates (presumably uncalibrated) are 4760 ± 150 , 5090 ± 120 , 5620 ± 200 and 6070 ± 170 BP.

THE ANALYSIS

Although a total of five habitation layers was excavated it was not possible to separate out the material from habitation layers 2-4 because of the convoluted stratigraphy and the excavation by spits. The units used for analysis are, therefore, habitation layer 1, an admixture of habitation layers 2-4, and habitation layer 5. Artefact classes present in each of these layers are set out in Table 1. The category of 'axes' was added for a number of pieces of uncertain function bearing bifacially stepped-back flaking (Figure 1); if this flaking was not the result of deliberate retouch then they could have served as hammers, although this was often difficult to determine.

RESULTS

Tables 1, 2 and 3 demonstrate the compositions of the three assemblages. They may be seen to be patterned, not in terms of formal tool types, but in terms of certain general classes such as flakes and steep-edged pieces. This may reflect a division of aims in that the heavy-duty steep-edged pieces are likely to have served in scraping, planing and chopping activities whilst the flake element provided materials for scraping, cutting and sawing. This pattern has been noted elsewhere in Southeast Asia, particularly at Niah Cave (Malaysia), where pieces were classified as heavy-duty and light-duty tools (Zuraina 1982). This distinction is worth making because it corrects old views of Southeast Asian industries as a 'chopper-chopping tool' complex. Indeed, no true example of a chopping tool has presented itself to me in any of the Thai assemblages viewed. The term 'pebble tool complex' would be a better description. It should also be stressed that flakes comprise a large part of the Tham Khao Khi Chan assemblages. These are not just bi-products from the manufacture of core tools because retouched and utilised examples occur.

This study also highlights the subclasses of flake forms in terms of the percentage of dorsal cortex. This is particularly useful for the so-called Hoabinhian where it has been argued that the retention of cortex is a major consideration. This is clearly the case for the steep-edged pieces, but examination of the flake component shows that if utilised flakes are considered the ratio of those with dorsal surfaces covered with cortex and those with none at all is 1:1. Thus, no selection for cortical pieces is here visible.

