Archaeological research in caves and rockshelters has been the major source of data about cultural developments in Southeast Asia during late Pleistocene and early Holocene times. Despite the numerous cave excavations in nearly every Southeast Asian country over the last 100 years, however, the earliest general archaeological schemes were ironically based on rather cursory findings from poorly dated open air sites. In recent years ongoing excavations and analyses of archaeological materials from caves and rockshelters have finally come into their own, and newer interpretations have superseded some of the more speculative aspects of the earlier archaeological schemes. During Late Pleistocene times, caves were used only as brief campsites, often selected for their inaccessibility; in the early Holocene Epoch they were frequently used as dwelling sites; in the middle Holocene time the more accessible caves and rockshelters were often used as burial sites. One site, the Lang Rongrien Rockshelter, southwestern Thailand, serves as a case study for pointing out problems encountered in cave and rockshelter excavations in Southeast Asia. This 3500–43000-year-old site is also used as the basis for exploring some more general issues concerning the lifeways of late Pleistocene *Homo sapiens* in the region and possibilities of preagricultural rainforest adaptation of their early Holocene descendants.

INTRODUCTION

The limestone karst regions of Southeast Asia are well known for their numerous archaeological cave and rockshelter sites. Most of what we know about the Early Holocene prehistory and nearly all of the admittedly little we know about the Pleistocene prehistory of the region come from excavations in these types of site locations.

During the first half of this century, however, archaeological research in caves, though active (Wray, 1905; Evans, 1918, 1928, 1931; Mansuy, 1924; Colani, 1930; Sarasin, 1933; Collings, 1936, 1938; Tweedie, 1936, 1953; Saurin, 1939; Callenfels and Noone, 1940), was largely secondary in importance to archaeological investigations of river terraces (Morris, 1932, 1935, 1936; von Koenigswald, 1937; de Terra and Paterson, 1939; Callenfels, 1940; Movius, 1943), and it was the latter settings that provided the generalized schemes of human evolution and cultural development for all of Southeast Asia (Movius, 1944, 1948, 1949). Ironically, the momentous beginnings in riverine Pleistocene archaeology and human paleontology that highlighted Southeast Asia in the first half of this century have not been followed up, having now been overshadowed by research in cave sites. In fact, Southeast Asian archaeological interpretation is still largely a legacy of early 20th cen-
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tury observations and speculation of research along the riverine terraces, de-
spite the fact that actual evidence of human existence in the Pleistocene is
largely derived from the caves and rockshelters. It is also true that even this
evidence has come from few archaeological sites dating earlier than the Last
Glacial Maximum (LGM), and well-documented pre-LGM sites in all of
Southeast Asia number fewer than a dozen (Harrisson, 1959; Fox, 1970;
Glover, 1973; 1981; Ha Van Tan, 1976, 1980; Majid, 1982; Pham Huy Thong,
1983; Majid and Tjia, 1988; Hoang Xuan Chinh, 1989; Anderson, 1990; Poo-

The caves and rockshelters are generally located in the limestone karst
regions of both the mainland and the island portions of Southeast Asia. Habi-
tats within which these archaeological sites are located vary from dry, almost
semiarid landscapes as in northern Myanmar to humid tropical rainforest on
the Malay Peninsula. The specific settings of the cave and rockshelter sites
vary considerably. Many of the more important rockshelter sites, such as
Leang Burung 2, Indonesia (Glover, 1981) and those from the Hoa Binh re-
gion, Vietnam (Colani, 1930; Boriskovskii, 1971; Ha Van Tan, 1976), are lo-
cated at the base of the limestone massifs, while others, such as Lang Ron-
grien, Thailand (Anderson, 1990), are located in notches rather high up on
the faces of these steep-sided formations (Figure 1). Still other sites, such as
Sai Yok, Thailand (van Heekeren and Knuth, 1967), Spirit Cave, Thailand
(Gorman, 1970), Gua Cha, Malaysia (Sieveking, 1954, 1955; Adi Haji Taha,
1985), and Padah-lin, Myanmar (Aung Thaw, 1971), are located on somewhat
less steep-sided limestone hills near rivers or streams, with talus aprons ex-
tending down to flat valley bottoms or river edge. Very few archaeological
cave sites have entrances below the surrounding ground level. The rarity of
subground level sites may be a sampling error, however, owing to the diffi-
culties of locating such sites, and there is a good possibility that such sites
exist over a wide area (Semendeferi, 1989: 55). In some regions, such as
Phang Nga Bay, southwestern Thailand, submarine caves are also numerous
and should be included in any discussion of potential archaeological sites,

Often the surficial deposits in Southeast Asian caves and rockshelters are
characterized by fine-grained sediments variously described as “powdery”
(Evans, 1922:267; Callenfels and Evans, 1928:152; Collings, 1936:7; Majid,
“very fine sandy loam” (Gorman, 1970). Although I am not certain of their
 genesis, the deposits contain high levels of phosphate suggesting a biological
origin. In the deeper, darker caves this can be easily explained by the activi-
ties of bats, but in the open, well-lighted rockshelters, the explanation must
be more complicated. It has also been suggested, however, that the “powdery
dust” may simply be the result of a constant sprinkling of rotting limestone
from the cave roof and walls (Evans, 1920:40), but this has never been con-
firmed. Caves near streams and only slightly above river level frequently have strata described as compact yellow clay (van Heekeren and Knuth, 1967; Glover, 1981; Adi bin Haji Taha, 1985), ostensibly groundwater or floodwater derived. Since one of our archaeological questions concerns the intensity and duration of episodes of human occupation of the Southeast Asian rockshelters, and understanding of the interaction between the human and natural
agencies in the formation of the deposits is critical and will be the focus of our next field investigations.

Caves and rockshelters in Southeast Asia generally do not undergo as much roof and wall collapse as in the higher latitudes, presumably because of the relative complacency of the climatic regimes in which they exist. As a result the deposits are not generally punctuated by episodes of increased or decreased natural soil or rock accumulation, geological processes that can help the archaeologist isolate and date individual cultural layers. On the other hand, where significant accumulation does occur, there is a good chance that it is anthropogenic.

The cultural deposits of the dry cave and rockshelter sites in Southeast Asia generally yield well-preserved faunal remains, and in many cases, also floral remains. Wood and bamboo, however, tend to decompose quite readily, although some cave burials dating as far back as 2000 or 3000 years still have remains of log or plank coffins. By far the most common cultural objects in these cave and rockshelter sites are the lithic remains.

Among the more common difficulties encountered in cave archaeology in Southeast Asia is the carbonate-cementing of the deposits associated with formation of dripstone or percolation of calcareous ground water. Usually, the dripstone is not so solid or thick as to preclude excavation of the affected sites, but occasionally it has proven to be a significant obstacle (van Heekeren and Knuth, 1967; Glover, 1976). The majority of cave and rockshelter sites on the Malay Peninsula appear to “bottom out” between 1 and 2 m below the surface of the deposits, whereas cave deposits in Vietnam and southern China are frequently about 1 m thicker. In all of the Malaysian cases, the lowermost cultural deposits thus far reported are of early Holocene age. That none of these previously excavated caves have Pleistocene deposits may be more apparent than real, however, as will be discussed later.