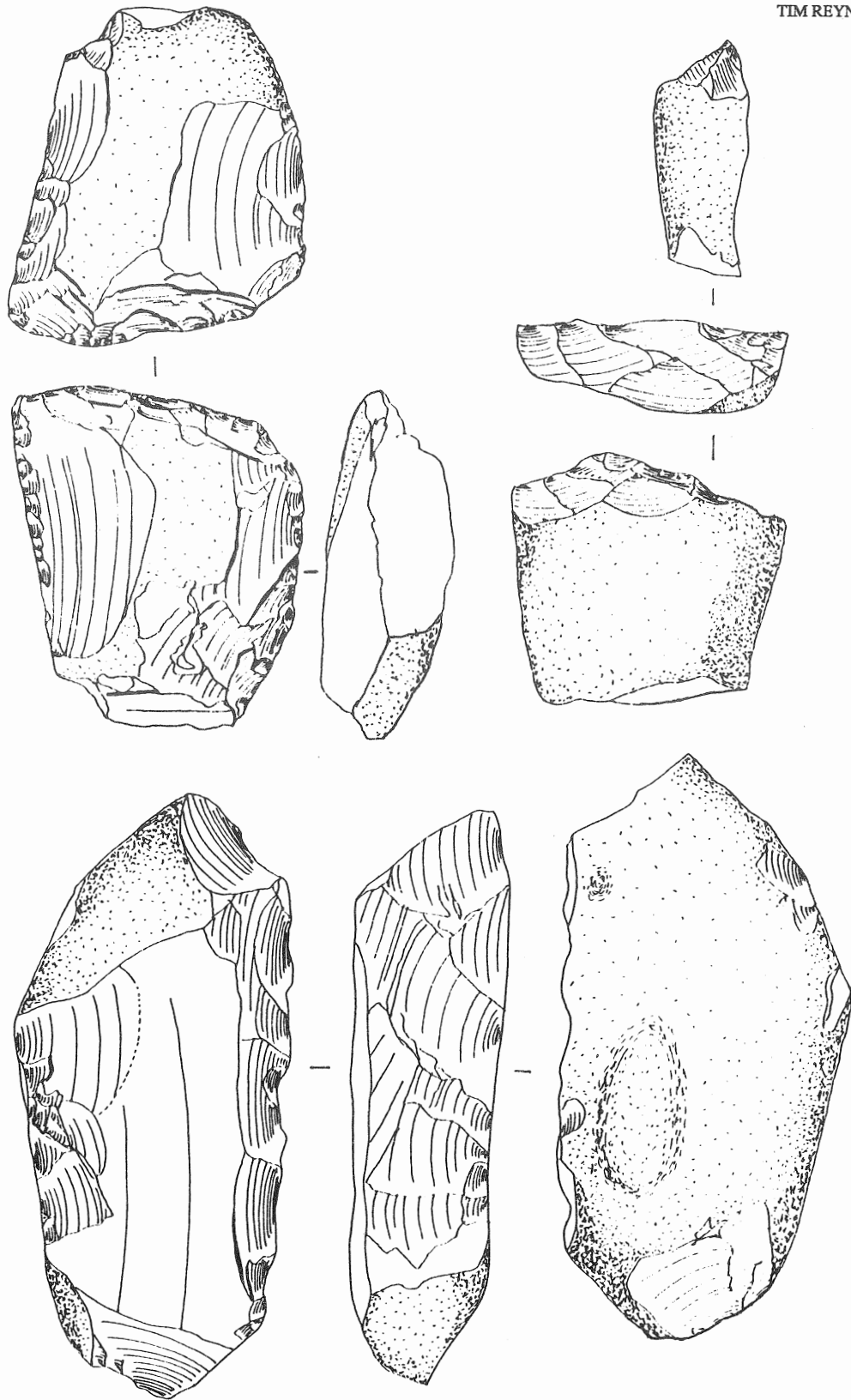


FIGURE 1: ARTEFACT CLASSES FROM THAM KHAO KHI CHAN. LEFT, STEEP-EDGED PIECE; TOP RIGHT, BIFACIALLY FLAKED 'AXE';
BOTTOM RIGHT, PEBBLE CHOPPER. 60% OF NATURAL SIZE

(1)	Manuports			
(2)	Local natural stones			
(3)	Hammers			
(4)	Anvil hammers			
(5)	Edge-ground pieces			
(6)	Flaked and edge-ground pieces			
(7)	Polished pieces			
(8)	Single platform and direction cores			
(9)	Single platform and two direction cores			
(10)	Two platform and two direction cores			
(11)	Two platform and three direction cores			
(12)	Two platform and four direction cores			
(13)	Three platform and direction cores			
(14)	Three platform and four direction cores			
(15)	Three platform and five direction cores			
(16)	Three platform and six direction cores			
(17)	Choppers			
(18)	Chopping tools			
(19)	Unifaces			
(20)	Steep-edged pieces	i)-whole	ii)-flake	iii)-fragment
(21)	Retouched flakes	i)-primary	ii)-secondary	iii)-tertiary
(22)	Utilised flakes	i)-primary	ii)-secondary	iii)-tertiary
(23)	Plain flakes	i)-primary	ii)-secondary	iii)-tertiary
(24)	'Axes'			
(25)	Miscellaneous			
(26)	Retouched pebble fragments			
(27)	Utilised pebble fragments			
DEBRIS				
A	Broken cores	i)-retouched	ii)-plain	iii)-utilised
B	Broken core tools	i)-retouched	ii)-plain	iii)-utilised
C	Broken flakes	i)-retouched	ii)-plain	iii)-utilised
D	Broken pebbles			

Total number of pieces

TABLE 1: THAM KHAO KHI CHAN – TABLE OF ARTEFACT CLASSES

Classes	Layer 1	Layers 2-4	Layer 5
(2)	10	29	4
(3)	4	7	2
(4)	-	-	1
(8)	9	3	5
(10)	-	3	-
(17)	3	-	-
(19)	-	2	-
(20i)	5	3	-
(20iii)	4	1	-
(21i)	-	1	-
(21ii)	2	-	-
(21iii)	-	2	-
(22i)	6	2	1
(22ii)	7	1	3
(22iii)	2	2	1
(23i)	12	8	3
(23ii)	15	17	15
(23iii)	21	26	6
(24)	-	3	2
(25)	-	1	-
(26)	-	2	-
(27)	1	-	-
DEBRIS			
Ai	1	-	-
Aii	2	-	-
Bii	1	-	-
Cib	-	1	-
Ciib	-	3	-
Ciia	1	3	1
Ciib	3	4	4
D	47	35	16
Total number of pieces	157	163	65

TABLE 2: THAM KHAO KHI CHAN – COMPOSITION OF THE ASSEMBLAGES

Separation of the flakes into retouched, utilised and plain categories also permits an examination of the arguments of White and Gorman (1979) that the majority of flakes in Hoabinhian assemblages show utilisation not from use as flakes but from use on core tools, i.e.

that the majority of utilised flakes are re-sharpening pieces. The frequencies of plain and retouched flakes at Tham Khao Khi Chan argue against this view, as does the position of the utilisation on the utilised class. On the latter the damage usually occurs on the flake edges that would not have been exposed to wear whilst on the core or core tool. An important point to be developed here is the question of whether the crushing of the edges of the steep-edged pieces and of the platforms of some of the flakes is the product of use or technology. Use of a relatively heavy hammer (as are common at Tham Khao Khi Chan) upon flattish cobbles resting on the ground can produce edge crushing and shattering which removes numerous small splinters as well as larger flakes. This 'unclean' removal also results in step-fracturing of the flakes as they come away from the core.

It must be stressed that there is an urgent need for replication experiments in the study of Southeast Asian lithic industries. Until these are conducted interpretations should be guarded. This is particularly important when raw material is considered, because the form (or lack of it) in Southeast Asian industries is often attributed to poor quality stone. The lack of good conchoidally fracturing stone is often cited to explain the amorphous and crude appearance of Mainland Southeast Asian industries, but this idea is linked to that of the old 'chopper-chopping tool complex'. Quartz, quartzite and silicified shale industries occur elsewhere in the world and these can contain well-worked pieces comparable to their flint and chert counterparts. These materials are not necessarily poor quality, but they vary greatly. Some of the quartzite at Tham Khao Khi Chan appears to be of good quality.

In Malaysia recently, I was fortunate enough to be able to visit the site of Kota Tampan in Perak (Zuraina and Tjia 1988). There, experiments replicating the 'anvil technique' (block on block) matched the excavated materials well, but my own 'European' techniques were also workable and produced pieces with a much cleaner appearance to the edge. It is the combination of techniques with raw materials that marks Southeast Asia as distinctive, not the raw materials alone. This may be related to the presumed major role of stone industries in Southeast Asia of providing tools to make tools. When better raw material was used at Tham Khao Khi Chan it was generally treated in the same way as the 'poorer' materials. Further experiments will be most useful in elaborating upon this.

This class list employed here serves to identify the 'Hoabinhian' nature of the industry at Tham Khao Khi Chan through the frequencies of the steep-edged pieces, with their 'cortex-retaining properties'. So, whilst the class list was not specifically designed to identify the Hoabinhian, it is possible to identify from it an assemblage pattern in which the frequencies of steep-edged pieces and unifaces are high. The underlying technological strategy was orientated to generalised material reduction with specific elements being taken for subsequent use. The inclusion of broken pieces allows for the demonstration that materials were either heavily used or of poor quality (possibly a combination of both). The re-use of broken pieces, as illustrated by the frequencies of retouched and utilised debris, is not such as to suggest that economy of raw materials was important. It is difficult to decide whether the pieces were retouched or utilised before or after breakage.

The ratios of cores to flakes in Tables 2 and 3 give an indication of whether pieces were being taken away for use elsewhere. This is determined in this instance by counts of the

minimum number of negative flake scars on the cores, which range between 4 and 8 (only major negative scars are counted), and also by the experiments reported in Pookajorn (1984). Ideally, experiments replicating the Tham Khao Khi Chan material on the same materials should be carried out, but time did not permit this. So, the core to flake ratio should fall between 1:4 and 1:8 if no removal of material has occurred. Two of the habitation layers do indeed fall within this range, but it should be noted that these figures are very low when compared to the experimental results. Supplementary evidence for the removal of pieces could come from refitting. This was attempted for all pieces within each spit but only one conjoining pair was recognised.