Perhaps the most widespread difficulty encountered by cave archaeologists, however, is anthropogenic. As soon as a road or other access is built close to a cave or rockshelter, the site becomes victim to phosphate collectors and increasingly, to antiquities collectors. Also, caves are historically attractive as settings for religious activities, and although not totally destroyed in the construction of shrines or hermitages, the sites are much less accessible for archaeological research. Finally, with modern development and the need for cement, many of the limestone tower karsts are being consumed for lime.

ARCHAEOLOGICAL INTERPRETATIONS OF CAVE SITES

While every cave and rockshelter site in Southeast Asia has unique aspects to its geological and archaeological history, there are many commonalities. The following discussion of one such site, the Lang Rongrien Rockshelter, southwestern Thailand, will serve to highlight some of the more general issues encountered in cave archaeology throughout Southeast Asia. Since so
few sites with a comparable age span are known from the region, however, many of the generalizations here are tentative and are intended simply to suggest avenues for further research.

**Lang Rongrien Rockshelter**

Located in southwestern Thailand about 50 km north of the Malaysian border, Lang Rongrien is one of the more recently excavated early sites in Southeast Asia. Excavations of this rockshelter, begun in 1974 and conducted intermittently for a period of 4 seasons until 1990 (Anderson and Suchitta, 1979; Anderson, 1984, 1985, 1987, 1988, 1990), have uncovered a 3.5-m-thick deposit comprising 10 stratigraphic units, labeled from the top down according to archaeological convention, that encompass the entire time span of radiocarbon dating (Figure 2).

The earliest occupations of Tham Lang Rongrien (tham = cave, Thai), from Stratigraphic Units 8–10, are represented by hunters’ campsites that predate the LGM. Radiocarbon ages of these three Pleistocene layers, fall between 27,000 and more than 43,000 B.P., the lowermost representing some of the earliest well-documented archaeological remains in all of Southeast Asia (Table I). The Pleistocene occupations of the site are evidenced by traces of campfires around which were distributed faunal remains, chipped stone tools, and stone debitage. Given the nature of the remains, these layers appear to have been the result of occupations by small groups of nomadic hunters capable of obtaining large game such as elephants, but extensively exploiting small, easily obtained game such as turtles. Evidence from Lang Rongrien and the other early sites throughout Southeast Asia indicate that Pleistocene hunters did not use rockshelters as dwelling sites, but used them only intermittently as brief campsites. Their stoneworking techniques produced rather generalized tools, primarily small amorphous flake implements with regular, well-defined working edges and some larger core tools.

Contrary to expectations based on often-repeated interpretations of the early prehistory of mainland Southeast Asia suggesting the existence of a long-standing, uninterrupted Chopper-Chopping Tool Complex (Movius, 1944) or Pebble-Tool Industry (van Heekeren and Knuth, 1967), the early assemblages from Tham Lang Rongrien are primarily of flake tools. In fact, they are rather consistent with Late Pleistocene assemblages from southern China to the north and Indonesia to the south, both of which are characterized by an extensive use of small, irregular flake implements (Glover, 1981; Glover and Presland, 1985; Jia Lanpo and Huang Weiwen, 1985; Olsen and Miller-Antonio, 1992). Other recently excavated sites in mainland Southeast Asia replicate these findings (Ha Van Tan, 1994).

Overlying the lowermost units at Lang Rongrien are cultural deposits labeled the middle layers (Anderson, 1987) that date to Early Holocene time. In this period, during which time more than 1 m of occupational midden accu-
Figure 2. Stratigraphic section along the 0 E–W face, facing west, from c. N-1 (right) to S-10 (left).
### Table I. Radiocarbon dates from the Lang Rongrien Rockshelter.

<table>
<thead>
<tr>
<th>Stratigraphic Unit</th>
<th>Lab No.</th>
<th>Field No. and Description of Sample</th>
<th>Coordinates and Depth of Sample</th>
<th>Comments</th>
<th>Date B.P. (Half-Life)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2B</td>
<td>PITT-1245</td>
<td>#2077, wood from coffin</td>
<td>S 8.90; E 2.50</td>
<td>Burial 12</td>
<td>2530 ± 45</td>
</tr>
<tr>
<td>2B</td>
<td>SI-5212A</td>
<td>#48 charcoal</td>
<td>S 0.70–1.00; E 2.00–2.05; depth 70 cm</td>
<td>Mixed stratum, with material from Units 5 and 6</td>
<td>7580 ± 70</td>
</tr>
<tr>
<td>2B</td>
<td>SI-6212B</td>
<td>#50, charcoal, Pit #1</td>
<td>NE quadrant; Mixed stratum, with materials from Units 5 and 6</td>
<td></td>
<td>8430 ± 70</td>
</tr>
<tr>
<td>5 upper</td>
<td>SI-6213</td>
<td>#202, charcoal</td>
<td>S 1.40–1.55; E 1.25–1.40; depth 162–166 cm</td>
<td></td>
<td>7765 ± 65</td>
</tr>
<tr>
<td>5 lower</td>
<td>SI-6213</td>
<td>#201, charcoal</td>
<td>S 1.25–1.42; E 2.00–2.36; depth 180–188 cm</td>
<td></td>
<td>7575 ± 75</td>
</tr>
<tr>
<td>5 or 6</td>
<td>SI-6817</td>
<td>#583, charcoal</td>
<td>S 0.76–0.80; E 3.30–3.90; depth 192–194 cm</td>
<td></td>
<td>9655 ± 90</td>
</tr>
<tr>
<td>6</td>
<td>SI-6215A</td>
<td>#339, charcoal</td>
<td>S 1.95–2.10; E 0.50–0.70; depth 190–200 cm</td>
<td></td>
<td>7655 ± 70</td>
</tr>
<tr>
<td>6</td>
<td>SI-6215B</td>
<td>#340, charcoal</td>
<td>S 1.20–1.30; E 1.20–1.40; depth 180–183 cm</td>
<td></td>
<td>8300 ± 85</td>
</tr>
<tr>
<td>7</td>
<td>SI-6216</td>
<td>#358, charcoal</td>
<td>S 4.00–5.00; E 1.00–1.20; depth 209–210 cm</td>
<td>From roof fall</td>
<td>&gt;43,000</td>
</tr>
<tr>
<td>7</td>
<td>PITT-1246</td>
<td>#1655, charcoal</td>
<td>S 3.66–4.01; W 18.00–20.00</td>
<td></td>
<td>31,370 ± 550</td>
</tr>
<tr>
<td>8</td>
<td>SI-6217</td>
<td>#44 and 45, charcoal</td>
<td>S 3.81–3.88; E 3.70–3.90; depth 273–279 cm and S 4.10–4.40; E 5.15–5.40; depth 284–286 cm</td>
<td></td>
<td>27,350 ± 570</td>
</tr>
<tr>
<td>8</td>
<td>SI-6816</td>
<td>#585, charcoal</td>
<td>S 4.90–5.75; E 2.00–2.20; depth 235–243 cm</td>
<td></td>
<td>27,110 ± 615</td>
</tr>
<tr>
<td>8</td>
<td>SI-6818</td>
<td>#583, charcoal</td>
<td>S 7.45–7.60; E 7.10–7.30; depth 308 cm</td>
<td></td>
<td>32,180 ± 1330</td>
</tr>
<tr>
<td>9</td>
<td>PITT-1247</td>
<td>#1981, charcoal</td>
<td>S 2.28–2.45; W 1.30–1.50</td>
<td>From hearth</td>
<td>34,380 ± 2030</td>
</tr>
<tr>
<td>9</td>
<td>SI-6819</td>
<td>#608, charcoal</td>
<td>S 4.90–5.50; E 0.60–1.20; depth 270 cm</td>
<td></td>
<td>37,000 ± 1780</td>
</tr>
<tr>
<td>10</td>
<td>PITT-1248</td>
<td>#1433, charcoal</td>
<td>S 6.50–6.95; E 1.50–2.00</td>
<td></td>
<td>37,265 ± 1000</td>
</tr>
<tr>
<td>10</td>
<td>PITT-1249</td>
<td>#1994, charcoal</td>
<td>S 1.40–2.20; W 1.25–2.00</td>
<td></td>
<td>&gt;43,000</td>
</tr>
<tr>
<td>10</td>
<td>PITT-1250</td>
<td>#2012, charcoal</td>
<td>N 0.03–S 0.10; W 1.60–1.75</td>
<td></td>
<td>9450 ± 135</td>
</tr>
</tbody>
</table>
mulated on the floor, the rockshelter served as a habitation site. The stone implements from these middle layers are identical to assemblages generally described throughout mainland Southeast Asia as Hoabinhian.

Differences in the terminal Pleistocene/Early Holocene assemblages from the various regions of this vast area appear to reflect differences in the local availability of lithic source materials selected for tools, rather than being stylistic. While at first glance these findings may not seem particularly noteworthy, they have two important implications. First, older interpretations suggesting that early *Homo sapiens* in Southeast Asia were culturally less developed than their counterparts in other regions of the Old World need to be reexamined in light of what is some of the first “hard” evidence from the Pleistocene sites of the region. Second, there is growing evidence that the heavy implement industries (the so-called primitive core-tool or thick corelike flake tool industries generally described as Hoabinhian) began to appear only at the end of the Pleistocene, that is, after the LGM. Hoabinhian in fact appears to represent a widespread introduction of stone tool forms and assemblages that replaced earlier lithic traditions made up primarily of flake tools, rather than the latest stage of a long uninterrupted cultural tradition of core-tool manufacture begun in the Middle Pleistocene.

During late prehistoric times at Lang Rongrien, represented by the upper levels, the site was occasionally used as a short-term shelter and between 2500 and 4000 years ago, as a burial site, with pottery-associated inhumations and cremations (Anderson, 1990). The use of caves and rockshelters as burial sites during the later Holocene periods is common throughout Southeast Asia.

**GEOARCHAEOLOGICAL CONTEXTS OF CAVE SITES**

Although perhaps not so severe as in other world regions, difficulties abound in interpreting the stratigraphy of cave and rockshelter sites in Southeast Asia. These difficulties are at least partially reflected in ongoing debates about excavation strategies in the region. A particularly difficult problem is correlating occupational debris from one part of the cave with that from another part without physically connecting the excavation units by a single stratigraphic section. Correlations are especially difficult in sites with the thick cultural deposits typical of the Early Holocene and with multiple burials typical of the Middle Holocene. Owing at least in part to the difficulties in unraveling the stratigraphic complexity of cave sites, archaeologists frequently focus their research on chronology and typology, and to some extent changes in stone tool technology through time (Gorman, 1970; Adi bin Haji Taha, 1985). With chronology the major concern, most researchers utilize a gridded square pit excavation strategy that maximizes the exposure of vertical excavation walls at the expense of horizontal layout. On the other hand, a chronologically focused excavation limits opportunities to identify evi-
evidence of past cultural activities that occurred over a larger portion of the site than can be traced out within small excavation pits. When the interpretation of cultural activities is a major concern, a preferable excavation strategy is one that maximizes the areal extent of the excavation by limiting the number of intersecting vertical excavation walls. Areal excavations facilitate the recognition and complete excavation of features and associated cultural materials. Which excavation strategy has been employed is usually apparent in the excavation drawings accompanying the reports. In Southeast Asia illustrations of stratigraphic sections in most cave site reports are numerous and detailed, but plan views of the excavated deposits are rare, or if they are included remain uninterpreted (Hoang Xuan Chinh, 1989).

Because of the easy compaction of sediments, it is especially difficult to distinguish between episodes of disturbance represented by the uppermost cave deposits. In fact, Early and Middle Holocene cave sites in Southeast Asia frequently include recently disturbed but recompacted deposits of stone tools, charcoal, ash, and hearth stones arranged in lenses or spatial patterns that are identical to undisturbed features. Only where there is the rare indication of former surfaces directly associated with such arrangements can one be certain that one is dealing with primary deposits.

**Middle Holocene Deposits**

In contrast to the major role open-air sites have played in the archaeology of the Middle Holocene in Southeast Asia, Middle Holocene cultural materials from cave sites have added little to our picture. Cave and rockshelter sites do contain significant deposits of Middle Holocene age, but they are rarely seriously investigated, and even when they are, they are poorly incorporated into the general archaeological schemes for the region. This situation is particularly awkward, since to penetrate to the Early Holocene levels of the cave sites, one must first excavate the Middle Holocene layers. As noted above, one reason for the neglect of serious research on Middle Holocene cave sites is the difficulty in distinguishing between primary and secondary cultural materials in the deposits.

For example, at Lang Rongrien the upper levels comprise largely reworked silt—the less consolidated portions resulting from recent disturbance by local soil collectors, and the more compacted portions a result of multiple factors, including prehistoric burial activities and occasional camping activities. Despite the powdery nature of these sediments, they are so easily compacted by trampling that, for example, unintended alignments of stones discarded by the soil collectors have often become indistinguishable from original, in situ features like stone-lined hearths. As an additional complication, many artifact types and faunal species from upper deposits of cave sites throughout Southeast Asia are indistinguishable from those of earlier periods. As a result, even though the burial pits are readily identified in section, it is fre-
quently impossible to distinguish among cultural materials originating from the preburial deposits, objects accompanying the burials, and artifacts post-dating the burials. In fact, even after 4 seasons of careful excavation at Lang Rongrien, we are still unsure of the relationship between the stone tools from these upper levels and the burials. At present we have concluded, contrary to our earlier views, that most, or perhaps even all, of the stone tools found in the upper levels have been displaced from the middle levels.

Even where burial pits are readily discernible in the cave deposits, analysis of the burials themselves is complicated. Typical of the cave sites in mainland Southeast Asia, the upper deposits of Lang Rongrien were dotted with numerous burial pits containing clusters of pottery vessels and an occasional shell, bone, or stone ornament. Several of the 18 interment pits at the site intersected each other, and all but the three cremation pits extended down into the next lower, otherwise undisturbed middle levels. As a result of the extensive prehistoric disturbance, not to mention the more recent disturbance of the soil collectors, dating of the prehistoric deposits of the upper levels has had to be based primarily on typological comparisons of the burial pottery to dated remains from Malaysia (Williams-Hunt, 1952; Dunn, 1966; Peacock, 1961) and Cambodia (Mourer, 1977; Mourer and Mourer, 1971), most of which themselves have been derived from similarly disturbed settings. Judging from the associated pottery types, the pottery-bearing burials in the cave sites of Southeast Asia probably postdate 4000 years ago, but a reliable chronology of the burials will probably be achieved only by dating a very large number of radiocarbon samples from the sites. On the other hand, the ceramic assemblages from the intact burials, which frequently include pots, bowls, cups, and other forms, occasionally with residues inside, can provide considerable information on the lifeways of the middle Holocene peoples even without close chronological controls over the sequences.