This lack of conjoining pieces implies that in-situ knapping took place in an area away from the excavation trench and that the material recovered is a dissociated collection of discarded materials. The original reduction sequence is only visible at the site through the technological analysis provided by the class list. It was hoped that refitting would also inform further on the stratigraphic relationships of the spits, but unfortunately no such information was forthcoming. The results of this study match those of Pookajorn at Heap Cave, Kanchanaburi, where only a single pair of refitting flakes was found (Pookajorn pers. comm.).

The ratio of core tools to retouched and utilised flakes provides an indication of whether the industry should be regarded as a pebble tool or flake industry. In all cases flakes outnumbered the core tools. This is particularly interesting in that previous publications on the Hoabinhian have focused mostly on the core tools, their functions and their cortex retaining character. An exception to this is Pookajorn (1984), and a fuller understanding of the Hoabinhian awaits more attention being given to the flake component.

The ratio of tertiary to primary flakes, whilst informing on the cortex retaining issue noted earlier, is also an indication of the degree of reduction of the cores. As a core is worked, fewer cortical pieces and more tertiary pieces are produced through time. This illustrates the importance of raw material economy to the knapper. In general terms, the tertiary flakes outnumber the primary ones but not to such a degree as to suggest intensive reduction (see Table 3).

In comparing the habitation layers in the site certain chronological trends are apparent. Firstly, the percentages of flakes decrease and core tools increase between the lowest two units studied. When the top two units are compared this ceases to be the case. The frequency of hammers and anvils decreases from the bottom of the site to the top, while the frequency of finer grained materials increases significantly in the top layer. No major techno-typological changes can be related to this increase, except the reduction in the numbers of hammers – this could be a casual relationship.

The technological changes visible occur mainly between the bottom two layers. Overall, however, the character of the industry remains much the same. Flakes dominate over core tools and steep-edged pieces remain the most recognisable features of the industry. None of the changes are sufficient to warrant separating out the assemblages in the different habitation layers. It is interesting that even when the frequency of better raw materials increased there was no related increase in finer tool forms. The finer grained materials were being treated in the same way as the coarser ones.

	Layer 1	Layers 2-4	Layer 5
No. of cores	10 (6.4%)	10 (6.1%)	5 (7.7%)
No. of core tools	13 (8.3%)	11 (6.7%)	2 (3%)
No. of flakes	65 (41%)	59 (36%)	30 (46%)
No. of flakes (including broken)	44%	43%	54%
No. of broken pebbles	47 (30%)	35 (21.5%)	16 (24.6%)
No. of non-worked pieces	14 (8.9%)	36 (22.1%)	7 (10.7%)
No. of hammers/anvils	4 (2.5%)	7 (4.3%)	3 (4.6%)
Ratio cores: flakes	1:6.5	1:5.9	1:6
Ratio cores: core tools	1:1.3	1:1.1	1:0.4
Ratio core tools: flakes	1:5	1:5.4	1:15
Ratio tertiary: primary flakes	1:1.3	1:0.4	1:0.6
Fine grained pieces	18.5%	6.7%	7.7%
Large cobbles & fragments	28%	27.6%	29%
Total no. of pieces	157	163	65

TABLE 3: THAM KHAO KHI CHAN – COMPARISON BETWEEN HABITATION LAYERS

In summary, the industry at Tham Khao Khi Chan appears to be a fairly typical Hoabinhian for southern Thailand, with many steep-edged core tools retouched in such a way as to retain cortex adjacent to the flaked edge. Flakes are an important part of the assemblage both technologically and functionally. The reduction strategy employed was generalised and not aimed at producing specific blank forms. Rather, such pieces as were suitable were selected from a range of flakes. Resharpener flakes were rare. Differential use of raw materials does not appear to have been significant, but further study of the raw materials and replicative experiments would be most informative.

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