**Early Holocene Deposits**

As noted above, Hoabinhian deposits in Southeast Asian cave and rock-shelter sites tend to be rather thick. At Lang Rongrien the middle layers are characterized by a 1.5-m-thick aggregate of thin, horizontal but discontinuous layers of reddish brown sediment containing charcoal, oxidized earth, and white ash, as well as flat-lying bits of fire-cracked rock, bones, artifacts, and other traces of human activity. The horizontality of the layers and embedded objects here and at many other early Holocene sites in Southeast Asia suggests that the accumulation of debris occurred through a long succession of camping activities in the rockshelter. On the other hand, it has been very difficult to isolate activity areas in these sites. After several unsuccessful attempts to trace out the microstratigraphy of the middle levels at Lang Rongrien, for example, we finally decided to abandon the finer stratigraphic distinctions originally proposed in our analysis (Anderson, 1990) and simply...
return to a focus on relative depth of the objects. As with the vast majority of studies of Hoabinhian cultural deposits in Southeast Asia, our analysis of the Hoabinhian materials has focused on change within the middle Holocene sequence, based primarily on differences in depth of each individual object from surface, except where the stratigraphic differences were clear. Nearly every other site in Southeast Asia has similarly utilized arbitrary levels (or relative depth) as the basis for stratigraphic interpretations of the early Holocene cave deposits.

At Lang Rongrien the deposits of the middle levels represent a period of frequent or extended occupation of the rockshelter between the 8th and 10th millennium B.P. A total of five radiocarbon dates have been obtained from these levels, but owing to some inversions, the dates do not bracket the occupation. In other words, although the deposits appeared to be the result of gradual accumulation, “reversals” in the radiocarbon ages suggest otherwise (Table I). Most dated Hoabinhian deposits in Southeast Asian caves suffer from the same sort of “reversals,” again indicating that, despite the apparent orderly accumulation of deposits, there are ground-disturbing activities that have gone undetected.

Pleistocene Deposits

In mainland Southeast Asia, Pleistocene cave and rockshelter deposits are few and far between. Vietnamese archaeologists have had the greatest success in penetrating below the Holocene–Pleistocene boundary, with a number of sites dating back to about 30,000 years B.P. (Pham Ly Thong, 1994). In these cases, however, the cultural materials appear to be only sporadically dispersed throughout the deposits. Just as at Tabon Cave, Philippines, Leang Burung 2, Sulawesi, and Niah, Sarawak, the cultural objects do not appear to lie on intact former living surfaces, but rather are embedded within thicker geological deposits that have gradually accumulated over considerable time. As with the Middle and Early Holocene cultural components of the Southeast Asian cave and rockshelter sites, the nature of these deposits may be the primary reason that the analyses of the cultural materials have focused primarily, if not exclusively, on technology, stylistic attributes, and associated biological data and their changes through time but not cultural activities represented by the materials.

The lowermost levels at Lang Rongrien (Stratigraphic Units 8, 9, and 10) are Pleistocene in age. Units 8 and 9 are, in contrast to nearly every other early site in Southeast Asia, clearly discernible thin layers that appear to be former living surfaces containing cultural remains directly associated with features and other indications of cultural activity. In Unit 10, the features and most of the cultural objects likewise came from the top of the unit, but a few other were found as much as 10 cm deeper within the layer.

Fortunately, the Pleistocene layers at Lang Rongrien were effectively
sealed off from the Holocene deposits by a thick layer of roof fall (Unit 7). Unit 7 is a 1- to 1.5-m-thick layer of friable, decayed white limestone rubble encasing decayed angular blocks ranging in size from gravel to boulders up to 80 cm in diameter. Although Unit 7 is clearly a product of some single geological process, by which limestone blocks or spalls accumulated on the floor of the rockshelter, we have not yet been able to determine the extent to which—or whether—it is the result of sudden roof collapse or of gradual accumulation. A sudden collapse is suggested by the absence of weathered surfaces anywhere in this unit, as would be expected had it been the result of long-term accumulation, and the generally smooth roof scarp over the excavated part of the rockshelter. In addition, a fault line cross-cutting the lower levels of the site could be the result of displacement caused by the impact of a large block from the roof of the rockshelter. On the other hand, gradual accumulation is suggested by the presence of a pocket of cultural material within the layer and the absence of any solid core of unweathered limestone such as might be expected had it once been a single large block. At present we favor the latter explanation of gradual accumulation.

The resolution of the problem of Unit 7 has implications for the early archaeology of the entire region. If, as it appears to be the case, the roof fall is a function of long-term accumulation and not a single chance event, then environmental change may have been involved (Butzer, 1981; Collins, 1991; Farrand, 1975). If so, it is entirely possible that many of the previously excavated caves and rockshelters throughout the region, now currently assumed to “bottom out” with early Holocene deposits, also have Pleistocene deposits, but capped by an episode of roof fall.

Stratigraphic Units 8 and 9 have been dated by a total of five dates between 27,000 and 37,000 B.P. (Table I). Each of the two units comprises a thin veneer of weathered sediment containing bits of charcoal, faunal remains and artifacts underlain by a thicker, noncultural zone of light gray CaCO₃. Despite the span of radiocarbon ages for cultural material from Unit 8 (27,110 ± 615 to 32,180 ± 1330) the stratigraphic position of the features and associated remains—all directly on top of the unit, suggests a relatively brief span of occupation. The same can be said for the occupations on Unit 9. Since the cultural materials from Stratigraphic Unit 10 came both from the top and from within the unit, Unit 10 probably represents a considerably longer span of time. Radiocarbon dates obtained for Unit 10 are 37,265 ± 1000 and >43,000 B.P., respectively. A third sample of charcoal from Unit 10, from the rear wall of the rockshelter, however, gave an anomalously recent date, possibly indicating some disturbance or contamination at the interface of the rockshelter wall. Additional radiocarbon dating of samples in that portion of the site should clarify the issue.

In general, all three of the lower stratigraphic units represent long periods of gradual but minimal sediment accumulation and exposure to the elements. Cultural activities represented by Unit 10 occurred sporadically over a long
period of time, perhaps millennia, but those from Units 8 and 9, occurred over rather brief periods of time. The human activities represented by Unit 8 terminated abruptly at the commencement of the period of roof spalling sometime around 27,000 years ago.

THE ANTHROPOLOGY OF CAVE SITES

In the past two decades cave archaeology in Southeast Asia helped resolve some major questions concerning the evolution of Homo sapiens (Nguyen Lan Cuong, 1985), development of lithic traditions, and the initial development of agriculture in Asia (Solheim, 1972; Gorman, 1977; Yen, 1977). Yet, chronological concerns and typology continue to dominate the archaeology of cave sites. By contrast open-air-site archaeology in the region, although concentrating on Middle and Late Holocene periods, has outpaced cave research, especially in addressing newer archaeological questions concerning the dynamics of social development. The work of Higham and his colleagues (Higham and Bananurag, 1990, 1991; Higham and Thosarat, 1993) is just one example of many. Yet, cave archaeology continues to offer great promise in helping us to understand the development of Pleistocene and Early Holocene societies and social arrangements. Following are suggestions by example of some promising avenues of new research. The first derives from a regional perspective and the second from some anthropological interpretations of the cultural remains.

Site Selection

Since caves and rockshelters abound in the karst regions of Southeast Asia, prehistoric peoples of the region had considerable latitude in choosing the locations of their sites. Although we can never fully know why some sites were favored over others, possible reasons include proximity to food or water, proximity to raw materials, protection from the elements, or protection from animals or other people, among others.

Accessibility is logically a fundamental criterion in any site selection, so that any indication that a particular cave site is not readily accessible should signal the overriding importance of some other factor. The Lang Rongrien Rockshelter lies a notch in the face of a steep-sided tower karst nestled in a small, secluded dry valley. Presently, access is very difficult from below and impossible from above. From the geology of the tower karst and environs it is clear that at least throughout the period of human occupation the setting of the site in a notch up the steep face has not changed. No erosional process would have significantly altered its elevation relative to the valley floor below. A number of other sites in the region are similarly situated. Despite the energy required to transport resources up a cliff face high, a location with difficult access thus appears to have been one factor favored by both the Late Pleistocene and Early Holocene inhabitants, possibly for protection against predators or against other human groups.
Frequently, cliff-foot rockshelters ringing the bases of Southeast Asian tower karsts, for example, Leang Burung 1, southern Sulawesi (Glover, 1976), also contain traces of occupation. Despite ease of access, however, use of these cliff-foot caves appears to have begun somewhat later in time. Reasons for the later use of such sites may be that once farming came into an area, natural shelters located directly adjacent to the fields became a prime location for temporary campsites. Or, possibly, once the higher caves and rockshelters became burial grounds (see below), they were no longer deemed ideal camping sites. In other cave and rockshelter sites, such as along rivers, easy access to the lowlands and river edge seems to have been a major factor (van Heekeren and Knuth, 1967).

Proximity to raw materials is logically another potential criterion for selecting a particular site location. Geologically, the valley floor surrounding Lang Rongrien and several other karstic towers in the area are underlain by limestone interbedded with shale, sandstone, siltstone, mudstone, conglomerate and volcanic tuff (Sinsakul, 1994). Although some of the objects from the earliest layers of the site are of geyserite, a siliceous sinter composed of quartz and quartz varieties that is found in boulder or cobble form in the region (Sinsakul, 1994), source materials for most objects from the earliest levels, such as siliceous limestone, honey-colored chalcedony, and black cherts are uncommon in the area and appear to have been obtained at a considerable distance from the site. This implies that the Pleistocene inhabitants of the site engaged in long-distance transport of materials, although whether via trade or self-procurement is impossible to determine. By contrast, during early Holocene time, many of the raw materials for stone implements found at the Lang Rongrien, such as rounded or flattened sandstone, shale, and quartzite pebbles, are found in river and stream beds nearby. These indicate more localized materials-procurement strategies. Shale, which was the most common stone used for the implements, is of three varieties, only one of which is local in origin, however. The exotic varieties of shale used by the Middle Holocene occupants of the site again imply long-distance transport, although how great a distance is currently impossible to determine. On the other hand, elsewhere throughout Southeast Asia many cave sites are located near lithic source areas, and in these cases proximity to the materials appears to have been a factor.

The physiographic settings of sites also suggest the importance of other factors operating in the selection of cave and rockshelter sites throughout Southeast Asia. These include protection from the elements, good lighting and good ventilation. In addition, the condition of the occupation area itself was apparently important. These attributes—good lighting, ventilation, and level floor areas—are repeated in nearly all of the cave and rockshelter sites in Southeast Asia. As an example, Lang Rongrien has a large open area with a floor space of approximately 450 square meters and a southern exposure. The roof overhang slopes steeply up from the rear of the rockshelter in an arc...
that is 18 m above the floor at 13 m out from the rear wall. The floor deposits extend out about 18 m from the rear wall before dropping abruptly down to the valley floor 35 m below. Even at the peak of the rainy season, the shelter remains dry. Also, prior to disturbance by the local soil collectors, the western half of the floor, which was the area of greatest artifact concentration, was level. By contrast, the eastern portion of the floor, which was essentially devoid of cultural materials, slopes steeply upwards toward the rear wall (Figure 3).

The use of the deep, dark recesses of the caves, now so common throughout mainland Southeast Asia, appears to be only a recent phenomenon due to religious ideology of the Buddhist period. Even where prehistoric rock paintings are common, the paintings are usually on open air ledges or shallow caves, or just inside the entrances of the deeper caves.

Ecological Factors

Owing to major displacements of the coastline with changes in Late Pleistocene and Early Holocene sea levels, ecological factors for site selection relative to proximity to marine resources, etc., are difficult to determine. Lang Rongrien currently lies about 12 km inland from the mangrove forests of the coast and 20–25 km south of the headwaters of the Krabi River. When the sea was at its lowest level at the LGM, the site was approximately 200 km from the coast, whereas when sea level was at its highest mid-Holocene level, calculated at between 3 and 5 m above present (Sinsakul, 1984), the site was only 1 or 2 km from the coast, and was probably at the edge of the coastal mangrove forests (Anderson, 1990). The archaeological sequence reflects the site’s changing distance to the sea in that intertidal resources only appear at the site after the close of the Pleistocene. Yet even in Early Holocene times when the coast was about the same distance from the site as now, the primary factor for selection of the site was not its proximity to the mangrove resources. The intertidal resources, in particular shellfish, were at first only a very minor component of the faunal remains. Rather, the faunal remains from the bottom of the middle levels are of mammalian and reptilian species whose ranges are essentially in the interior—a circumstance repeated throughout the cave sites in mainland Southeast Asia. At Lang Rongrien these animals include a wide variety of medium-sized game species like deer, pig, and cattle, as well as smaller animals like tortoise, lizard, and rats (Kijngam, 1990). Larger game, like rhinoceros, was indicated by only a few isolated bones. The only arboreal animal present was the squirrel, which suggests that the residents of the rockshelter were either not interested in or capable of hunting the high tree-dwellers like gibbon or monkey. On the other hand, Hoabinhian sites from Malaysia and Vietnam frequently do contain faunal remains of high tree-dwellers (Groves, 1985; Ha Van Tan, 1985), so that there appears to be regional, habitat, or seasonal variations in Hoabin-
Figure 3. Lang Rongrien Rockshelter, surface topography, extent of excavations, and area of local sediment removal.
hian food procurement patterns that have yet to be identified. In view of the variety of resources evidenced in Hoabinhian sites, the number of occupied sites throughout the region, and the density of occupation in each of the sites, it is suggested here that the Early Holocene hunter/gatherers enjoyed a rather bountiful existence.

According to paleobotanical evidence the region was rainforest at the time of these Early Holocene occupations (Flenley, 1979; Whitmore, 1984; Stuıı̈ts et al. 1988; Stuıı̈ts, 1994). The selection of sites during the Early Holocene thus appears to have been oriented to their rainforest locations, even where near the coast. It is only with the passage of time that the shellfish resources increased in importance and became a factor in site selection. In other words, throughout mainland Southeast Asia, the focus of both the near-coast sites and the deep interior sites was on products of the rainforest.

Evidence of well-adapted hunter-gatherers occupying rainforests in early Holocene times runs counter to suggestions that rainforests could not support human groups prior to the introduction of agriculture (Gomes, 1982; Bailey et. al., 1989). If we accept the argument that deep rainforests are not a favorable habitat for people, yet Southeast Asian rainforests did easily support many human groups, then a reconciliation of the two arguments is needed. Here, some observations by Terry Rambo (1979) are relevant. According to Rambo, adaptations to rainforest regimes actually require that most of an animal's time be spent in the “disturbed zones of early successional vegetation created by natural disasters or by acts of man.” (Rambo, 1979:15).

Applying this principle to Southeast Asia, he suggests that even prior to the introduction of jungle farming practices “primitive man in Malaysia initially sought out areas in early states of succession, either forest disrupted by natural disasters or zones of permanent or self-renewing catastrophe such as strand lines, mangrove swamps, and rivers subject to periodic flooding” (Rambo, 1979:17).

Applying this view to Southeast Asia in general, we suggest that the scale at which the Early Holocene rainforest zone of mainland Southeast Asia has been identified by palynologists and geologists and used in arguments that rainforests cannot support human habitation is not the scale at which people living in the rainforests adapted to their habitat. Rather, from a human perspective the preagricultural Southeast Asian rainforest may well have comprised complex natural mosaics of successional vegetation that permitted the predictable local exploitation of the wide variety of resources evidenced by the archaeological evidence. The local patchy habitats must have been of sufficient size and their existence of sufficient predictability to sustain the foragers for millennia prior to the introduction of swidden agriculture.

The questions concerning the human occupation of the rainforest zone highlights the need of researchers to begin to focus on the nature, location, history, and extent of local disturbed and secondary ecosystems embedded within the broader rainforest ecoregions. Not only will this focus on locality as
well as region help unravel the complexity of Late Pleistocene and Early Holocene archaeology in Southeast Asia, but also will help us understand the nature of pre-agricultural forager adaptations to rain forests in general. An example of the ramifications of this focus on the local patches may be seen in Karl Hutterer’s insightful observation (Hutterer, 1977) that much of the archaeology in Southeast Asia currently interpreted as changes through time may in fact be cultural variants that reflect varying uses of the different local habitats.

Cultural Activity Patterns in the Rockshelters and Caves

*Middle Holocene Time.* The dense cultural nature of the middle deposits suggests that Lang Rongrien was utilized during the Early Holocene not simply as intermittent campsites, but rather as a dwelling site. Owing to the lack of discrete features in the deposits, however, the nature of such a dwelling site is difficult to interpret. Historic counterparts do exist in the region as documented in the descriptions of hunter-gatherers like the Sakai of Pahang, Malaysia, who at times lived in caves (Wray, 1897, 1905; Evans, 1920, 1927). Around the beginning of this century the Sakai built stone-lined hearths and made extensive use of small pole frames, sleeping platforms, fences, etc., in their cave dwelling sites (Wray, 1905). But since none of these features is in evidence at Lang Rongrien, we have no way of knowing if this example has any applicability to the use of Lang Rongrien in Early Holocene times, especially since the Sakai foragers were part of a complex forest–agricultural economic exchange system with its own settlement and subsistence demands (Endicott, 1979). At the very least, however, it does indicate that cave dwelling sites can be scenes of intense activity and considerable perishable organic refuse that would be invisible to the archaeologist.

Activities evidenced in the middle layers at Lang Rongrien include food preparation and stone tool manufacture. A wide variety of animals were brought to the site, where at least some were roasted, as indicated by the charring of some of the ends of the bones. The extent to which plants were utilized is unknown, since preservation of floral material was surprisingly poor. None of the stone artifacts appears to have been used for seed grinding. At other Hoabinhian sites in Southeast Asia, plant remains are numerous, and appear to have contributed significantly to the diet (Gorman, 1977; Yen, 1977).

Stone technology in mainland Southeast Asian Hoabinhian components is relatively uniform, except for differences accountable by differences in lithic source materials. At Lang Rongrien the artifacts from the middle levels are predominantly large Carboniferous shale core and flake tools with bifacially retouched margins. Most of the shale utilized for tools comes from within a radius of 20 km of the site. The larger stone tools all appear to have been flaked by a hard hammer technique, similar to that described for Hoabinhian

The most common tool form at Lang Rongrien is a discoid, usually somewhat less than 10 cm in diameter, that is bifacially retouched around the entire margin. Nearly all of these implements have heavily worn edges. A common type of flake from the same levels as the discoids is a bifacial margin removal flake (Flenniken, 1990), that appears to have been a by-product of resharpening of the discoids. These flakes are distinguished by their worn bifacial edges. The rarity of cortical flakes indicates that the tools were largely manufactured elsewhere. At best, stoneworking at the site began with blanks, although the number of flakes relative to finished implements seems too few to have been the standard practice. On the other hand, a few margin removal flakes do not show any traces of wear and are likely biface reduction flakes produced as a byproduct in the original manufacture of the discoids.

We are uncertain as to the use of the discoids. The wear on the edges is clearly a dull polish without any apparent striations that might suggest scaping, at least at 40× magnification. The polish follows the contours of the uneven edges, indicating that the working margins were used on some sort of pliable material, as, for example, skins, meat, or possibly grasslike stems or stalks (Kamminga, 1979). The direction of wear cannot be determined. Interestingly, despite the differences in lithics and edge configuration, the polish appears to be similar to that observed on the majority of the Hoabinhian implements from Tham Pha Chan I, a Hoabinhian cave site in northwestern Thailand (Bannanurag, 1988). According to Bannanurag’s analysis, one of the few microwear studies ever conducted on Hoabinhian implements, most of the Tham Pha Chan tools are steeply flaked waterworn quartzite pebbles with use-polish along the margins. On the other hand, she also observed pitting and striations on some of the implements, neither of which is present on the Lang Rongrien specimens. Bannanurag concluded that the implements were for wood working. Other experiments and observations on edge damage of Late Pleistocene–Early Holocene stone tools from Southeast Asia (Sinha and Glover, 1984) have indicated a much wider variety of use wear than those from Lang Rongrien. From my experiments and observations of the Lang Rongrien specimens, I conclude that the implements there were most likely butchering implements, although they could possibly have been used on wood or bamboo.

Other chipped stone implements in Hoabinhian sites include elongate knife blades with single long cutting edges flaked either unifacially or bifacially, and semilunar chopperlike tools with single strongly curved bifacially flaked cutting edges backed by thick transverse flake scars. At Lang Rongrien several flakes appear to be ad hoc tools, both with utilized and with minimally retouched portions of margins. Waterworn quartzite and sandstone pebbles, frequently with circular pitted areas, were used as grindstones or ham-
merstones. Also present at Lang Rongrien were a few waterworn pebbles, obviously carried into the site, that showed no signs of use or modification. Traces of red ochre were found on two hammerstones and on two other implements. In addition, several small ground and unground pieces of red ochre were present. Pottery is absent, except for one sherd located in the first season of excavation in the uppermost portion of the middle layers. The question of the presence of pottery in Hoabinhian contexts continues to be debated (Ha Van Tan, 1980; Pookajorn, 1984b).

The hammerstones are for the most part fist-sized water-worn pebbles. The traces of battering (pitted areas) are on the flatter portions of the cobbles. The whetstones/grindstones are tabular blocks of sandstone with ground faces but unground edges.

Traces of oxidized sediment and charcoal throughout the middle levels at Lang Rongrien indicate that campfires were frequently built in the rock-shelter. Few, if any, of these were stone-lined. Despite the multiple horizontal layerings observed in cross-section of the middle levels, we were unable to isolate spatially any discrete activity areas. In fact, it was difficult to discern any patterns of concentration of artifacts, stone debitage, or faunal remains accompanying any of the charcoal or oxidized areas. The identical situation prevails through the Southeast Asian Hoabinhian sites.

Late Pleistocene Epoch. Except for Lang Rongrien, few, if any, of the Pleistocene assemblages from Southeast Asia are derived from demonstrable living surfaces, so it is impossible to generalize about patterns of activities of the period. Interpretations of cultural activities of late Pleistocene time at Lang Rongrien are thus more an attempt to frame some initial lines of inquiry than to produce conclusions. It is hoped that in the future greater attention to large areal excavations and the recovery of spatial data concerning features and associated cultural objects from these areas of other sites will soon produce good comparative data.

The Pleistocene stratigraphic units at Lang Rongrien are capped by thin layers of cultural material and traces of former hearths. They are unusual in Southeast Asia in that the layers represent discrete living surfaces comprising stone artifacts and faunal remains directly associated with features, such as hearths, ash deposits, and bone concentrations. However, given the several millennia time spread of radiocarbon ages, several different episodes of occupation are indicated for each of the units.

The Unit 8 layer directly underlies the thick deposit of limestone roof fall, and Unit 9 lies between 2 and 8 cm below Unit 8. Charcoal bits, bone fragments, stone tools, and debitage lie within each of the paleosols, primarily concentrated around hearth and ash areas. The lowermost level, Unit 10, is represented by a thicker and more diffuse paleosol. As with Units 8 and 9, the top of Unit 10 is somewhat indistinct in areas lacking hearths, charcoal, or charred bone; but, in contrast to Units 8 and 9, where the cultural objects were confined to the uppermost part of each layer, several of the objects in
Unit 10 were imbedded well within the layer. This lowermost unit grades downward into angular limestone gravel devoid of any traces of weathering. Test pits dug down an additional 60 cm below Unit 10 did not indicate the existence of other cultural layers.

The Unit 8 surface evidenced the remains of 12 distinct hearths, each about 1 m in diameter, identified by the presence of charcoal, ash, and fire-reddened sand (Figure 4). Four of the hearths also had ash areas extending out to one side of the oxidized core, suggesting that open fires were first built in a small confined area, and from here coals were then spread to one side over a larger area. This pattern may have implications for cooking techniques employed. Two of the hearths were partially stone-lined, the effect having been produced by the removal of extraneous stones from the center of each hearth.

Traces of considerable cultural activity associated with Unit 8 were apparent in the southeastern portion of the site. Most prominent among the fea-
tures here were remains of an elephant skull, including a tusk, and bits of bone from several other mammalian species. These remains, bits of charcoal, and several large cobbles lay in between two hearths. In and around these hearth areas were scattered a dozen stone implements, mostly side scrapers on flakes, and some unretouched flakes apparently derived from the final production of these and other flake tools. In general the faunal remains from the level lay near enough to hearths to suggest association. On the other hand, two hearth areas lacked associated cultural materials altogether.

There is some indication that the occupants of Unit 8 practiced some pressure flaking, a feature of stone technology that has heretofore been unrecorded for late Pleistocene assemblages in Southeast Asia. Around one hearth, we screened 16 small (0.7 × 0.4 cm), triangular chalcedony, black chert, and limestone chips with tiny platforms (between 0.2 and 0.04 cm). In all of these cases the platforms themselves were portions of single facets, indicating that the objects from which these were derived were essentially unifaces. We screened all other areas of flake concentrations, but did not find any comparable chips, so these stand alone in the assemblage. None of the artifacts from Unit 8 (or from Units 9 and 10) has pressure flaked margins, however.

Unit 9 had eight hearth areas, one of which was stone-lined. All but the stone-lined hearths are less than 1 m in diameter (Figure 5). As in Unit 8, all of these hearth areas were roughly circular, but unlike the Unit 8 hearths they lacked extensions of ash deposits beyond the fire-reddened cores. Ash deposits were present, however, but in four separate areas. Two of these were within 1.5 m of hearths and may be associated, but two others were associated with a large bone deposit without hearths. This large bone scatter covered a 2 × 3.5 m oval area behind one of the paired hearth and ash areas. Three of the 29 artifacts from this unit came from this bone scatter.

Most of the lithic debitage from Unit 9 lay tightly clustered behind the hearth at W1-2; S2-3, along with one scraper and two faunal remains. Most of the other artifacts and some flakes but no faunal remains were rather widely dispersed in an area in front of the stone-lined hearth. The four smallest hearth areas had no associated lithic or faunal remains.

Most flaked lithic materials from both units 8 and 9 are of a silicified limestone, a honey-colored chalcedony, or black chert. Shale, which was so common in the middle layers, was altogether absent.

Unit 10 had five hearth areas, four of which were between 0.75 m and 1 m in diameter and one over 2.5 m in diameter (Figure 6). The small hearth in the northwestern part of the unit was surrounded by areas of ash. Also present were two other ash concentrations, one about halfway between the two southern hearths and the other adjacent to the large hearth area. The large hearth area was at least three times larger than any of the other hearth areas on the Pleistocene units of the site.

The greatest number of flakes and stone artifacts, as well as about a dozen
faunal remains, were distributed around the hearth in the northwestern part of the rockshelter. The other major concentration of cultural materials, flakes and flaked tools but no faunal remains, lay clustered in front of the southernmost hearth. Other lithic and faunal remains lay scattered in the southeastern portion of the unit, unassociated with any features. The large hearth area, in places 3 or 4 cm thick, had only four lithic implements and two bones, a pattern that was not replicated anywhere else. One of the hearth areas was a rather diffuse charcoal scatter over 2 m in diameter. The faunal remains were mostly around the rear hearth and adjacent areas. One area, in the southeastern section of the site between E 4-8 and S 5-9, lacked hearths or other features, but contained flakes and bone. At present we can offer no explanations for the variations in attributes of the Pleistocene hearths at Lang Rongrien.

The Unit 10 chipped stone materials are evenly divided between black shale and tan-green limestone, with a few flakes of black chert and even
fewer of a honey-colored chalcedony. Very few objects have cortex adhering, indicating that the worked stone objects in the unit had been initially shaped elsewhere. Many of the flakes have thick platforms, ranging around 8 mm, and about half of these are multifaceted. This seems to suggest that much of the flintworking at the site involved early stages of tool manufacture, but the paucity of large unifacial thinning flakes in the assemblage argues this interpretation. Whatever the explanation for the particular kinds of flakes present, it is clear that the majority of the artifacts themselves had been carried away from the site.

The shale flakes include both bifacial thinning flakes and margin removal flakes, both products in the final shaping of artifacts that had not been left at the site. Of the bifacial thinning flakes some are from rather well-retouched bifacially edged objects that originally had convexly curved cutting edges. Other margin removal flakes have unfaceted platforms, suggesting

Figure 6. Lang Rongrien Rockshelter: Stratigraphic Unit 10.
that the objects from which they were detached were unifacial in character. Also, some of the shale flakes are bits of shatter, added confirmation of the use of percussion flaking techniques. As with the assemblages from Units 8 and 9, no bipolar technique is evidenced.

In all, the nature and distribution of cultural materials on the Pleistocene levels at Lang Rongrien suggest activities carried out by people who were using the site on a temporary basis. The episodes of activities centered on small campfires around which the people processed game and sharpened or re-edged their stone tools. They were not engaged in major stone tool manufacturing activities, which would have produced considerable debitage of large flakes, nor did they engage in any activities, such as digging pits, that would have appreciably disturbed the living surface. Other cave and rock-shelter sites in Southeast Asia suggest a similar pattern of use.

The preponderance of late Pleistocene archaeology coming from the cave sites, however, has skewed the picture of the lifeways of the early Homo sapiens in Southeast Asia. The only known open-air site localities from that period—Kota Tampan, Malaysia (Majid and Tia, 1988) and a series of sites along the ancient shore of Pleistocene Lake Tingkayu, Sabah (Bellwood, 1984, 1988)—assume critical importance in filling in the picture. The Lake Tingkayu sites, dated by radiocarbon dating of the former lake shore to the interval between 28,000 and 18,000 B.P., are dispersed around the former lake in clusters between 100 m² and 800 m² in extent. The site locations suggest that the activities at the sites were focused on resources in or adjacent to the lake. Especially striking, however, is the fact that the implements include tabular bifaces along with the more usual “platform and single-platform (horsehoe)” cores, and utilized flakes” (Bellwood, 1984:43). The bifaces include well-made tabular ovoids, thin lenticular cross-sectioned lanceolate bifaces, and small pointed bifaces. Part of the explanation for the unusually high quality of flintknapping can be attributed to the quality of the stone—a tabular gray chert and water-worn pebbles of brown chert—but especially striking is the standardized, formal nature of the shapes produced. Why formal tools would be associated with open-air sites and the less formal tools associated with cave and rockshelter sites is difficult to answer.

The open-air site of Kota Tampan, dated to approximately 30,000–35,000 B.P., appears to be a stone workshop or “factory” site (Majid and Tia, 1988). The site area, situated at the time of occupation on a lake shore, was strewn with locally abundant quartzite flakes and cores (Sieveking, 1958). The cultural objects at the site are located in clusters of anvil stones, cores, and flakes, arrangements that suggest that the implements were being roughed out in situ. In addition to the manufacture of stone implements, however, some artifacts show evidence of other uses. One pebble tool, for example, had a beveled ground edge, and several flake tools exhibited edge damage either through use or trimming (Majid, 1992).
CONCLUSIONS

The archaeological remains from the few known Upper Pleistocene archaeological sites in Southeast Asia are beginning to provide a glimpse into the nature of lifeways of early Homo sapiens in that part of Asia. Contrary to expectations built up from more than half a century of archaeological research and speculation, they suggest that the people relied primarily on the manufacture of flaked stone tools fashioned from flakes, not pebbles. Although the overall tool forms were rather amorphous, the working edges themselves were well made.

Caves and rockshelters were used by the early Homo sapiens, but not as primary residences. The residences must have been in open air locations, such as along the edges of lakes and rivers. The people were apparently sufficiently aware of their own region's landscape, so that once large game was obtained in the vicinity the hunters could—at least on occasion—retreat to known nearby caves and rockshelters in which to butcher and cook the food. The preponderance of smaller game, like tortoise, in sites further suggest that the adjacent valley bottoms and streams were actively exploited and that—again at least on occasion—the resources were carried up to previously identified caves for final processing.

The caves and rockshelters appear to have been sought for their strategic locations and for shelter from rain or direct sunlight, as well as for ventilation and good lighting. There is no evidence that the caves were used for other purposes like religious activities. The inner areas of the caves show no indication of habitation or use, nor were any of the cave walls used for paintings.

The early Homo sapiens were able to make or obtain fire at will, a conclusion based on the fact that the hearths are small, with no apparent attempt to keep a fire going for long periods of time (in which case the hearth areas should have been larger, more deeply oxidized, and more charcoal-laden).

The variety of stone employed by the people during Late Pleistocene times shows that they had an appreciation of the qualities of stone necessary to produce certain tool forms, and in addition had a knowledge of a relatively wide region from which to obtain these stone. The use of stone implements in the cave and rockshelter sites was primarily in their finished form. Ad hoc flake tools are present, but are small enough to have been produced from flakes created by refurbishing larger flake tools. The bulk of the stoneworking occurred elsewhere, although whether at a base residence or at a quarry is currently unknown.

Because lower sea level had positioned the coastline many kilometers away from any of the Pleistocene sites investigated, we currently have no indication that coastal or intertidal resources were exploited. We anticipate being able to address this question in the future through research in the numerous submarine caves located in several regions of Southeast Asia.

Interpretations of Hoabinhian archaeological assemblages from Southeast Asia continue to be controversial. As presented here, indications are that the
so-called Pebble-Tool Industry (which includes nonpebble core tools in parts of Southeast Asia) represents an introduction of a large tool industry in the latter part of the late Pleistocene (Anderson, 1990), an industry that continued throughout much of the region until the beginnings of rice agriculture (Gorman, 1971). On the other hand, another Pleistocene pre-LGM site in southwestern Thailand, Moh-Khiew, reportedly has large stone tools identical to early Holocene Hoabinhian forms (Pookajorn, 1991, 1996), which would argue for the more traditional Movius scheme. In Vietnam, Son Vi represents a series of cave and open-air assemblages that also appear to predate Hoabinhian assemblages. Described as a pebble industry, Son Vi has been viewed both as ancestral Hoabinhian (Ha Van Tan, 1994) and as belonging to Movius’ Chopper-Chopping Tool tradition (Trinh Nang Chung, 1994). On the other hand, Ha Van Tan (1994) has called attention to the existence of a flake industry termed Nguomian (after finds from the Nguom Rockshelter) that predates Son Vi in northern Vietnam. Whether the earliest Homo sapiens in Southeast Asia depended primarily on Pebble-Tool/Chopper-Chopping Tool Industries or focused on manufacturing flake tools, or used both “industries,” depending on activity and situation, can be resolved only through the excavation and dating of more Late Pleistocene sites.

The increasing awareness that rockshelters throughout Southeast Asia may have traces of human occupation underlying the Holocene deposits once considered basal should stimulate a return to previously excavated sites, especially on the Malay Peninsula. Since phosphate collectors have shown little interest in the deepest deposits of caves, these Pleistocene layers, if they exist, will be undisturbed. Further, given the recovery of human remains from Niah Cave, Sarawak (Harrisson, 1959), and from numerous caves in Vietnam (Nguyen Lan Cuong, 1985; 1986; Ciochon and Olsen, 1986) and southern China (Jia Lanpo and Huang Weiwen, 1985), as well as from Moh-Khiew, Thailand (Pookajorn, 1991), the possibilities of Pleistocene deposits in the caves should also renew interest in the search for early human remains.

In Southeast Asia, early cultural materials continue to be found primarily in caves and rockshelter sites, but research is expanding into a search for open-air sites as well. The recognition that early Homo sapiens likely lived in open-air settlements, rather than caves, should sharpen this interest. A renewed effort to find and excavate Pleistocene-age cave sites and a return to the earlier search for open air-sites should allow Pleistocene archaeology in Southeast Asia to fulfill its early 20th century promise.

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REFERENCES


CAVE ARCHAEOLOGY IN SOUTHEAST ASIA


ANDERSON

Ha Van Tan (1985). The Late Pleistocene Climate in Southeast Asia: New Data from Vietnam. Modern Quaternary Research in Southeast Asia 9, 81–86.


